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## A-22 Free Communication/Poster - Antioxidants

MAY 27, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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### 1399 Board #1 May 27 9:30 AM - 11:00 AM

#### Sports Medicine Australia Young Investigator Award - The Acute Effect Of Prolonged Intense Cycling And Blackcurrant Extract On Protein Carbonyls In Well-trained Male Cyclists

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(No relationships reported)

Prolonged intense endurance exercise can induce oxidative stress in athletes when their endogenous antioxidant network is overwhelmed by free radicals and reactive species. Antioxidant supplementation may therefore be of benefit for athletes under those conditions.

**PURPOSE:** To measure acute changes in plasma protein carbonyl concentration, a marker of oxidative stress, in response to prolonged intense cycling with or without a pre-ride dose of blackcurrant extract.

**METHODS:** A randomised, double-blind placebo-controlled crossover design was used. Eight well-trained male cyclists performed a 90-min laboratory-based cycling trial at 55% of peak aerobic power output (67% of  $\text{VO}_{2\text{max}}$ ) under extract-supplemented and placebo conditions. The extract dose contained 480mg of anthocyanins (potential antioxidants). Blood samples were collected prior to, 30 min after and 60 min after the trials for analysis of protein carbonyl concentration. These data were log-transformed and standardised for assessment of magnitude of change. Heart rate, blood lactate and perceived exertion were also measured during the trials.

**RESULTS:** There was little change in protein carbonyl concentration 30-min post-trial in either condition. By 60 min there was an increase of  $13\% \pm 12\%$  (mean  $\pm$  SD) with the placebo but a reduction of  $6\% \pm 14\%$  with the extract, a moderate difference between conditions of 17% (90% confidence limits 8% to 25%). Differences in heart rate, blood lactate and perceived exertion between trials were inconclusive.

**CONCLUSION:** A single dose of blackcurrant extract estimated to contain a quantity of anthocyanins equivalent to 140g of New Zealand blackcurrants may provide a useful acute nutritional intervention for well-trained athletes prior to intense endurance training or competition.

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### 1400 Board #2 May 27 9:30 AM - 11:00 AM

#### Antioxidant Vitamin - Mineral Supplement Effects On Antioxidant And Oxidative Status With Strenuous Exercise

Valerie Duran, Masha Fox-Rabinovich, Lisa S. McNulty, Steven R. McNulty, David C. Nieman, FACSM, Dru A. Henson, Fuxia Jin, Michael Landramm. *Appalachian State University, Boone, NC.*

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(No relationships reported)

**INTRODUCTION:** Oxidative stress derives from metabolic processes and can cause damage to DNA, lipids, and proteins. Supplementation with antioxidant vitamins A, C, and E, and the mineral selenium, has been suggested to counteract oxidative stress; however, the existing literature has not produced definitive outcomes.

**PURPOSE:** This project investigated the effects of daily supplementation with a vitamin-mineral complex, emphasizing vitamins C (2000 mg), E (800 IU), A (3000 IU) and selenium (200 ug), respectively for 6-wks on the antioxidant and oxidative damage markers of athletes prior to and after strenuous exercise.

**METHODS:** Twenty-four trained cyclists were randomized into vitamin-mineral (VM) (n=12) or placebo (P) (n=12) groups. Blood samples were collected at baseline, immediately pre- and post-exercise, and 12-h post-exercise and examined for indicators of antioxidant status (Oxygen Radical Antioxidant Capacity (ORAC) and Ferric Reducing Antioxidant Potential (FRAP)) and oxidative damage (F2-isoprostanes). The study design allowed examination of supplementation effects during chronic, exercise, and exercise recovery phases. A 2 (treatment) x 4 (times) repeated measures ANOVA was performed and statistical significance was set at  $P < 0.05$ . Values are mean $\pm$ SE.

**RESULTS:** F2-isoprostanes (pg/mL) were not significantly affected during any phase of supplementation and increased 28% from pre-exercise (22.5 $\pm$ 2.1) to post-exercise (28.9 $\pm$ 4.0) in P and 10% from pre-exercise (21.0 $\pm$ 1.8) to post-exercise (23.3 $\pm$ 1.9) in VM. ORAC (ng/mL trolox equivalents) declined significantly in both groups ( $P < 0.001$ ) with a 31% decline from pre-exercise (19.6 $\pm$ 5.5) to post-exercise (13.5 $\pm$ 4.8) in P and 22% from pre-exercise (21.2 $\pm$ 3.4) to post-exercise (16.6 $\pm$ 3.9) in VM but, was not significantly different during any phase of supplementation. FRAP ( $\mu\text{M/L}$  ascorbate equivalents) increased 9% from pre-exercise (401.7 $\pm$ 104.5) to post-exercise (440.2 $\pm$ 85.7) in P versus 19% from pre-exercise (410.4 $\pm$ 110.8) to post-exercise (488.7 $\pm$ 109.1) in VM with a strong trend for a time effect ( $P = 0.063$ ). However, supplementation was not effective during any phase.

**CONCLUSION:** These results do not support use of an antioxidant vitamin-mineral supplement to augment antioxidant status or suppress exercise-induced oxidative damage.

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### 1401 Board #3 May 27 9:30 AM - 11:00 AM

#### Moderate Volume And Intensity Aerobic Exercise Training Does Not Attenuate Postprandial Oxidative Stress In Pre-diabetics

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(No relationships reported)

**PURPOSE:** Exercise training improves glucose and lipid metabolism and increases antioxidant defense. These adaptations may serve to minimize the oxidative stress which typically occurs post feeding, in particular for those with metabolic dysfunction. The purpose of this study was to determine the effects of aerobic exercise training on postprandial oxidative stress in a sample of pre-diabetic subjects.

**METHODS:** Twenty previously sedentary, pre-diabetic subjects were randomly assigned to an eight week aerobic exercise training intervention (3 sessions/week; 30-45 minutes/session; n=10; age: 36 $\pm$ 3yrs; fasting blood glucose: 106 $\pm$ 4mg $\cdot\text{dL}^{-1}$ ; BMI: 34 $\pm$ 2 kg $\cdot\text{m}^{-2}$ ) or a no exercise control group (n=10; age: 31 $\pm$ 2yrs; fasting blood glucose: 101 $\pm$ 4mg $\cdot\text{dL}^{-1}$ ; BMI: 33 $\pm$ 2 kg $\cdot\text{m}^{-2}$ ). Before and within two days following the intervention, subjects consumed a lipid/carbohydrate rich test meal. Blood samples were collected pre meal (fasted), and at 1, 2, 4, and 6 hours post meal and assayed for xanthine oxidase activity (XO), hydrogen peroxide ( $\text{H}_2\text{O}_2$ ), malondialdehyde (MDA), triglycerides (TAG), and glucose. Area under the curve (AUC) was calculated for each variable, both pre and post intervention.

**RESULTS:** Exercise training had no effect on decreasing the AUC for any variable ( $p > 0.05$ ). All variables increased post feeding, with a peak response noted at 4-6 hours post meal.

**CONCLUSION:** Aerobic exercise training performed at the frequency, duration and intensity in the present study has no effect on postprandial oxidative stress or TAG within a sample of pre-diabetic subjects.

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**1402 Board #4 May 27 9:30 AM - 11:00 AM****Cytokine Alteration Following Antioxidant Supplementation And Anterior Cruciate Ligament Surgery**

Tyler Barker<sup>1</sup>, Scott W. Leondard<sup>2</sup>, Thomas B. Martins<sup>3</sup>, Roy H. Trawick<sup>4</sup>, Harry R. Hill<sup>5</sup>, Carl R. Kjeldsberg<sup>5</sup>, Maret G. Traber<sup>2</sup>. <sup>1</sup>The Orthopedic Specialty Hospital & Oregon State University, Murray, UT. <sup>2</sup>Oregon State University, Corvallis, OR. <sup>3</sup>ARUP, Salt Lake City, UT. <sup>4</sup>The Orthopedic Specialty Hospital & Clinic, Murray, UT. <sup>5</sup>ARUP & University of Utah, Salt Lake City, UT.  
(No relationships reported)

Vitamins E and C display immuno-modulatory properties. Cellular and humoral mediated immune responses are associated with T helper 1 (Th1) and Th2-type cytokines, respectively. Balance disruptions to the interleukin (IL)-6:IL-10 and Th1:Th2-type cytokine ratios indicate a shift in pro-/anti-inflammatory and pattern of adaptive immunity cytokine dominance, respectively. Furthermore, disruptions to the IL-6:IL-10 ratio may provide prognostic potential following severe trauma or surgery. Interleukin (IL)-10 is an anti-inflammatory cytokine that suppresses pro-inflammatory (i.e., TNF- $\alpha$ , IL-1, IL-6, etc.) and Th1-type (i.e., IL-2, IL-12, IFN- $\gamma$ ) cytokines. IL-10 increases during the reperfusion following anterior cruciate ligament (ACL) surgery, which we found is ameliorated with vitamin E and C supplementation.

**PURPOSE:** To identify the influence of vitamins E and C on the IL-6:IL-10 ratio, and Th1- (IFN- $\gamma$ , IL-2, IL-12) - Th2- (IL-4, IL-5, IL-10) type cytokine ratios following ACL surgery.

**METHODS:** A randomized, double-blind, placebo-controlled study was carried out in men undergoing ACL reconstructive surgery, who were randomly assigned to twice daily supplementation with either: 1) antioxidant (AO; 300 mg RRR- $\alpha$ -tocopheryl acetate (400 IU) and 500 mg ascorbic acid (AA),  $n = 13$ ), or 2) matching placebos (PL;  $n = 12$ ). Experimental treatment began ~2-wks prior and continued through 7-d post-surgery. Subjects provided fasting blood draws: 1) Baseline (Bsl, ~2 wk prior to surgery), 2) pre-surgery (Pre, ~90-min pre-surgery), 3) 90-min, 4) 72-h and 5) 7-d post-surgery. Plasma  $\alpha$ - and  $\gamma$ -tocopherols ( $\alpha$ - and  $\gamma$ -T), AA, cytokines, and serum high-sensitivity C-reactive protein (hsCRP) were measured.

**RESULTS:** Following AO supplementation, circulating  $\alpha$ -T and AA increased, while  $\gamma$ -T decreased ( $P < 0.05$ ; treatment X time interaction). Both IL-6 and hsCRP were elevated at 72-h and 7-d ( $P < 0.05$ ). Interestingly, depressions in the IL-6:IL-10, IFN- $\gamma$ :IL-10 and IL-2:IL-10 ratios following ACL surgery were ameliorated with AO supplementation ( $P < 0.05$ ; treatment X time interaction).

**CONCLUSION:** Moderate supplementation levels of vitamin E and C minimize the depression in the IL-6:IL-10, IFN- $\gamma$ :IL-10 and IL-2:IL-10 ratios post-ACL surgery.

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**1403 Board #5 May 27 9:30 AM - 11:00 AM****Oxidative-Stress, Muscle Forces/Soreness Responses To Eccentric Exercise: Fruit/Vegetable Concentrate Compared To Placebo.**

Allan H. Goldfarb, FACSM, Ryan S. Garten, Changmo Cho, Philip D.M. Chee, Lauren A. Chambers. Univ., of North Carolina, Greensboro, NC.  
(A.H. Goldfarb, Awarded contracted research from NSA, Contracted Research.)

**PURPOSE:** This study was designed to test the efficacy of a fruit/vegetable concentrate (FVC) supplement on oxidative stress, muscle force/work, and muscle soreness (MS) to an acute bout of eccentric exercise (EE) compared to a placebo.

**METHODS:** Forty (18-35 yrs) healthy volunteers were randomly assigned to either a (FVC) or placebo (P) double blind treatment. The subjects took capsules for 28 days (24 days prior to the EE and for the next four days) with compliance = 97.5% FVC; 98.5% P. Subjects arrived in the morning, a resting blood sample was obtained and maximal isometric forces (MIF), and MS (on both arms) were determined prior to the EE (4 sets of 12 repetitions of elbow flexion with their non-dominant arm [ND]). Blood, MIF, and MS were also obtained immediately after EE, 2, 6, 24, 48, and 72 hrs post-exercise. Protein carbonyls (PC), lipid hydroperoxides (LH), and creatine kinase (CK) were determined from plasma.

**RESULTS:** Total work for the EE was similar for the P = 1636.2  $\pm$  172.9 J and FVC = 1784.4  $\pm$  174.4 J. The % decline in work was similar across treatments {1<sup>st</sup> set to 4<sup>th</sup> set for the EE = 35.3  $\pm$  4.2 % (P) and 31.7  $\pm$  3.7 % (FVC)}. MIF decreased immediately post EE for the ND {35.9%  $\pm$  4.0 (P) vs. 31.1%  $\pm$  3.2 (FVC)} reaching its nadir at 2h hrs post EE. CK increased over time and peaked at 72 hrs after EE (292.0  $\pm$  64.6 IU (P); 240.8  $\pm$  66.9 IU (FVC) with no difference across treatments. LH did not demonstrate any changes across time or treatment. PC increased over time ( $p < 0.001$ ) with no time x treatment effect. PC were similar across treatment prior to and immediately post EE. PC increased 2hr post EE in the P group and increased over time with a peak at 48 hrs post EE (0.52 nmol/mg protein<sup>-1</sup>). PC were significantly lower in the FVC treatment compared to P ( $p < 0.034$ ) from 2hr post time through 72 hr post EE.

**CONCLUSIONS:** The data indicates that four weeks of pre-supplementation and continued treatment after EE with a fruit/vegetable concentrate had no apparent effect on the muscle forces and MS but attenuated blood oxidative stress compared to placebo treatment as indicated by protein carbonyls.

Supported by a grant from NSA.

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**1404 Board #6 May 27 9:30 AM - 11:00 AM****Plasma Antioxidant Capacity Of Olympic Sailors Prior To The Olympic Games**

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(No relationships reported)

**PURPOSE:** Routine haematological and biochemical monitoring of an Olympic Sailing Squad was undertaken over a 12 month period leading up to the Olympic Games. An aspect of this, plasma total antioxidant capacity (TAC), was considered in more depth for the present study. TAC scores are known to increase during and post-exercise but little is known about changes over the course of a competitive season, particularly in elite athletes.

**METHODS:** The athletes comprised the entire 2008 Great Britain Olympic Sailing Team, as well as the men's 470 2008 World and European Champions who were not selected for the Olympics. Individual blood samples were collected from the sailors (13 Males, 7 females, age 29  $\pm$  3 yrs, weight 70.4  $\pm$  11 kg) on a minimum of three and a maximum of seven occasions as part of routine haematological and biochemical profiling. The frequency of sampling was determined by sailor availability in the U.K. Sailors were sub-divided into illness prone (IP) and non-illness prone (NIP) groups based on the categorisation used by Cox et al (2007). Blood sampling was undertaken with samples drawn between 8-10 am, fasted and 36-48 hours post training. Haematological and biochemical analysis was performed on venous blood samples collected into K3 EDTA tubes and analysed at a clinical laboratory. Plasma total antioxidant capacity (TAC) was determined using a chemiluminescent assay (ABEL<sup>®</sup>, Knight Scientific Ltd, UK). This measured the capacity of EDTA plasma to scavenge the peroxynitrate radical derived from the reaction between superoxide and nitric oxide radical (Nourooz-Zadeh et al 2006). Data are expressed as vitamin E analogue equivalents (umol/L) and presented as mean (SD).

**RESULTS:** Over 12 months a total of 20 sailors were sampled, with 18 from the Olympic Squad. A total of 110 blood samples were drawn. The TAC score for the whole squad was 396 (58), with TAC scores of 364 umol/L (48) and 413 (57) umol/L for the IP and NIP groups respectively. The largest intra-individual athlete variation in TAC score across 12 months was 53 umol/L, and the smallest 11 umol/L, with the range of TAC scores across the squad being from 259-544 (umol/L).

**CONCLUSIONS:** The sailors' TAC scores varied considerably over 12 months, with greater inter than intra variation. The IP sailors showed a trend towards lower mean TAC scores than the NIP group.

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**1405 Board #7 May 27 9:30 AM - 11:00 AM**

## Effect On Anti-oxidative Capacity Of California Almond Supplementation In Elite Chinese Cycling

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(No relationships reported)

**PURPOSE:** The aim of this study was to examine the effect of California almond supplementation on Anti-oxidative capacity of elite Chinese Cycling athletes.

**METHODS:** Using a crossover balance design, 12 Elite Chinese Cycling athletes (age: 22.0±0.6 years; height: 180.1±1.9 cm; weight: 73.7±2.1 kg; VO2max: 69.0±0.9 ml/min/kg BW) were randomly divided into 2 groups. While almonds group was given 75g almond per day for 4 weeks, control group was fed with cookies which energy is equivalent to the almond daily consumed. After 2-week washout, the two groups were crossed and fed with cookies and almonds, respectively for another 4 weeks. The almonds were provided by the Almond Board of California, USA. During the study, all athletes were trained at the same road/facility and dined in the same canteen and they drank a measured amount of sport beverage containing no vitamin E. Performance tests were done before and after the 4-week feeding treatment. Venous blood samples were drawn in the morning of performance test after overnight fast and immediately post-performance and next morning before and after the 4-week feeding treatment to evaluate plasma TAOC, GPx, SOD, XOD, serum MDA, NO, Vit E etc.

**RESULTS:** After 4-week almond supplementation, the TAOC level of Almond Group became significantly higher than that of Cookie Group (15.81±0.80 vs 12.86±1.11, p<0.05). The SOD activity has no significant difference in both Groups (p>0.05), but the SOD level of Almond Group in next morning of performance tests were significantly higher than that of before treatment (62.2±1.3 vs 57.8±0.6, p<0.05) and that of Cookie Group (62.2±1.3 vs 59.8±1.8, p<0.05). Vit E level at each time point in Almond Group was slightly higher than that of Cookie Group, but no statistically significant difference. No significant difference was observed in plasma GPx, XOD serum MDA.

**CONCLUSIONS:** The supplementation of almond in Elite Chinese Cycling athletes elevated TAOC level, SOD activity and vitamin E level. It suggested that almond supplementation could improve the antioxidant capacity of endurance athletes.

Supported by The Almond Board of California (ABC)

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1406 Board #8 May 27 9:30 AM - 11:00 AM

### Effect Of Acute Exercise On Lipid Peroxidation And Antioxidant Enzyme Status In Lean And Obese Zucker Rats

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(No relationships reported)

**PURPOSE:** Exercise performance and its beneficial effects depend on the intensity and duration of exercise and also on the body weight. In this study we made an attempt to examine the effect of acute exercise treatment on antioxidant enzymes status and lipid peroxidation levels in lean and obese Zucker rats.

**METHODS:** Both lean (200±10gms) and obese (450±15gms) rats were divided as control and acute exercise (90min, swimming) groups.

**RESULTS:** In the results, we observed a significant (p<0.05) drop in hepatic superoxide dismutase (SOD) activity and glutathione (GSH) levels with acute exercise in both lean and obese rats. Interestingly, catalase (CAT) activity was significantly increased with acute exercise in obese rats. This is may be the compensatory response to cope with the high amount of free radical toxicity in obese rats. The sister antioxidant enzymes, glutathione peroxidase (GSH-Px) and glutathione reductase (GR) were not significantly altered with acute exercise. All antioxidant enzyme activities are higher in lean control group compare to that of obese control group. However, hepatic MDA levels was significantly elevated with acute exercise treatment in both groups and this elevation was more pronounced in obese than that of lean group.

**CONCLUSIONS:** The lower antioxidant enzyme status and higher MDA values in obese rats suggests that obese rats are more vulnerable to expose oxidative stress. From these findings it is appeared that obese zucker rats have high risk from oxidants and acute exercise has been shown to increase oxidative stress.

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1407 Board #9 May 27 9:30 AM - 11:00 AM

### Plasma Antioxidant Capacity And Protein Modification In Adolescent Competitive Athletes

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(No relationships reported)

**INTRODUCTION:** Exercise is known to increase production of reactive oxygen species, which might impair cell integrity and contractile function of muscle cells. Additionally, it is evident that the endogenous antioxidant defense system is elevated in adult athletes. Studies analyzing the effect of regular exercise on the antioxidant status in adolescent athletes are lacking.

**PURPOSE:** To evaluate the impact of age, gender and exercise on the plasma antioxidant capacity and protein modifications in adolescent athletes.

**METHODS:** Plasma antioxidant capacity was measured in male (MA, n=35, 16±2yrs) and female athletes (FA, n=56, 16.5±1.9yrs) and male (MSC, n=9, 16.5±2.2yr) and female (FSC, n=11, 16.2±2.2yr) sedentary controls (total N= 111, 12-20yrs) using the TEAC-Assay. Protein modifications were assessed by MALDI-tof-MS employing the TTR microheterogeneity model. Exercise related energy expenditure (EEtrain) was calculated based on a 7d-activity protocol. In addition, plasma antioxidants were measured in fasting blood samples. Data were analyzed by two-way ANOVA (α=0.05).

**RESULTS:** Though plasma levels of nutritional antioxidants did not differ between the groups, plasma antioxidant capacity was higher in athletes (MA 1.47±0.2 mmol TE/L; FA 1.45±0.2 mmol TE/L) compared to controls (MSC 1.17±0.04 mmol TE/L; FSC 1.14±0.04 mmol TE/L) and rises with both age (P<0.05) and EEtrain (P<0.05). No differences in TTR microheterogeneity between athletes (MA 0.87±0.3 n/cysTTR; FA 0.73±0.1 n/cysTTR) and controls (MSC 1.39 ±0.2 n/cysTTR; FSC 1.11 ±0.2 n/cysTTR) could be observed considering age (P=0.44), gender (P=0.24) and EEtrain (P=0.55).

**CONCLUSION:** Results of the study suggest that both age and exercise increase plasma antioxidant capacity in young athletes. In addition, exercise does not promote protein modification. Thus, in young athletes beneficial effects of exercise training on antioxidant status rather than oxidative stress may be anticipated.

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1408 Board #10 May 27 9:30 AM - 11:00 AM

### Effects Of Oxidative Stress On Glutathione Levels In Patients With Parkinson's Disease

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J. DiFrancisco-Donoghue Presenting

(No relationships reported)

Resting glutathione (GSH) levels are lower in people with Parkinson's disease (PD) than any other neurological condition. Levels of GSH are important markers of oxidative stress and protect the body against reactive oxygen species. Oxidative stress causes free radical damage in the body that might result in cell damage and death. Medications used

to treat PD have been shown to further increase oxidative stress. Maximal exercise stress testing has been shown to be an effective tool to determine a healthy individual's ability to handle oxidative stress and measure GSH response.

**PURPOSE:** To understand the response of GSH system as a criterion measure of oxidative stress in people with PD during acute exercise stress both on and off medication.

**METHODS:** Fourteen men with PD and 15 Healthy Controls (HC) underwent a maximal treadmill exercise stress test. Subjects with PD performed the test once off PD medication (PD-Off) for 12 hours and one week later on medication (PD-On). Venous blood was collected at rest and post exercise. The criterion for peak exercise was: 1) attained 90% of target heart rate (HR); 2) RPE 9; 3) unable to maintain pace; 4) RER over 1.3. Outcome measures included HR, V02, GSH, GSSG, GSH: GSSG ratio.

**RESULTS:** At both rest and peak exercise GSH levels were lower in the PD-On group than the PD-Off Group (rest  $p=.0299$ ; peak  $p=.0002$ ), and both groups were lower than HC ( $p<.0001$  for all). GSH decreased more in the PD-On and PD-Off groups compared to the HC (PD-On  $p=.0013$ ; PD-Off  $p=.0321$ ). There was no difference in the GSH change between the PD-On and PD-Off groups. GSSG levels were higher in the PD-On group than PD-Off group, and the PD-Off group was higher than HC. This held true at rest and peak exercise ( $p<.0001$  for all). All groups increased a comparable amount with exercise. As compared to HC, the ratio of GSH:GSSG was less in the PD-On group and the PD-Off group was less than the PD-On group, in both rest and peak exercise ( $p<.0001$  for all except PD-On vs. PD-Off  $p=.0002$ ). With exercise, this ratio decreased the same amount in all groups.

**CONCLUSIONS:** People with PD have higher oxidative stress levels than healthy controls at rest and have a lower tolerance to acute exercise stress. PD medication increases this oxidative stress. Maximal exercise testing is an accurate tool to indicate how subjects with PD respond to oxidative stress.

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## A-23 Free Communication/Poster - **Blood Flow**

MAY 27, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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### 1409 Board #11 May 27 11:00 AM - 12:30 PM

#### **Systemic Vascular Resistance And Total Vascular Impedance In Multiple Sclerosis**

Christine Frederiksen<sup>1</sup>, Cecilie Fjeldstad, PhD<sup>2</sup>, Anette Fjeldstad, PhD<sup>3</sup>, Michael Bembem, PhD, FACSM<sup>1</sup>, Gabriel Pardo, MD<sup>2</sup>. <sup>1</sup>University of Oklahoma, Norman, OK. <sup>2</sup>Mercy NeuroScience Institute, Oklahoma City, OK. <sup>3</sup>University of Utah, Salt Lake City, UT.

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(No relationships reported)

**BACKGROUND:** Multiple sclerosis (MS) is a chronic inflammatory autoimmune disease that affects the central nervous system (CNS). It has been reported that autoimmune diseases such as rheumatoid arthritis and systemic lupus erythematosus have reduced arterial compliance and increased resistance to blood flow.

**PURPOSE:** The primary purpose of this study was to examine systemic vascular resistance (SVR) and total vascular impedance (TVI) in patients with Relapse-Remitting MS (RRMS) compared to healthy age-matched controls.

**METHODS:** Fifty-eight men and women between the ages of 18-64 years were separated into 8 different groups; young ( $\leq 40$  years old) control men ( $n=13$ ), old ( $\geq 41$  years old) control men ( $n=8$ ), young men RRMS ( $n=5$ ), old men RRMS ( $n=2$ ), young control women ( $n=14$ ), old control women ( $n=8$ ), young women RRMS ( $n=4$ ), old women RRMS ( $n=11$ ) who volunteered for this study. Total vascular impedance and systemic vascular resistance were measured by using the Pulse Contour Analysis (PCA), which analyzes blood pressure waveforms. A 2-way ANOVA (gender x group) was used to explore differences in the outcome variables with  $p \leq 0.05$  set for statistical significance.

**RESULTS:** A 2-way ANOVA showed there was no significant gender effect, however there was a significant group effect ( $p=0.048$ ). The young controls had a significantly lower TVI than the young and old MS. Where, the young controls showed a significantly lower SVR than the old controls and the old MS.

**CONCLUSION:** TVI and RSV are significantly compromised in individuals with MS, compared to age-matched controls, thus, indicating there is a systemic effect of an inflammatory process with in the CNS.

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### 1410 Board #12 May 27 11:00 AM - 12:30 PM

#### **Evidence For Impaired Exercising Forearm And Leg Muscle Blood Flow At Higher Exercise Intensity In Copd**

Mikhail Kellawan, Katherine Webb, Denis O'Donnell, Michael E. Tschakovsky. *Queen's University, Kingston, ON, Canada.*

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(No relationships reported)

Chronic Obstructive Pulmonary Disease (COPD) is characterized by extreme exercise intolerance. Patients often report leg discomfort as the reason for stopping, both during a progressive exercise test and during continuous exercise. Given the impact of compromised oxygen delivery on exercise performance it is possible that exercise intolerance is in part due to reduced exercising muscle oxygen delivery.

**PURPOSE:** To test the hypothesis that exercising muscle oxygen delivery in both small (forearm handgrip) and large (leg kicking) muscle mass exercise is compromised in COPD.

**METHODS:** 12 COPD ( $59.4 \pm 2.7$  yrs, forced expiratory volume in 1 s (FEV1)  $42.6 \pm 4.0\%$  predicted) and 12 age and activity matched control subjects ( $60.5 \pm 2.8$  yrs) participated in four exercise protocols on separate occasions: progressive increases in forearm handgrip and knee extension/flexion exercise to exhaustion, and step increases in forearm handgrip and knee extension/flexion to 50% peak work rate. Beat by beat Doppler and Echo ultrasound measures of forearm blood flow (FBF; brachial artery) and leg blood flow (LBF; femoral artery) and mean arterial blood pressure (MAP; arterial tonometry, Colin 5000), arterial oxygen saturation were made. Venous blood samples provided measures of Hb content (StatProfile M Blood Gas Analyzer, Nova Biomedical) **RESULTS:** data are mean  $\pm$  SE. Peak forearm exercise intensity (weight lifted in lbs) for COPD was 83% of control ( $33.7 \pm 2.7$  vs.  $40.7 \pm 3.0$ ). Forearm oxygen delivery (FOD; ml O<sub>2</sub>/min) was similar between COPD and Control until exercise intensity reached 25 lbs (COPD vs. Control FOD  $76 \pm 5$  vs.  $96 \pm 9$ ,  $P=0.058$ ). However, there were no differences in any parameters quantifying blood flow kinetics with step increase to 50% peak (all  $P>0.60$ ). Responses for leg exercise mirrored those for the forearm.

**CONCLUSIONS:** Oxygen delivery to exercising muscle in COPD may be compromised at higher exercise intensities in both small and large muscle mass exercise. However, the speed with which oxygen delivery adjusts at exercise onset is not.

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### 1411 Board #13 May 27 11:00 AM - 12:30 PM

#### **Venoarteriolar Response Is Unaltered By Beta-adrenergic Blocker Or Exercise Training In Postural Orthostatic Tachycardia Syndrome**

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(No relationships reported)

Postural Orthostatic Tachycardia Syndrome (POTS) is characterized by excessive tachycardia during orthostasis. We previously found that POTS patients have enhanced



venoarteriolar response (VAR) when compared to healthy sedentary women. Whether a standard pharmacologic treatment for POTS such as beta blockers, or non-pharmacological treatment like exercise training could normalize the VAR in these patients is unknown.

**PURPOSE:** We tested the hypothesis that short-term exercise training would attenuate cutaneous VAR to a greater extent than beta blocker treatment.

**METHODS:** Nineteen patients (18 females, 1 male), age 15-44 years were studied. First, patients were given a random, double-blind assignment to receive either placebo (n=10) or non-selective beta blocker (n=9, propranolol, 80 mg q.d.) treatment for 4 wk, and then patients (n=17) completed a 3-mo exercise training program. Female patients were tested during mid-luteal phases of their menstrual cycles before and after medication treatment, and after exercise training. Skin blood flow (SkBF, laser-Doppler flowmetry), was measured in the calf at heart level (baseline, BL) and during leg dependency of 17-35 cm below the heart for 2 min each while supine.

**RESULTS:** Blood pressure (BP, Portapres) and heart rate (HR, ECG) were monitored continuously. Both HR and BP were not different at BL compared to during leg dependency, except diastolic BP was slightly higher during leg dependency in the pre exercise training group [BL  $62 \pm 11$  (SD) mmHg vs. leg dependency  $63 \pm 12$ ,  $P=0.037$ ]. HR was significantly lower after beta blocker (BL  $86 \pm 16$  bpm vs.  $71 \pm 13$ ,  $P=0.002$ ) and after exercise training ( $81 \pm 14$  bpm vs.  $72 \pm 15$ ,  $P=0.002$ ). Only the group taking beta blocker had significant reductions in systolic and diastolic BP ( $P=0.013$  and  $0.008$ ) after treatment. VAR, determined by the relative decrease in SkBF during leg dependency, was not different after placebo ( $-45 \pm 10\%$  vs.  $-42 \pm 13$ ,  $P=0.571$ ), beta blocker ( $-42 \pm 12\%$  vs.  $-38 \pm 14$ ,  $P=0.471$ ) or exercise training ( $-41 \pm 13\%$  vs.  $-46 \pm 11$ ,  $P=0.314$ ).

**CONCLUSION:** These results suggest that the enhanced VAR observed in POTS patients is not affected by beta blocker or exercise training. However, the pathophysiology for such enhanced VAR and the effective therapy still need to be determined.

Supported by NIH K23 (HL0752 83) and the GCRC grant (RR00633).

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**1412 Board #14 May 27 11:00 AM - 12:30 PM**

**Influence Of Arterial Structure, Vasoreactivity And Flow Patterns On Physical Function: Modification Through Daily Activity**

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(No relationships reported)

Recent evidence indicates the importance of hemodynamic forces on endothelial cell expression, with in vivo shear stress producing beneficial and oscillatory forces producing proatherogenic effects.

**PURPOSE:** (1) To examine the association between vascular conductance, flow velocity patterns, vascular structure/reactivity and physical function; and (2) to determine the possible modifying role of daily physical activity on these associations, in the elderly.

**METHODS:** Participants (n=66; Age:  $83 \pm 11$ , Range: 61 to 98yrs) from the Louisiana Healthy Aging Study (LHAS) were used for these analyses. Carotid artery and brachial dimensions (diameter, arterial mass (CMASS), and brachial artery reactivity (BAR)) were determined using high-resolution ultrasonography. Physical activity status (Total Daily Energy Expenditure (TDEE) and amount of daily physical activity (PAL=TDEE/RMR) were assessed using doubly-labeled water. Physical function (CSPFP-10) was determined from a previously validated instrument used to assess basic and instrumental activities of daily living.

**RESULTS:** Vascular conductance was significantly related to retrograde velocity ( $r=-0.33$ ,  $p=0.008$ ) and the antegrade/retrograde ratio ( $r=0.34$ ,  $p=0.005$ ). The antegrade/retrograde ratio was associated with carotid arterial mass ( $r=-0.27$ ,  $p=0.03$ ), and BAR ( $r=0.24$ ,  $p=0.06$ ). A multivariate prediction model (using vascular conductance, flow velocity measures, and vascular structure/reactivity) accounted for ~25% of the variance in the CSPFP-10 score. TDEE ( $r=0.41$ ,  $p=0.03$ ) and PAL ( $r=0.30$ ,  $p=0.09$ ) were associated with the antegrade/retrograde ratio. Moreover, both TDEE ( $r=0.64$ ,  $p=0.001$ ) and PAL ( $r=0.51$ ,  $p=0.001$ ) were strongly associated with CSPFP-10. A MANOVA revealed those in the higher daily physical activity tertiles had lower CMASS (Low PAL:  $13.91 \pm 1.35$ ; Mod PAL:  $12.76 \pm 2.06$ ; High PAL:  $12.21 \pm 1.96$ ,  $p=0.05$ ), and greater BAFMD (Low PAL:  $2.65 \pm 2.05$ ; Mod PAL:  $3.47 \pm 3.10$ ; High PAL:  $5.36 \pm 2.98$ ,  $p=0.03$ ).

**CONCLUSION:** These data indicate higher vascular resistance is associated with altered flow patterns, and increased carotid arterial mass. These changes contribute to lower physical function. However, higher daily energy expenditures contribute to a positive vascular phenotypic expression and greater physical function.

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**1413 Board #15 May 27 11:00 AM - 12:30 PM**

**Regional Hemodynamics And Calf Venous Compliance During Post-exercise Hypotension In Humans**

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(No relationships reported)

Prolonged dynamic aerobic exercise is associated with a post-exercise reduction in arterial blood pressure. This post-exercise hypotension (PEH) arises from an increase in systemic vascular conductance (TVC), which is thought to be predominantly attributed to increased vascular conductance (VC) within the muscles that were active during the exercise. However, arterial vasodilation does not entirely account for the rise in TVC, and the contribution of distention and vasodilation of the venous system in PEH is not well resolved.

**PURPOSE:** We, therefore, aimed to ascertain the contribution of the VC of the legs, arms, kidneys and viscera to TVC during PEH, as well as blood flow (BF) to the skin and the compliance of the calf vein after exercise.

**METHODS:** Eight subjects performed a single bout of upright cycle ergometry at 60% of resting HR reserve for 60 minutes. Stroke volume was measured by echocardiography, and BF in the right renal, superior mesenteric, right brachial, and right femoral arteries was measured by the pulsed echo-Doppler ultrasonography in supine position before exercise, and twice during recovery (15-30 min and 40-55 min). Heart rate, mean arterial pressure, and skin BF was measured continuously by laser-Doppler flowmetry. VC in each vessel was calculated from BF/MAP. Calf venous compliance was measured by venous congestion plethysmography (Halliwill et al., JAP 87:1555-1563, 1999) before exercise and 40-55 min post exercise.

**RESULTS:** MAP decreased in every subject from ~20 min after exercise cessation. TVC significantly increased (~23 %;  $P<0.05$ ) in the initial post-exercise measurement compared to baseline. This rise resulted from increases in VC in leg (~33 %), arm (~20 %), and kidney and viscera (~2 %). There was no significant change in VC in the skin during this period. Calf venous compliance was unchanged between pre-exercise and recovery ( $P>0.05$ ).

**CONCLUSIONS:** PEH was induced by arterial vasodilation in active and inactive muscles, but not the renal and splanchnic vascular beds. Furthermore, there was no post-exercise increase in venous compliance in the active musculature.

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**1414 Board #16 May 27 11:00 AM - 12:30 PM**

**Role Of Central Command In Middle Cerebral Blood Flow Velocity During Static Exercise In Humans**

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Signals descending from higher brain centers are involved in cardiovascular regulation during exercise. The concept of these descending signals has been incorporated into the widely accepted theory of "central command." However, the extent up to which central command contributes to the regulation of cerebral blood flow responses during exercise remains unknown.

**PURPOSE:** The purpose of the present study was to examine the role of central command in the exercise-induced increase in cerebral blood flow.

**METHODS:** Eleven subjects performed static elbow flexion for 2-min at 30% maximal voluntary contraction (MVC) with the manipulation of central command by vibrations applied to the biceps brachii tendon. The influence of the central command can be decreased without altering the muscle mechanoreflex activation by tendon vibration to assist an exercising muscle in developing a given force. The same subjects also performed static elbow flexion without vibrations (control). We continuously recorded cardiovascular parameters and the mean blood flow velocity of the middle cerebral artery ( $V_{MCA}$ ).  $V_{MCA}$  was measured using an ultrasound system with color-coded representation of blood flow equipped with a 2.0-MHz sector transducer. Cerebrovascular resistance index (CVRI) was calculated by dividing the mean arterial pressure (MAP) by  $V_{MCA}$ . In addition, rating of muscle fatigue sensation (MFS) in exercising muscles was taken after the end of exercise by using 1 - 10 category scale.

**RESULTS:** The MFS at the end of the exercise with vibration was significantly lower as compared to without vibration. The increase in the MAP, heart rate (HR) and  $V_{MCA}$  during exercise with vibration was significantly lower than that during exercise without vibration. However, there was no significant difference in CVRI between with and without vibrations.

**CONCLUSION:** Our results suggested that central command has an indirect effect on the regulation of MCA blood flow resulting from the changes in cerebral perfusion pressure and cardiac output.

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**1415 Board #17 May 27 11:00 AM - 12:30 PM**

**Nitric Oxide Inhibition Attenuates Cutaneous Vasodilation During The Post-menopausal Hot Flash.**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to test the hypothesis that local inhibition of nitric oxide and prostaglandin synthesis would attenuate cutaneous vasodilator responses during post-menopausal hot flashes.

**METHODS:** Four microdialysis membranes were inserted into forearm skin (dorsal surface) of 8 post-menopausal women (51±7 yrs). Ringers solution (control), 10mM Ketorolac (Keto), 10mM  $N^G$ -l-arginine methyl ester (L-NAME), and a combination of 10mM Keto + 10mM L-NAME were each infused at the separate sites. Skin blood flow at each site was indexed using laser-Doppler flowmetry. The onset of a flash was defined as an increase of 0.002 mg/cm<sup>2</sup> · minute<sup>-1</sup> per second in sternal sweat rate (capacitance hygrometry). Cutaneous vascular conductance (CVC) was calculated as laser-Doppler flux/mean arterial pressure. CVC is expressed as a percentage of the maximal calculated CVC (CVC<sub>max</sub>) obtained following infusion of 50mM sodium nitropruside at all sites at the end of the study.

**RESULTS:** Data from 13 hot flashes were analyzed. At the control site, the mean peak increase in CVC was 14±5 % CVC<sub>max</sub> units. This value was not different relative to the peak increase in CVC at the Keto site (15±7% CVC<sub>max</sub> units,  $P = 0.77$ ). However, the peak increase in CVC during the flash was attenuated at the L-NAME and L-NAME + Keto sites (7±4 % CVC<sub>max</sub> units and 8±7 % CVC<sub>max</sub> units, respectively,  $P < 0.05$  for both sites) relative to both the control and the Keto sites. There was no difference in sweat rate between any of the sites ( $P = 0.99$ ).

**CONCLUSION:** These data demonstrate that cutaneous vasodilation during a hot flash has a nitric oxide component. Increases in CVC despite the inhibition of prostaglandin synthesis suggest prostaglandins do not contribute to cutaneous vasodilation during a hot flash.

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**1416 Board #18 May 27 11:00 AM - 12:30 PM**

**Superior Mesenteric And Renal Artery Blood Flow During Low And Moderate Intensity Cycling Exercise In Humans**

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(No relationships reported)

Sympathetic induced-vasoconstriction is known to induce a reduction in the abdominal (e.g. splanchnic and renal) blood flow (BF) during exercise. The degree of this vasoconstriction is typically suggested to be proportional to exercise intensity. However, increased sympathetic nerve activity is not a simple linear function of intensity, but rather increases only once work rates eliciting a heart rate (HR) response of about 100 bpm are exceeded. As such, the degree to which sympathetic nerve activity contributes to the regulation of abdominal blood flow during low and moderate intensity exercise is not well understood (Am J Physiol 294:H2322-H2326, 2008).

**PURPOSE:** We, therefore, aimed to determine BF in the superior mesenteric artery (SMA) and renal artery (RA) during exercise above and below this 'threshold' of sympathetic nervous activation.

**METHODS:** Twelve subjects performed 4 minutes of cycle ergometer exercise in a semi-supine position followed by 3 minutes rest, at two work intensities: low-intensity exercise (L) at ~90 bpm (n=12) and moderate-intensity exercise (M) at ~130 bpm (n=7). Mean blood velocity (MBV) in the right RA and SMA were measured by pulsed echo-Doppler ultrasonography throughout, and HR and mean arterial pressure (MAP) were measured beat-by-beat using Finapres. Vascular resistance index (RI) in each artery was calculated from MAP/MBV.

**RESULTS:** Steady states were achieved in all measurements by the 4th minute of L and M exercise. MAP was unchanged in L (82±6 vs 85±8 mmHg), and increased in M (82±5 vs 113±9 mmHg;  $P < 0.05$ ) compared to rest. During L exercise MBV was lower (-9.7±9.8 %;  $P < 0.05$ ) in the RA and unchanged in SMA, compared to rest. During M exercise MBV in both RA (-22±11 %) and SMA (-21±13 %) were significantly decreased ( $P < 0.05$ ) compared to rest; responses which were mirrored in RI.

**CONCLUSION:** Even low intensity exercise with a heart rate maintained below 100 bpm caused a significant vasoconstriction in the kidney, but not in upper visceral area, i.e. regulation of abdominal blood flow appears to be regionally dependent.

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**1417 Board #19 May 27 11:00 AM - 12:30 PM**

**Blood Flow In The Inferior Vena Cava At The Onset Of Cycling Exercise In Humans**

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(No relationships reported)

At the onset of exercise, the stroke volume (SV) is typically augmented through the Frank-Starling mechanism by increased venous return (V-Return) from blood storage regions such as the lower limbs and viscera. However, the influence of the respiratory pump in effecting this increased V-Return is not well understood.

**PURPOSE:** We, therefore, aimed to measure blood flow (BF) in the inferior vena cava (IVC) at the onset of cycle ergometry, during modulation of respiratory and muscle pumps.

**METHODS:** Seven healthy females (19-32 yrs) sat at rest in a semi-supine position before the onset of 10 seconds of low-intensity cycling exercise (40 W). BF in the IVC (2-3 cm below the renal vein bifurcation) and the portal vein (PV; as an index of BF of the visceral organs) was measured by echo-Doppler ultrasonography for 30 s, across the rest (20 s) - exercise (10 s) transition. HR and blood pressure were measured continuously by Finapres. As a control, subjects breathed spontaneously throughout (C condition). To reduce the influence of respiratory pump, the subjects did a 20 s breath-hold (at end-expiration) from 10 s before exercise onset (non-RP condition). In addition, muscle pumped BF was reduced by inflating a cuff (80 mmHg) on the upper thighs from 10 s before exercise onset (non-MP condition).

**RESULTS:** The time course of BF in the IVC was not different ( $P>0.05$ ) between C and non-RP conditions: an abrupt increase at exercise onset (C; from rest 639 to 2035 at first 2 s after exercise onset, non-RP; 565 to 1848 ml/min,  $P<0.05$ ) followed by a rapid reduction to a constant level (approx. 1500-1600 ml/min during 5-10 s). BF in the PV was also similar between C and non-RP, decreasing rapidly after exercise onset. The exercise-induced increase BF in IVC was completely ablated in the non-MP condition (averaged 440 ml/min throughout exercise).

**CONCLUSION:** The offsetting of positive and negative effects on BF during inspiration and exhalation appeared to provide no net gain to V-Return, suggesting that the respiratory pump has little influence on the dynamics of cardiac output at exercise onset. In contrast V-Return was determined predominantly by muscle pump - even during low-intensity cycling exercise.

(Supported by JSPS #20700526 to MYE, #19650158 to YF and #18207019 to SK)

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**1418 Board #20 May 27 11:00 AM - 12:30 PM**

**Fluid Replacement And Heat Stress During Exercise Alters Postexercise Cardiac Hemodynamics In Endurance Trained Men**

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(No relationships reported)

Endurance exercise-trained men have decreases in cardiac output with no change in systemic vascular conductance during postexercise hypotension, which differs from sedentary and normally active populations.

**PURPOSE:** As inadequate hydration may explain these differences, we tested the hypothesis that fluid replacement prevents this postexercise fall in cardiac output, and further, exercise in a warm condition would cause greater decreases in cardiac output.

**METHODS:** We studied 14 trained men ( $63.5 \pm 4.7$  ml kg<sup>-1</sup> min<sup>-1</sup>) before and through 90 min after cycling at 60%  $\dot{V}O_{2peak}$  for 60 min under three conditions: (1) fluid replacement and thermoneutral, (2) no fluid replacement and thermoneutral, and (3) no fluid replacement and exercise in a warm environment. Arterial pressure and cardiac output were measured pre and postexercise in a thermoneutral environment.

**RESULTS:** The fall in mean arterial pressure following exercise was not different between conditions ( $P = 0.453$ ). Postexercise cardiac output ( $P = 0.027$ ), systemic vascular conductance ( $P = 0.001$ ), stroke volume ( $P < 0.001$ ), and heart rate ( $P < 0.001$ ) were different between conditions, as higher cardiac output ( $D 0.4 \pm 1.6$  l/min;  $P = 0.023$ ), systemic vascular conductance ( $D 6.0 \pm 2.2$  ml min<sup>-1</sup> mmHg<sup>-1</sup>;  $P = 0.008$ ), and stroke volumes ( $D 9.1 \pm 2.1$  ml/beat;  $P = 0.002$ ) were seen in the fluid condition compared to the no fluid condition, but there was no difference between the fluid condition versus the no fluid and warm condition (all  $P > 0.05$ ).

**CONCLUSION:** These data suggest that fluid replacement mitigates the postexercise decrease in cardiac output in endurance-exercise trained men. Surprisingly, exercise in a warm environment also mitigates the fall in cardiac output postexercise. Funding by AHA 555623Z and The Evonuk Foundation.

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**1419 Board #21 May 27 11:00 AM - 12:30 PM**

**Older Age Has No Effect on Orthostatic Tolerance Following Prolonged Exercise**

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(No relationships reported)

Ageing and prolonged exercise independently affect the cerebral blood flow (CBF) response to orthostatic stress (e.g. standing). The extent to which prolonged exercise affects the CBF response to orthostatic stress in older people is unknown.

**PURPOSE:** To determine the effect of age and prolonged exercise on blood pressure and CBF responses to orthostatic stress.

**METHODS:** Measures were obtained before and within 45 min after 4 h of continuous running at 70-80% of maximal heart rate in nine (7 male, 2 female) young (Y;  $27 \pm 4$  y;  $\dot{V}O_{2max}$   $59.0 \pm 9.6$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) and twelve (10 male, 2 female) older (O;  $65 \pm 5$  y;  $\dot{V}O_{2max}$   $45.5 \pm 7.7$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) athletes. Middle cerebral artery blood flow velocity (CBFv; transcranial Doppler ultrasound) and blood pressure (BP; Finometer) were measured continuously whilst supine and during 60° head-up tilt for 15 min or to pre-syncope).

**RESULTS:** Prior to exercise, CBFv was 25% higher in the young [Y:  $67 \pm 7$  cm.s<sup>-1</sup>; O:  $50 \pm 9$  cm.s<sup>-1</sup>;  $P=0.00$ ]. Following exercise, mean arterial blood pressure (MAP) whilst supine was lowered [Pre:  $90 \pm 9$  mm Hg; Post:  $82 \pm 8$ ;  $P=0.00$ ], with similar responses between age groups ( $P=0.38$ ). Following exercise, orthostatic tolerance was reduced [Tilt completed, Pre:  $14:39$  (min:s)  $\pm 0:55$ ; Post:  $5:59 \pm 4:53$ ;  $P=0.00$ ] and the tilt-induced drop in MAP was greater [ $-10 \pm 11\%$ ;  $-31 \pm 15\%$ ;  $P=0.00$ ], but responses were similar between age groups ( $P=0.74$ ). Heart rate rose more with tilt in the young post-exercise [Y:  $+47 \pm 25\%$ ; O:  $+16 \pm 10\%$ ; (at 60 s pre-syncope)  $P=0.00$ ], but was similar between groups at pre-syncope ( $P=0.94$ ). Pre-syncope developed in 17/21 athletes post exercise vs. 3/21 pre exercise. Although the pre-syncope-induced reduction in CBFv was greater in the young [Y:  $43 \pm 18$  cm.s<sup>-1</sup>; O:  $21 \pm 12$  (vs. supine);  $P=0.01$ ], at the point of pre-syncope, absolute CBFv was similar across groups [Y:  $34 \pm 10$  cm.s<sup>-1</sup>; O:  $32 \pm 13$ ;  $P=0.77$ ].

**CONCLUSION:** Despite older athletes having lower basal CBFv and similar exercise-induced hypotension to young adult athletes, age does not appear to be a risk factor for the marked orthostatic intolerance and syncope following prolonged exercise. Interestingly, the similar CBFv at pre-syncope suggests there may be an age-independent critical CBFv threshold at which syncope occurs.

Supported by Sport and Recreation New Zealand, and the Department of Physiology.

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**1420 Board #22 May 27 11:00 AM - 12:30 PM**

**Impact Of Maximal Dynamic Exercise On Blood Flow In Subjects With Enos Gene Polymorphism (894G>T)**

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(No relationships reported)

The presence of endothelial nitric oxide synthase (eNOS) gene polymorphism on exon 7 (894G>T) may decrease the bioavailability of nitric oxide and has been associated with endothelial dysfunction, but the impact of exercise on vascular reactivity is still unknown.

**PURPOSE:** To investigate the influence of this polymorphism on the post-exercise effect of maximal dynamic exercise on vascular reactivity.

**METHODS:** Fifty three healthy sedentary volunteers (35±9years; 26%male) were studied - 22 with (GT or TT genotypes) and 31 without (GG genotype; controls) 894G>T polymorphism. Vascular reactivity was assessed by forearm venous occlusion plethysmography during 3 min recording before and after 5 min of circulatory arrest (3 min recording; reactive hyperemia - HR). The measurements were performed before and immediately after a maximal cardiopulmonary exercise test on a treadmill. Blood flow was determined as the area under the curve and conductance derived from blood flow/mean arterial pressure. The kinetics of the blood flow during HR was analyzed based on the time-constant (tau) after adjusting the data to a mono-exponential model. ANOVA-Newman-Keuls was used to compare groups along time (Ethics Committee-005/07).

**RESULTS:** Groups were similar for anthropometry, biochemical, and exercise variables. Subjects with 894G>T polymorphism (GT+TT) presented lower basal blood flow and conductance before exercise (GT+TT: 2.27±0.17 AU; GG: 2.74±0.20 AU; P=0.049), but increased to control values after exercise (GT+TT: 2.57±0.27 AU vs. GG: 2.72±0.23 AU; P=0.57). Blood flow during HR increased after exercise in both groups, but the kinetics was slower only for subjects with 894G>T polymorphism as time-constant was higher when compared to controls (GT+TT: 46.0±5.8s vs. GG: 33.3±4.9s; P=0.043).

**CONCLUSIONS:** Healthy young subjects with 894G>T polymorphism present lower forearm blood flow due to lower conductance before exercise that was normalized after effort. Reactive vasodilation increased after exercise regardless of the genotype for eNOS on exon 7, but in subjects with GT+TT polymorphism the phenomenon was slower suggesting altered control of blood flow after exercise.

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**1421 Board #23 May 27 11:00 AM - 12:30 PM**  
**The Effect Of Atropine On Cerebral Perfusion During Systemic Hypotension**

Peizhen Zhang, Kevin Formes, Nancy Tierney, Xiangrong Shi, FACSM. UNT HEALTH SCIENCE CENTER, Fort Worth, TX.

(No relationships reported)

**PURPOSE:** The aim of this study was to seek the importance of reflex control of heart rate (HR) in maintaining cerebral perfusion during systemic hypotension.

**METHODS:** Eight healthy subjects (28.4±1.9 yr) gave the written consent to participate in the study that was approved by IRB at UNTHSC. Systemic hypotension was elicited by cuff deflation (CD) following 3-min bilateral supra-systolic occlusion at rest and during lower-body negative pressure (LBPN).

**RESULTS:** Atropine increased baseline HR from 63±2 to 103±3 bpm. However, neither middle cerebral arterial blood flow velocity ( $V_{MCA}$ , Doppler) nor mean arterial pressure (MAP, Tonometry) was significantly altered by atropine (before vs after: 66.3±4.0 vs 70.1±4.8 cm/s and 84±4 vs 87±4 mmHg). Though CD elicited hypotension was greater after atropine, the decreases in  $V_{MCA}$  were not different (see Table 1). Nonetheless, MAP recovery time following CD was not different before and after atropine despite significant diminution of the tachycardiac response.  $V_{MCA}$  recovery time had a trend (P = 0.10) to be longer after atropine.

**CONCLUSION:** MAP recovery remained fully compensated after atropine, whereas  $V_{MCA}$  recovery was partially dependent on HR reflex.

Table 1. Response to cuff deflation after 3-min supra-systolic occlusion

LBPN	Drug	DMAP mmHg	DV <sub>MCA</sub> cm/s	DT <sub>MAP</sub> sec	DT <sub>V<sub>MCA</sub></sub> sec	DHR bpm
0	Control	-11±2	-7.6±1.7	12.3±2.5	6.6±2.3	+18±3
	Atropine	-16±2	-8.4±1.6	12.3±2.1	9.0±1.9	+6±1 <sup>†</sup>
-15	Control	-16±2	-10.1±2.5	13.2±1.7	5.8±0.9	+23±3
	Atropine	-23±2	-10.9±1.9	11.1±2.7	6.7±0.7	+10±1 <sup>†</sup>
-40	Control	-21±2*	-14.2±2.1	11.2±1.5	4.9±0.9	+26±3
	Atropine	-25±2*	-12.7±1.8	7.8±0.7	6.4±0.7	+13±2* <sup>†</sup>
P	Drug	0.0001	0.9774	0.2178	0.1039	0.0001
	LBPN	0.0001	0.0005	0.2391	0.1703	0.0082

DT<sub>MAP</sub> and DT<sub>V<sub>MCA</sub></sub>: recovery time for DMAP and DV<sub>MCA</sub>, respectively. P indicates the outcome of two-way ANOVA. \* And † denote a significant change from 0 Torr LBPN and a significant difference before and after atropine, respectively.

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**1422 Board #24 May 27 11:00 AM - 12:30 PM**  
**Skeletal Muscle Blood Flow During Limb Movement: The Role Of Joint Angle.**

Stephen J. Ives<sup>1</sup>, John McDaniel<sup>2</sup>, Anette S. Fjeldstad<sup>1</sup>, Melissa A. Hayman<sup>1</sup>, David W. Wray<sup>1</sup>, Russell S. Richardson<sup>1</sup>. <sup>1</sup>University of Utah, Salt Lake City, UT. <sup>2</sup>Veterans Affairs Hospital, Salt Lake City, UT.

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(No relationships reported)

Although it is clear that blood flow varies across a duty cycle, thought to be predominately a consequence of changing intramuscular pressure, there is also an unknown contribution of joint angle.

**PURPOSE:** To isolate the effects of joint angle on skeletal muscle blood flow in humans by adopting a reductionist approach.

**METHODS:** Six apparently healthy male volunteers (32±7 yr, 89±19 kg, 180±10 cm) participated in 1 trial of passive supine knee extensor exercise. Each trial consisted of 4 complete oscillations from approximately 180° of knee extension to 90° knee flexion at a rate of 5 degrees \* sec<sup>-1</sup>. Blood flow was assessed using Doppler ultrasonography, and was analyzed second by second. The lower leg was occluded at a supra-systolic pressure (250 mmHg), at the level of the tibial tuberosity during all measurements. Joint angle was measured using a modified knee brace instrumented with a digital goniometer, and heart rate was measured using ECG output from the Doppler system. All variables were collected at a frequency of 200 Hz on an A-D system.

**RESULTS:** No differences were observed between antegrade and retrograde femoral blood flows across joint angle. In contrast net blood flow was progressively attenuated ( $p < .01$ ) between the high (180°), mid (135°), and low (90°) joint angles, irrespective of heart rate. Full knee extension facilitated a 52% greater flow (272.6 mL\*min<sup>-1</sup>); as compared to the flexed joint angle (178.6 mL\*min<sup>-1</sup>). Additionally, when the systolic pulse and optimal joint angle align (systole + full extension), joint angle and systolic pulse acted synergistically and blood flow was optimized. The magnitude of the effect is quite remarkable, such that optimal joint angle can acutely raise skeletal muscle blood flow equal to that of a systolic pulse.

**CONCLUSIONS:** During supine passive knee extensor exercise, skeletal muscle blood flow was joint angle dependent and likely due to the associated mechanical deformation of the vasculature.

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**1423 Board #25 May 27 11:00 AM - 12:30 PM**  
**NMR-based Evidence Of Improved Skeletal Muscle Perfusion And Energetics In The Elderly Following Acute Antioxidant**



## Administration

D. Walter Wray<sup>1</sup>, Steven K. Nishiyama<sup>1</sup>, Aurélien Monnet<sup>2</sup>, Claire Wary<sup>2</sup>, Sandrine Duteil<sup>2</sup>, Pierre Carlier<sup>2</sup>, Russell S. Richardson<sup>1</sup>. <sup>1</sup>University of Utah, Salt Lake City, UT. <sup>2</sup>AIM-CEA Institute de Myologie, Paris, France.

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(No relationships reported)

**PURPOSE:** We sought to examine the potential role of oxidative stress on skeletal muscle function with advancing age.

**METHODS:** Nuclear magnetic resonance (NMR) was employed to simultaneously assess muscle perfusion (arterial spin labeling, ASL) and energetics (31P NMR spectroscopy) in the lower leg of young ( $26 \pm 5$  yrs,  $n = 6$ ) and older ( $70 \pm 5$  yrs,  $n = 6$ ) healthy volunteers following consumption of either placebo (PL) or an oral antioxidant (AO) cocktail (Vitamins C, E, and alpha lipoic acid) previously documented to decrease plasma free radical concentration. NMR measurements were made during and after 5-min of moderate intensity ( $\approx 5W$ ) plantar flexion exercise.

**RESULTS:** AO administration significantly improved end-exercise perfusion ( $50 \pm 5$  ml $\cdot$ 100g $\cdot$ 1 $\cdot$ min $\cdot$ 1, AO;  $43 \pm 4$  ml $\cdot$ 100g $\cdot$ 1 $\cdot$ min $\cdot$ 1, PL) and post-exercise perfusion area-under-the-curve ( $1286 \pm 236$  ml $\cdot$ 100g $\cdot$ 1, AO;  $866 \pm 144$  ml $\cdot$ 100g $\cdot$ 1, PL) in older subjects, while AO administration did not alter hemodynamics in the young group. Concomitantly, muscle oxidative capacity (time constant of PCr recovery) was improved following AO in the older ( $43 \pm 1$ s, AO;  $51 \pm 7$ s, PL) but not the young ( $54 \pm 5$ s, AO;  $48 \pm 7$ s, PL) group.

**CONCLUSIONS:** These findings support the concept that oxidative stress is partially responsible for the age-related decline in skeletal muscle perfusion. Acute antioxidant administration restored perfusion toward that of the young and consequently improved oxidative capacity in the elderly, demonstrating the functional consequence of free-radical-mediated hypoperfusion on skeletal muscle energetics in this cohort.

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### 1424 Board #26 May 27 11:00 AM - 12:30 PM

#### Transfer Function Characteristics Of The Arterial Baroreflex Neural And Peripheral Arcs At Rest And During Muscle Metaboreflex Activation In Humans

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Previous studies have demonstrated an increase in the sensitivity of arterial baroreflex (ABR) control of muscle sympathetic nerve activity (MSNA) in humans during isolated activation of the muscle metaboreflex with post exercise muscle ischemia (PEMI). However, this increased ABR-MSNA control does not appear to enhance the ABR control of arterial blood pressure (BP), suggesting potential alterations in the transduction of MSNA into a peripheral vascular response and a subsequent ABR-mediated change in BP.

**PURPOSE:** To examine the neural and peripheral arcs of the ABR and their interactive relationship at rest and during muscle metaboreflex activation.

**METHODS:** Graded isolation of the muscle metaboreflex was achieved by PEMI following isometric handgrip performed at 15 and 30% maximal voluntary contraction (MVC) in nine healthy subjects. BP, MSNA and femoral artery blood velocity were continuously recorded. To assess the sensitivity (i.e. gain) of the ABR neural and peripheral arcs, the transfer function from BP to MSNA and MSNA to femoral vascular conductance index, respectively were analyzed.

**RESULTS:** Compared to rest no changes were observed in the ABR neural or peripheral arcs during PEMI following 15%MVC handgrip. However, PEMI after 30%MVC handgrip increased the low frequency (LF) transfer function gain between BP and MSNA (ABR neural arc;  $+58 \pm 28\%$ ,  $P=0.036$ ), whereas the LF gain between MSNA and femoral vascular conductance index (ABR peripheral arc) was decreased from rest ( $-36 \pm 8\%$ ,  $P=0.017$ ).

**CONCLUSION:** The gains of both the neural and peripheral ABR arcs were altered during muscle metaboreflex activation in an intensity-dependent manner. Indeed, during high intensity muscle metaboreflex activation an increased ABR gain of the neural arc appears to offset an attenuation of the peripheral arc gain to help maintain the overall ABR control of systemic blood pressure.

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### 1425 Board #27 May 27 11:00 AM - 12:30 PM

#### Lower Body Negative Pressure Shifts The Volume Indifferent Point

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(No relationships reported)

During head-up tilt, gravity redistributes  $\sim 700$  mL of blood to the legs, abdomen, and pelvis. We have developed a quantitative approach to examine how splanchnic pooling influences orthostatic tolerance. The volume indifferent point (VIP) is the point where blood volume does not change, regardless of posture. Its location is influenced by regional compliances and should be coincident with the hydrostatic indifferent point (HIP). Thus, a more inferiorly located HIP/VIP should result in less venous return and lower orthostatic tolerance. We hypothesized that excessive splanchnic pooling induced with lower body negative pressure (LB)NP would result in a more inferior VIP.

**PURPOSE:** To determine the location of the VIP during a control period and during  $-20$  mmHg LB)NP.

**METHODS:** Four segments (xyphoid process-iliac crest, umbilicus-iliac crest, iliac crest-mid thigh, manubrium-xyphoid process) were identified; their distance was referenced to the floor. Segmental bioelectrical impedance from each segment was collected continuously while subjects were tilted ( $0^\circ$ ,  $15^\circ$ ,  $30^\circ$ , and  $50^\circ$ ) for 6 min each and repeated during  $-20$  mmHg LB)NP. D)Segmental blood volume ( $15-0^\circ$ ,  $30-0^\circ$ ,  $50-0^\circ$ ) was calculated from impedance and non-linear regression was used to determine the distance from the floor in which segmental blood volume did not change (the VIP).

**RESULTS:** The VIP was located  $64 \pm 4\%$  of an individual's height during control measurements. LB)NP induced an inferior shift in the location of the VIP ( $-5.3 \pm 6.2$  cm,  $p=0.02$ ).

**CONCLUSIONS:** The VIP is located roughly at the level of the diaphragm in healthy individuals. Application of  $-20$  mmHg LB)NP induces splanchnic pooling and shifts the VIP toward the feet.

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### 1426 Board #28 May 27 11:00 AM - 12:30 PM

#### Effects Of Kaatsu Training On Haemostasis In Healthy Subjects

Haruhito Takano<sup>1</sup>, Toshiaki Nakajima<sup>1</sup>, Miwa Kurano<sup>1</sup>, Nami Kubota<sup>1</sup>, Haruko Iida<sup>1</sup>, Tomohiro Yasuda<sup>1</sup>, Yoshiaki Sato<sup>1</sup>, Hiroshi Ohshima<sup>2</sup>, Takashi Abe<sup>1</sup>, Naokata Ishii<sup>1</sup>, Toshihiro Morita<sup>1</sup>. <sup>1</sup>University of Tokyo, Tokyo, Japan. <sup>2</sup>Japan Aerospace Explosion Agency, Tokyo, Japan.

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(No relationships reported)

The KAATSU training is performed under the reduction of muscle blood flow by a specially-designed belt (KAATSU belt), which induces blood pooling in capacitance vessels by restricting venous return. However, no prior studies have examined the effects of KAATSU training on haemostasis.

**PURPOSE:** We investigated acute effects of KAATSU training on haemostasis including fibrinolytic responses under several conditions. in healthy subjects.

**METHODS:** Two protocols have been performed. (1) 6 healthy men (mean age,  $48 \pm 5$  yr) performed KAATSU ( $160$  mmHg) of both thighs for 15 minutes and then KAATSU

training combined with low-intensity leg and foot aerobic exercises for ~10 minutes in hypobaric chamber, which mimics 8000 feet in airflight. (2) Another 7 men (mean age,  $30 \pm 4$  yr) performed leg press exercises (30 % 1 RM) with and without KAATSU of both thighs 24 h after bed rest. Blood samples were taken at rest, immediately after KAATSU, and exercises with or without KAATSU, and after exercise. For the investigation of blood fibrinolysis, determinations of tissue-type plasminogen activator (tPA) activity or antigen, plasminogen activator inhibitor (PAI)-1 activity or antigen, fibrin degradation product (FDP) and D-dimer were used. Prothrombin time (PT) and platelet counts were also measured.

**RESULTS:** (1) In hypobaric chamber, KAATSU by itself significantly increased tPA activity, while PAI-1 activity was unchanged. Furthermore, immediately after the exercise, tPA activity increased significantly. (2) During the exercises combined with KAATSU 24 h after bed rest, tPA antigen significantly increased, compared with control exercises, but PAI-1 antigen was unchanged. In both cases, KAATSU training did not induce fibrin formation as assessed by fibrin D-dimer and FDP.

**CONCLUSIONS:** This study indicates that potentially favorable changes occur in fibrinolytic factors after KAATSU and KAATSU training in healthy subjects.

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**1427 Board #29 May 27 11:00 AM - 12:30 PM**  
**Coagulation And Fibrinolytic Responses To Exercise In Hot And Cold Temperatures**

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(No relationships reported)

Most adverse cardiovascular events are the result of an occlusive blood clot. During exercise, ischemic risk transiently increases, possibly due to exertion-related changes in coagulation and fibrinolytic activity. Previous research suggests ambient temperature affects resting coagulation and fibrinolytic potential, but the effect of heat and cold on hemostasis during exercise is unknown.

**PURPOSE:** To assess changes in coagulation and fibrinolysis during maximal exercise in hot and cold temperatures, and to compare those responses to exercise under normal, temperate conditions.

**METHODS:** Fifteen healthy male subjects ( $25.3 \pm 4.3$  years) completed maximal cycle ergometer exercise tests in hot ( $30^\circ\text{C}$ ), temperate ( $20^\circ\text{C}$ ) and cold ( $5^\circ$  or  $8^\circ\text{C}$ ) temperatures. Blood samples were obtained before and immediately after exercise and analyzed by ELISA to determine plasma concentrations of thrombin-antithrombin complex (TAT), tissue plasminogen activator (tPA) and plasminogen activator inhibitor-1 (PAI-1). Results were analyzed with a two-factor ANOVA using temperature and time (pre-, post-exercise) as within-subjects factors. Post-hoc pairwise comparisons were made using Fisher's LSD method.

**RESULTS:** VO<sub>2</sub>peak was not different among the three temperatures (temperate =  $40.7 \pm 8.7$ , hot =  $41.8 \pm 9.4$ , cold =  $41.2 \pm 9.2$  ml/kg/min,  $p > 0.05$ ). A main effect of time was observed for TAT (temperate =  $0.45 \pm 0.26$  -  $1.04 \pm 0.44$  ng/ml, hot =  $0.64 \pm 0.55$  -  $1.18 \pm 0.95$  ng/ml, cold =  $0.88 \pm 0.57$  -  $1.34 \pm 0.79$  ng/ml, PRE to POST, respectively,  $p < 0.01$ ) and tPA activity (temperate =  $0.72 \pm 0.44$  -  $2.71 \pm 0.55$  IU/ml, hot =  $0.72 \pm 0.38$  -  $2.64 \pm 0.61$  IU/ml, cold =  $0.86 \pm 0.45$  -  $2.65 \pm 0.77$  IU/ml, PRE to POST, respectively,  $p < 0.01$ ). A non-significant trend was observed for the PAI-1 response to exercise (temperate =  $14.5 \pm 23.7$  -  $12.3 \pm 20.2$  IU/ml, hot =  $15.1 \pm 26.5$  -  $10.0 \pm 15.1$  IU/ml, cold =  $10.5 \pm 10.4$  -  $7.9 \pm 9.7$  IU/ml, PRE to POST, respectively,  $p = 0.08$ ). Cold temperature resulted in significantly higher TAT concentrations than temperate conditions ( $p = 0.05$ ). No other main effects of temperature or time x temperature interactions were observed.

**CONCLUSIONS:** The potential for clot formation is elevated during exposure to cold temperatures. These data suggest that risk of an ischemic event may be elevated in the cold.

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**A-24 Free Communication/Poster - Body Composition**

MAY 27, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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**1428 Board #30 May 27 9:30 AM - 11:00 AM**  
**Effects of Covert Subject Actions on Percent Fat by Air Displacement Plethysmography**

R. Randall Clark<sup>1</sup>, Michelle H. Tegenkamp<sup>2</sup>, Greg L. Landry<sup>3</sup>, Dale A. Schoeller<sup>2</sup>. <sup>1</sup>UW Hospital Sports Medicine Center, Madison, WI. <sup>2</sup>University of Wisconsin-Madison, Madison, WI. <sup>3</sup>University Hospital and Clinics, Madison, WI.

(No relationships reported)

Athletes in weight classification sports may engage in rapid weight loss methods to "make weight" prior to competition. Distance runners and endurance athletes, where there is a perception of improved performance at a lower body weight, may also engage in excessive weight loss methods prior to competition. Such practices may cause poor athletic performance and can be harmful to the body. Some trainers and coaches, and in the case of wrestling, the NCAA have adopted programs aimed at reducing unhealthy weight loss behaviors by measuring body fat using hydrostatic weighing, skinfolds or air-displacement plethysmography (ADP). Athletes, however, may use covert methods during body composition testing to artificially increase their percent body fat allowing them to reach a lower minimum weight.

**PURPOSE:** The goal of this study was to examine the accuracy of ADP under altered conditions. This study examined the susceptibility of the Bod Pod ADP instrumentation to intentional manipulation of body composition measures by subjects.

**METHODS:** Subjects underwent body composition analysis in the Bod Pod following the standard procedure previously validated. They then underwent eight more measurements while performing the following: four breathing patterns altering lung volume, foot movement, hand cupping to trap air, and heat and cold exposure.

**RESULTS:** Increasing and decreasing lung volume during thoracic volume measurement and during body density measurement altered the apparent percent body fat assessment ( $p < 0.001$ ). High lung volume during thoracic gas measures (HLV-TG) overestimated fat by  $3.7 \pm 2.1\%$ . Lowered lung volume during body volume measures (LLV-BV) overestimated body fat by an additional  $2.2 \pm 2.1\%$ . The summation effect of the covert manipulation resulted in an overestimation of the athletes' body composition by 5.9 percent body fat. The heat and cold exposure, tapping and cupping treatments were not significantly different from control.

**CONCLUSION:** These results demonstrate that athletes can covertly alter their body composition measurement to obtain a lower competition weight when measured by ADP. It is therefore important that technicians monitor for intentionally altered breathing when using ADP that could artificially increase percent body fat and invalidate the test result.

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**1429 Board #31 May 27 9:30 AM - 11:00 AM**  
**Self-perception Of Body Composition In Lean Pole Vault Athletes**

Michael G. Coles, Tim R. Anderson, Jacobo O. Morales, Lisa J. Leininger. *California State University, Fresno, Fresno, CA.*

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(No relationships reported)

Research has shown that certain individuals may have a distorted self-perception of body size, shape, and weight. Most studies in this area do not include very lean athletes and are not focused specifically on body composition.

**PURPOSE:** This investigation was done in order to determine if there is a difference between self-perceived and actual estimated body fat percentages in lean pole vault athletes.

**METHODS:** A cohort of 168 men and women pole vaulters from 3 competitive categories, pre-collegiate, collegiate, and post-collegiate, participated in the investigation. Each participant was asked to self-predict his or her percent body fat ( $BF_{pred}$ ) before having their body composition estimated using a 7-site skinfold technique ( $BF_{skf}$ ). Paired t-tests were used to determine if the  $BF_{pred}$  value differed from the  $BF_{skf}$  result for each combination of gender and competitive category.

**RESULTS:** Table 1 contains the mean ( $\pm$  SD) for descriptive data,  $BF_{pred}$ , and  $BF_{skf}$  for men and women grouped by competitive level.

**CONCLUSION:** These results indicate that there was a significant difference ( $p<0.05$ ) between  $BF_{pred}$  and  $BF_{skf}$  for all men, regardless of competitive level, and pre and post collegiate women. All of these groups overestimated their percent body fat. There was no significant difference ( $p>0.05$ ) between  $BF_{pred}$  and  $BF_{skf}$  for collegiate level women pole vaulters. These results suggest that these lean female pole vault athletes have a more accurate self-perception of their percent body fat than other groups in this study. Reasons for this could be that they have more knowledge and/or experience with the construct of percent body fat and/or put more emphasis on monitoring this component of fitness.

Competitive Level & Gender	Age (y)	HT (m)	BM (kg)	%Fat Self-Predicted	% Fat Skin Fold Estimate
Pre-Collegiate Male	16.9 $\pm$ 1.13 N = 35	1.79 $\pm$ 0.07	69.76 $\pm$ 7.15	9.23 $\pm$ 3.99	5.66 $\pm$ 2.78
Pre-Collegiate Female	16.9 $\pm$ 1.05 N = 37	1.63 $\pm$ 0.14	58.08 $\pm$ 6.75	18.08 $\pm$ 6.65	14.44 $\pm$ 3.11
Collegiate Male	20.7 $\pm$ 2.0 N = 46	1.80 $\pm$ 0.07	75.31 $\pm$ 6.89	8.34 $\pm$ 3.07	6.49 $\pm$ 2.73
Collegiate Female	16.7 $\pm$ 1.25 N = 24	1.64 $\pm$ 0.08	60.23 $\pm$ 7.32	18.29 $\pm$ 5.31	17.19 $\pm$ 5.47
Post-Collegiate Male	26.1 $\pm$ 4.4 N = 12	1.79 $\pm$ 0.06	74.99 $\pm$ 6.7	9.17 $\pm$ 2.37	7.23 $\pm$ 2.53
Post-Collegiate Female	23.5 $\pm$ 3.6 N = 14	1.67 $\pm$ 0.07	60.53 $\pm$ 4.72	15.89 $\pm$ 3.16	13.98 $\pm$ 3.66

#### 1430 Board #32 May 27 9:30 AM - 11:00 AM Validity And Reliability Of Skinfold Measurement In Assessing Body Fatness Of Hong Kong Chinese Children

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(No relationships reported)

The prevalence of childhood obesity in Hong Kong has increased closed to 70% in the past 13 years. For tracking the childhood obesity level effectively, there is an urgent need to evaluate the obesity level of children in Hong Kong using objective and practical measurement.

**PURPOSE:** Using Air Displacement Plethysmography (ADP) as a criterion, we evaluated the validity and reliability of skinfold (SKF) measurement in predicting percent body fat of Chinese children in Hong Kong.

**METHODS:** A heterogeneous sample of healthy voluntary Chinese children (142 boys and 88 girls) with a wide age range (9-19 years) and body composition was recruited through stratified purposeful sampling.

**RESULTS:** The internal consistency of SKF and ADP measurements were very high ( $r \geq .988$ ). Repeated t-test showed no significant difference between %fat measured by ADP (%fatADP) and that measured by dual X-ray absorptiometry in a sub-sample (N = 41), and significant difference was found between percent fat estimated by the Slaughter equations (%fatSlaughter) and %fatADP. The Slaughter equations slightly underestimated %fat of Hong Kong children, in which 1.52% for boys and 1.84% for girls. Despite the high R squares (.81 for boys and .64 for girls), the slope of the regression line for boys was significantly different from the line of identity. Subsequent stepwise regression analyses found three alternative SKF prediction models for estimating percent body fat of Chinese children in Hong Kong, which combining waist circumference, height and children's age. The most accurate model for boys was %fat = 22.091 - 0.147 (height) + 0.760 ( $\Sigma$ 3SKF) - 0.003 ( $\Sigma$ 3SKF)<sup>2</sup> (R square = .88, SEE = 3.70%), and that for girls was %fat = 17.539 + 0.303 ( $\Sigma$ 2SKF) + 0.516 (height) - 0.175 (waist circumference) (R square = .71, SEE = 3.38%). The third model for boys and girls was the convenient model, as only triceps SKF and age is required for the estimation. The equation for boys was %fat = 14.405 + 1.479 (triceps) - 0.856 (age) (R square = .81, SEE = 4.67%), and the equation for girls was %fat = 13.936 + 1.170 (triceps) - 0.502 (age) (R square = .63, SEE = 3.77%).

**CONCLUSION:** The accuracy of these models is comparable to the Slaughter equations, but the estimated %fat by these new models were less deviated from %fatADP than that estimated by the Slaughter equations.

#### 1431 Board #33 May 27 9:30 AM - 11:00 AM Comparison Of Somatotype Measurements Of Physical Education Students From Singapore And India

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Somatotype measurements provide accurate descriptive information of athlete's physique than anthropometric measurements. Somatotype measurements describe the relative muscularity, fatness, and slenderness of the physique. There are few studies on somatotypes of Asian population and the comparison of somatotypes between two Asian cohorts has not been investigated.

**PURPOSE:** The purpose of this study was to measure and compare somatotypes of Physical Education (PE) students in Singapore and India.

**METHODS:** 13 healthy males (age, 26.8 $\pm$ 0.8 yrs; BMI, 22.7 $\pm$ .67 kg•m<sup>-2</sup>) and 8 females (age, 24.1 $\pm$ .6 yrs; BMI, 19.7 $\pm$ .66 kg•m<sup>-2</sup>) from Singapore and 16 healthy males (age, 26.3 $\pm$ .78 yrs; BMI, 23.2 $\pm$ .81 kg•m<sup>-2</sup>) and 7 females (age, 19.3 $\pm$ .64 yrs; BMI, 21.8 $\pm$ 1.56 kg•m<sup>-2</sup>) from India were selected for this investigation. Somatotype components [Endomorphy (END), Mesomorphy (MES), and Ectomorphy (ECT)] were calculated according to the procedure by Heath and Carter (2002) for all subjects. Somatotype software was used to calculate the somatotypes of subjects. Data was plotted using probability-probability (P-P plot) and Box-and-Whisker plot. Shapiro-Wilk statistics was utilized to assess the data's goodness of fit to the normal distribution. As the data was not normally distributed, Kruskal-Wallis non-parametric statistical test was employed to compare MES, END, and ECT among both countries according to gender.

**RESULTS:** The Singapore females (mean somatotype: 3.66-3.15-3.19; SD: 0.81-1.22-1.09) were balanced endomorph while Indian females (mean somatotype: 4.71-4.03-2.16; SD: 1.48-0.92-1.25) were mesomorphic endomorph. In addition, Singapore males (mean somatotype: 3.43-4.65-2.49; SD: 1.27-1.31-1.43) and Indian males (mean somatotype: 2.76-4.31-2.00; SD: 1.53-1.33-1.18) had similar endomorphic mesomorph body type. There were no significant differences in somatotypes between Indian and Singapore males ( $p>0.05$ ) and between Indian and Singapore females ( $p>0.05$ ).

**CONCLUSIONS:** Results indicated similarities in somatotypes among Singapore and Indian PE students. The male students of both countries were muscle framed and female students were generally endomorph. Results suggest that students of Asian origin with similar somatotypes may be currently enrolled as PE students in India and Singapore.

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**1432 Board #34 May 27 9:30 AM - 11:00 AM**  
**Is Body Mass Index Useful In Sports Medicine ?**

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(No relationships reported)

**PURPOSE:** The Body Mass Index (BMI) is very often used in sports medicine to evaluate obesity/leanness and to guide athletes to a particular sport. Is this index relevant ?

**METHODS:** We studied the morphological characteristics of 563 soccer players involved in the French soccer 1st league championship. These players are divided into forwards (F, n=127), backs (B, n=176), goalkeepers (G, n=60) and midfielders (M, n=200) by soccer journals. We compared mean values to see if each position on the field of play was associated to a particular morphological profile.

**RESULTS:** Soccer players are  $27 \pm 4.27$  years old,  $1.81 \pm 1.81$  m tall and weigh  $75.0 \pm 6.5$  Kg ( $165.0 \pm 14.3$  lbs). Their BMI is  $22.9 \pm 1.2$ . Forwards are younger than backs and goalkeepers ( $p<0.05$ ) and they are as old as midfielders. They are smaller than backs and taller than midfielders ( $p<0.01$ ); they are as tall as goalkeepers. They are lighter than backs and goalkeepers but a little heavier than midfielders. Their BMI is only different from the BMI of midfielders. Backs are older than midfielders and they as old as midfielders. They are smaller than goalkeepers and midfielders. They are lighter than goalkeepers and heavier than midfielders. Their BMI is lower than that of goalkeepers but higher than that of midfielders. Goalkeepers are older, higher and heavier than midfielders with a higher BMI.

**CONCLUSIONS:** The best data to characterize soccer players are simply height and weight : we know that goalkeepers have to be large and need explosive power. They are taller than other players. If we look at BMI, we lose information : there is no difference in BMI between goalkeepers, forwards or backs, but height and weight are very significantly different. "Overweight" could reflect musculature rather than obesity. So, BMI is not useful for the evaluation of sportsmen. Moreover, the BMI does not permit any notion of the distribution of regional adiposity, or health risks that are associated with visceral obesity.

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**1433 Board #35 May 27 9:30 AM - 11:00 AM**  
**Associations Between Body Composition And Measures Of Physical Activity**

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(No relationships reported)

The prevalence of obesity in adolescent girls continues to rise worldwide. The increase in obesity is often attributed to low levels of physical activity although large inconsistency exists between reported levels of physical activity and level of fatness. These inconsistencies may be related to methodological variation in assessing measures of body composition.

**PURPOSE:** The purpose of this investigation was to determine if adjusting for height relative to body composition would improve the association between body composition and levels of physical activity.

**METHODS:** A cross-sectional analysis was conducted in 328 female adolescents aged 9-15yrs (age,  $11.0 \pm 1.0$  years; BMI,  $27.6 \pm 6.2$  kg/m<sup>2</sup>). Youth were asked to wear a pedometer during waking hours to get an objective measure of physical activity (steps/day) for seven consecutive days. Body weight and standing height were measured to the nearest 0.1 kilograms and centimeters, respectively. Body composition was assessed via dual energy x-ray absorptiometry. To adjust for body size, fat mass (FM) and lean mass (LM) were normalized for height and expressed as fat mass index (FMI) and lean mass index (LMI). All regression analyses were controlled for age and race.

**RESULTS:** We found that 2.6% of the variance in physical activity was accounted for by FM ( $R = .16$ ;  $P = 0.04$ ) and this association was not strengthened after adjusting for height (FMI,  $R = .16$ ;  $P = 0.04$ ). LM ( $R = .120$ ;  $p > 0.05$ ) and LMI ( $R = .122$ ;  $p > 0.05$ ) were not significantly associated with physical activity. When expressing FM and LM as a percentage of body mass, percent fat mass predicted 2.8% ( $R = .17$ ;  $P = 0.03$ ) of the variance in physical activity whereas percent lean mass explained 2.7% ( $R = .16$ ;  $P = 0.03$ ) of the variance in physical activity.

**CONCLUSION:** Adjusting for height does not increase the association between measures of body composition and levels of physical activity. All measures of FM and percent LM are similarly related to physical activity in adolescent girls.

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**1434 Board #36 May 27 9:30 AM - 11:00 AM**  
**An Intracellular Water Reduction Before A Competition Decreases Upper-body Power Output In Elite Judo Athletes**

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(No relationships reported)

**PURPOSE:** To analyze the effect of body composition changes, from a period of weight maintenance to before a competition (nearly 1-month apart), on upper-body power output (PO) in male judo athletes.

**METHODS:** A total of 23 men, top-level athletes (age:  $22.8 \pm 2.7$  yrs), were evaluated at baseline [weight:  $73.0 \pm 7.3$  kg; percent fat mass (%FM):  $11.7 \pm 2.4$  %] and before a competition (Weight:  $72.0 \pm 7.2$  kg; %FM:  $11.2 \pm 2.3$  %). Before the competition some of these athletes lost weight through self-determined means while others remained or increased their weight. A 7-day recall of dietary food intake was recorded at baseline and before the competition. At both moments, and after an overnight fasting, total body water (TBW), extracellular (ECW), and intracellular water (ICW) were estimated by bioelectrical impedance spectroscopy while FM, fat-free mass (FFM), lean soft tissue (LST), and arms LST were assessed by dual-energy x-ray absorptiometry (DXA). At baseline, a power-load spectrum was used to assess upper-body PO in a bench-press position while, before the competition, and after a standardized warm-up, only the individual load where the peak PO value was obtained at baseline was used to assess PO changes. Changes are expressed as a percentage of the baseline value; comparisons of means, bivariate and partial correlations were used.

**RESULTS:** A significant mean reduction ( $p<0.05$ ) in weight was observed [ $-1.3 \pm 2.5$  %,  $-6.2$  to  $2.8$  % (mean  $\pm$  SD, range)] while no significant mean changes were found in FM ( $-4.3 \pm 10.1$  %,  $-21.9$  to  $14.0$  %), FFM ( $-0.8 \pm 2.3$  %,  $-5.4$  to  $3.1$  %), LST ( $-0.9 \pm 2.5$  %,  $-5.8$  to  $3.2$  %), arms LST ( $-1.8 \pm 4.4$  %,  $-9.9$  to  $4.1$  %), TBW ( $-0.9 \pm 3.9$  %,  $-9.2$  to  $5.9$  %), ECW ( $-0.5 \pm 5.0$  %,  $-15.8$  to  $5.9$  %), ICW ( $-1.0 \pm 5.4$  %,  $-10.9$  to  $8.6$  %), energy intake ( $-4.3 \pm 29.0$  %,  $-54.1$  to  $54.9$  %), and PO ( $2.9 \pm 12.3$  %,  $-24.0$  to  $41.3$  %). Changes in PO were only related with changes in TBW ( $r=0.711$ ,  $p<0.001$ ) and ICW ( $r=0.605$ ,  $p=0.002$ ); these associations remained after controlling for weight and arms LST changes ( $r=0.658$ ,  $p=0.001$  and  $r=0.633$ ,  $p=0.002$ , respectively) which means that those athletes that lost TBW, specifically the ICW compartment, were those that reduced PO.

**CONCLUSIONS:** To avoid upper-body power reductions before a competition, athletes should not decrease TBW and ICW. Together, these findings highlight the need of assessing hydration changes in Judo athletes.



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**1435 Board #37 May 27 9:30 AM - 11:00 AM**  
**Prone Vs. Supine Dxa Scans In Ambulatory Subjects: A Pilot Study**

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Dual energy X-ray absorptiometry (DXA) is widely used technique for bone mineral density as well as body composition, since it provides an accurate estimation in healthy adults and clinical population. In clinical population, supine position may not be feasible due to medical complications such as pressure ulcers.

**PURPOSE:** To determine if there is an agreement in bone mineral content (BMC) and body composition (Fat Free Mass (FFM) and Fat Mass (FM)) in supine versus prone positioning on the Lunar Prodigy DXA scanner.

**METHODS:** Thirteen (7 males and 6 females; aged  $33.7 \pm 8.7$  yrs;  $26.0 \pm 5$  kg/m<sup>2</sup>) subjects were recruited to perform two full body scans while on the DXA (1 prone and 1 supine). Each scan took approximately 6 minutes to perform and had about one-minute between scans in order to reposition into either a supine or prone position.

**RESULTS:** Pearson correlations demonstrated strong agreement between supine and prone position in BMC ( $r = .99$ ,  $p = .0001$ ), FFM ( $r = .98$ ,  $p = .0001$ ), FM ( $r = .99$ ;  $p = .0001$ ). Paired T-test revealed significant differences in supine vs. prone in BMC ( $3.0 \pm 0.5$  vs.  $3.1 \pm 0.5$ ,  $p = .0001$ ) and FM ( $20.9 \pm 10.0$  vs.  $20.3 \pm 9.9$ ,  $p = .002$ ); however, there was no significant difference in FFM ( $53.9 \pm 10.0$  vs.  $53.7 \pm 9.8$ ,  $p = .412$ ).

**CONCLUSIONS:** The current study suggests that prone can be used as an alternative position during DXA scans to measure BMC and body composition.

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**1436 Board #38 May 27 9:30 AM - 11:00 AM**  
**Four Models For Predicting Pediatric Body Composition For Anglo And Hispanic Youth**

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Body composition is becoming recognized as a critical component in the reporting of health-related measures in children due to the increase in metabolic disorders. However, measuring body composition is often difficult due to lack of training, privacy issues and cost of accurate measuring devices. Therefore, it may be advisable to develop a prediction equation that can be used to accurately determine body composition in youth.

**PURPOSE:** To develop a body composition prediction equation for elementary age youth.

**METHODS:** A stratified sampling method was used to select volunteer children for this study. Height, weight, BMI, age, and skinfold were collected on 886 Anglo ( $n = 445$ ) and Hispanic ( $n = 441$ ) children between the ages of 7 and 12 ( $9.1 \pm 2.1$ ). Body composition was determined by using a standard two site procedure that is common in most schools. Group body fat means were examined through two-way ANOVA. Correlation matrices were run with each group on the variables of height, weight, BMI, age, and body fat percent. Regression prediction models were developed using stepwise regression techniques. Cook's D and Mahalanobis D distances were examined to determine outlier affects.  $R^2$  and standard error of the estimate (SEE) were examined for each resulting model.

**RESULTS:** The data was split by gender and ethnicity after two-way ANOVA revealed a significant difference between males and females and between Anglo and Hispanic groups. Prediction models were established with the following variables for the following groups: Anglo Females: BMI, Weight, Age ( $R^2 = .555$ ,  $SEE = 4.34$ ); Hispanic Females: Weight, Height ( $R^2 = .478$ ,  $SEE = 4.52$ ); Anglo Males: BMI, Weight, Age ( $R^2 = .561$ ,  $SEE = 5.83$ ); Hispanic Males: Weight, Age ( $R^2 = .403$ ,  $SEE = 5.32$ ). All models indicated acceptable means and ranges for Cook's and Mahalanobis distances.

**CONCLUSIONS:** The results indicate that reasonable field-based prediction models can be used as a general assessment tool when clinical methods are not available or practical within Anglo and Hispanic youth populations. The prediction variables also indicated consistency within ethnicities. Weight, age and BMI are consistent body fat prediction variables for Anglo youth while weight is a consistent body fat prediction variable for Hispanic youth. Future studies should examine these variables more closely.

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**1437 Board #39 May 27 9:30 AM - 11:00 AM**  
**Validity Of Equations For Total And Regional Skeletal Muscle Mass By Ultrasound In Japanese Prepubertal-boys**

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At the present time, there are very few effective methods to accurately and non-invasively estimate skeletal muscle (SM) mass in children. Recently, we developed ultrasound-derived prediction equations for estimating total and regional (i.e. arm, trunk and leg) SM mass in adults males and females (Eur J Appl Physiol 96: 24-31, 2006). However, it is unknown whether these equations are a valid method to estimate SM mass in prepubertal children.

**PURPOSE:** To investigate whether ultrasound-derived prediction equations for estimating total and regional SM mass in adults are applicable for prepubertal children.

**METHODS:** Sixty-one healthy Japanese prepubertal boys (mean age 10yr) volunteered for the study. Contiguous MRI images with a 1-cm slice thickness were obtained from the first cervical vertebra to the ankle joints as reference data. The volume of SM was calculated from the summation of digitized cross-sectional area. The volume units were converted into mass by an assumed SM density of 1.041g/cm<sup>3</sup>. The regional SM mass was determined by anatomical landmarks visible in the scanned images. Muscle thickness was measured by B-mode ultrasound (5 MHz scanning head) at 9 sites on different muscles (lateral forearm, anterior and posterior upper arm, abdomen, subscapular, anterior and posterior thigh, anterior and posterior lower leg). Total and regional SM mass were estimated using prediction equations for adult males, which were developed based on the relationship between ultrasound-measured muscle thickness and MRI-measured SM mass.

**RESULTS:** The measured SM mass by MRI was  $11.3 \pm 2.8$  kg for total,  $1.1 \pm 0.3$  kg for arm,  $4.6 \pm 1.2$  kg for trunk,  $4.2 \pm 1.2$  kg for thigh and  $1.4 \pm 0.5$  kg for lower leg, and were significantly different from the predicted total and regional SM mass by ultrasound (total  $8.0 \pm 3.6$ kg, arm  $0.9 \pm 0.3$ kg, trunk  $5.9 \pm 1.1$ kg and lower leg  $0.9 \pm 0.4$ kg, respectively,  $p < 0.01$ ) except for thigh ( $4.2 \pm 1.3$ kg).

**CONCLUSIONS:** The ultrasound-derived prediction equations for adults are not applicable for prepubertal boys. The specialized equation for estimating total and regional SM mass in prepubertal children is needed.

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**1438 Board #40 May 27 9:30 AM - 11:00 AM**  
**Body Mass Index For Women's National Basketball Association Players**

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(No relationships reported)

**PURPOSE:** Body Mass Index (BMI) has been proposed as a method to assess the body type of individuals in a relatively simple manner by taking into account one's height and weight. Categories of described body type include underweight, normal weight, overweight, obese class 1, obese class 2, and extreme (morbid) obesity. One of the

inaccuracies of using BMI as a screening tool for obesity is that it does not take into account lean body mass versus adipose tissue. Despite this challenge, it remains a popular and widely-used screening tool. The purpose of this study was to assess the body mass index of women's professional basketball players. The authors have previously identified patterns of BMI for competitive athletes in sports inclusive of football, baseball, ice hockey, soccer, and others. Previous work has been successful in identifying patterns for male athletes whereby a higher percent of the recorded BMI's have typically been noted to fall in the overweight category. It was assumed that similar trends would be noted with competitive female athletes, in particular professional basketball players.

**METHODS:** Height and weight were recorded for 164 females currently playing in the Women's Professional Basketball Association (WNBA). This data was obtained from publicly available team websites during 2008 and used to calculate the body mass index for team averages and by player position throughout the league.

**RESULTS:** Body mass index by player position ranged between 22.5 - 23.8, falling within the acceptable BMI range. Specifically, by player position, BMI outcomes were 22.5 (Guards, N = 75), 22.6 (Forwards, N = 61), and 23.8 (Centers, N = 28). Overall team averages for the 14 teams ranged from 21.9 - 23.4, all within normal acceptable ranges. Analysis of variance showed no significant difference between BMI's by position.

**CONCLUSIONS:** The overall difference between the position players of guard, center and forward were not significant and did not reveal an overweight classification based upon average BMI. As expected, the average of players in the position of center had slightly higher BMI's. Future studies should continue to assess how BMI is utilized with female athletic populations.

**1439 Board #41 May 27 9:30 AM - 11:00 AM**  
**Characteristics Of Body Mass Index For Women's Professional Volleyball Players**

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 (No relationships reported)

**PURPOSE:** Body Mass Index (BMI) is a commonly used measurement tool for assessing the body type of individuals in a relatively simple manner by taking into account one's height and weight. The lack of complexity and required equipment contribute to the high utilization of this method. Categories of described body type include underweight, normal weight, overweight, obese class 1, obese class 2, and extreme (morbid) obesity. One of the inaccuracies of using BMI as a screening tool for obesity is that it does not take into account lean body mass versus adipose tissue. The purpose of this study was to assess the body mass index of women's professional volleyball players. The authors have previously identified patterns of BMI for competitive athletes in sports inclusive of football, baseball, ice hockey, soccer, and others. The majority of the previously published findings report BMI's of male athletes who readily make their body weight available for public knowledge. Attempts to locate disclosed body weight measurements for female professional athletes have not been made as readily available. It was hypothesized that trends would be noted with competitive female professional volleyball players that might be indicative of an overweight BMI despite participating at an elite level of International athletic performance.

**METHODS:** Height and weight were recorded for 124 females currently playing Women's Professional Volleyball. This data was obtained from publicly available team websites during 2008 and used to calculate the body mass index for team averages and by player position throughout the league.

**RESULTS:** Body mass index by player position averages ranged between 20.1 - 21.4, falling within the acceptable BMI range. Specifically, by player position, BMI outcomes were 21.4 (Liberio, N = 11), 20.9 (Middle Blocker, N = 36), 20.8 (Setter, N = 20), 20.1 (Universal, N = 18), and 21.4 (Wing Spiker, N = 35). Analysis of variance showed no significant difference between BMI's by position.

**CONCLUSIONS:** The overall difference in BMI between the position players for women's professional volleyball players were not significant and did not reveal an overweight classification based upon average BMI. Future studies should continue to assess how BMI is utilized with female athletic populations.

**1440 Board #42 May 27 9:30 AM - 11:00 AM**  
**Comparison Of Body Composition Measurement Methods In Female Soccer Players**

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Optimal body size is important for peak performance in sport. Assessment of body composition provides the coach and athlete with insight into the optimal body weight for performance in a given sport. Laboratory techniques for determining body composition are often not generally available for coaches and athletes because of the complex equipment required for the assessment. Consequently, several techniques have been developed which are more suited for use in the field. However, the accuracy of these techniques has not been fully established in an athletic population.

**PURPOSE:** to compare commonly used techniques for determining body composition against densitometry to determine their accuracy in a specific athletic population.

**METHODS:** Subjects were 18 members of a division I university women's soccer team (164.5 ± 1.1 cm; 63.0 ± 1.5 kg). Body composition was determined by dual-energy X-ray absorptiometry (DEXA), air plethysmography (BodPod), bioelectrical impedance analysis (BIA), near infrared reactance, ultrasound, and skinfold fat thickness (3, 4, and 7 site), and compared with the results obtained by densitometry (hydrostatic weighing).

**RESULTS:** Correlations ( $r^2$ ) between densitometry and the other techniques were

DEXA	BodPod	BIA	Near IR	Ultrasound	SF 3 site	SF 4 site	SF 7 site
.85	.68	.08	.35	.48	.85	.88	.37

**CONCLUSION:** These results suggest that measures of skinfold thickness, either 3 site (triceps, abdomen, suprailiac) or 4 site (triceps, abdomen, suprailiac, thigh), assuming a competent administrator, provide the most accurate field technique for assessing body composition. Despite the ease of measurement provided by the other field techniques, the accuracy of such techniques is questionable in this population.

**1441 Board #43 May 27 9:30 AM - 11:00 AM**  
**Role Of Body Mass Index And Race On Two And Three Component Percent Fat Of Young Adults: Tiger And Heritage Family Studies**

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Much of the classic body composition research used a two-component (2C) model to estimate percent body fat (BF%) from body density determined by underwater weighting (U-BD). Dual-energy X-ray absorptiometry (DXA), a three-component model, is becoming the laboratory method of choice to measure BF%.

**PURPOSE:** To compare the effects of race and body mass index (BMI) on BF% measured by U-BD, 2-C and DXA methods.

**METHODS:** The subjects included white (W) and African-American (AA) men and women from the HERITAGE family (n=385) and TIGER studies (n=826). The young

adults ranged in age from 17 to 35 y. The subjects underwent in an exercise intervention and had their BF% measured 1 to 3 times over 9 months. The BF% of the TIGER subjects was measured by DXA. Sex and race specific 2-C equations were used to calculate BF% from U-BD of the HERITAGE subjects. Linear mixed models (LMM) regression was used to analyze the all observations, which were 1,266 for women and 820 for men. The independent variables were BMI, BF% method (2-C vs. DXA) and race (W vs. AA) and the dependent variable was BF%. The men and women's data were analyzed separately.

**RESULTS:** The LMM results for women and men were similar. A significant BMI by method showed that below a BMI of about 25 kg/m<sup>2</sup>, the Siri BF% for a given BMI was lower than DXA BF%, but above 25 kg/m<sup>2</sup> the 2-C BF% was higher than DXA BF%. Adding race to the LMM improved model fit ( $p < 0.001$ ) for both men and women. Graphic examination of the trends showed that for a given BMI, the DXA BF% of AA men was about 4.6% lower than W. The DXA BF% of AA women was nearly 2% lower than W women.

**CONCLUSIONS:** These results showed there is both a race and method effect for young men and women when using the DXA and U-BD, 2-C laboratory methods to measure BF%. The method effect is a function of BMI level.

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**1442 Board #44 May 27 9:30 AM - 11:00 AM**  
**Serum Levels Of Human Angiopoietin-related Growth Factor In Human Body**

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The angiopoietin-related growth factor (AGF) is a novel hepatokine that increases energy expenditure and insulin sensitivity. Animal models demonstrated AGF as a candidate for treatment of obesity and diabetes; however, no human study has been reported.

**PURPOSE:** To determine the serum levels of AGF in human body and the correlations with biochemical markers or body measurement data.

**METHODS:** From Korean Rural Genomic Cohort (KRG) study, 195 subjects were enrolled (age  $56.1 \pm 8.015$ , 98 were male, 97 were female). Sandwich ELISA was performed to measure the serum levels of AGF; biochemical markers and body measurement data collected in KRG study were used for correlation analysis.

**RESULTS:** Serum AGF levels were significantly increased in the people with metabolic syndrome ( $328.48 \pm 16.28$  ng/mL) compared to those of healthy people ( $276.65 \pm 10.72$  ng/mL). Among the components of metabolic syndrome, people with high waist circumferences showed significant higher serum AGF than in control group. Correlations with significance were observed between serum AGF and weight, waist, hip, body mass index, total body fat, visceral fat, LDL, AST, ALT, fasting insulin, or 1 hour insulin level of oral glucose tolerance test (OGTT) in positive, and age in negative.

**CONCLUSIONS:** Serum levels of human AGF were diametrically opposed to hypotheses from animal models. Further study is needed to investigate the AGF resistance. This is the first report of serum levels of AGF in human.

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**1443 Board #45 May 27 9:30 AM - 11:00 AM**  
**Body Composition Associated With Physical Conditioning And Sports Performance In Males And Females.**

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The impact of physical conditioning on body composition is determined by performance requirements, training regimen, and training history. However, in some instances meeting competition weight class requirements may dictate the relationship between fat-free mass (FFM) and fat mass (FM) with an emphasis on low fat mass and limited, perhaps minimal, muscle mass.

**PURPOSE:** To examine the relationship and limits of FFM and FM accumulation in individuals with a history of physical conditioning and competition.

**METHODS:** Males (age:  $21.2 \pm 3.1$  yrs) and females (age:  $21.8 \pm 4.4$  yrs) were divided into two groups: Controls (CON) were military personnel participating in high-level of physical conditioning (males:  $n=52$ ; females:  $n=24$ ) and Athletes (ATH: males:  $n=379$ ; females:  $n=32$ ) were competing at the NCAA, national, international, or Olympic level. Body composition was determined by hydrostatic weighing, BodPod, or ultrasound.

**RESULTS:** Height and body mass were greater in ATH. The relationship between height and weight was significant in all groups; with the slopes of the regression lines (males: 2.17 kg cm; females 1.07 kg cm) being greater and intercepts (males: -298 kg; females 112 kg) being less in ATH ( $R^2=0.596$  and  $0.398$ ). The relationship between body mass and % fat ( $R^2=0.76$ ) and FM ( $R^2=0.87$ ) was significant in male ATH, but only FM ( $R^2=0.44$ ; %Fat  $R^2=0.05$ ) was related to body mass in female ATH. There was a strong, curvilinear relationship between FFM and FM in male ATH ( $y=0.599^{0.0391x}$ ;  $R^2=0.71$ ), but not female ATH ( $y=0.16x+8.2$ ;  $R^2=0.07$ ) or C. In males there appears to be a threshold such that athletes with  $> 80$  kg FFM have significantly greater height (8-13 cm), body mass (30-41 kg), % fat (~8%), and fat mass (13-15 kg). The difference in body mass between female ATH and CON is almost entirely due to FFM accumulation as % fat (CON:  $26.9 \pm 4.5\%$ ; ATH:  $23.3 \pm 4.9\%$ ) and FM (CON:  $17.9 \pm 3.9$  kg; ATH:  $16.9 \pm 4.9$  kg) are similar.

**CONCLUSION:** ATH are taller with greater body mass than CON. Male athletes who compete in "weight class" sports carry less FFM but similar FM at the same height and body mass as non-weight class athletes. Accumulation of FM appears to accompany FFM in males, whereas females appear to carry a constant, larger component of FM throughout the body mass range.

Supported in part by PEO Soldier Grant # AHS1131

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**1444 Board #46 May 27 9:30 AM - 11:00 AM**  
**Appendicular Lean Soft Tissue Can Be Well Predicted From Simple Anthropometric Measurements**

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(No relationships reported)

Anthropometric measurements of the upper arm have been used to assess skeletal muscle (SM) and nutritional status. However, these assessments have never been validated.

**PURPOSE:** To evaluate the strength of the Frisancho equation (upper arm SM area) for predicting SM and to predict appendicular lean soft tissue (ALST) from simple anthropometric measurements.

**METHODS:** Height, weight, upper arm circumference, and seven (subscapular, triceps, chest, midaxillary, abdomen, suprailiac, and thigh) skinfolds (7SKF) were measured in 96 (50 women,  $169.0 \pm 6.5$  cm,  $63.5 \pm 7.4$  kg,  $26.2 \pm 2.5$  cm,  $118.3 \pm 31.4$  mm, 46 men,  $182.9 \pm 7.3$  cm,  $75.9 \pm 11.4$  kg,  $28.9 \pm 2.8$  cm,  $83.7 \pm 38.8$  mm) healthy 18 year-olds. Estimates of whole body and regional body composition were obtained via dual energy X-ray absorptiometry and ALST was used to calculate whole body SM. Subjects were randomized into prediction equation developmental (DEV,  $n=66$ ) and cross-validation (C-V,  $n=30$ ) groups.

**RESULTS:** No differences were found in the physical characteristics between the DEV and C-V groups ( $p=0.097-0.858$ ). The upper arm SM area from the Frisancho equation predicted ALST ( $22.5 \pm 5.4$  kg,  $r=0.74$ ,  $SEE=3.8$  kg,  $p<0.001$ ), whole body SM ( $26.3 \pm 6.3$  kg,  $r=0.73$ ,  $SEE=4.5$  kg,  $p<0.001$ ), and upper arm LST ( $2.8 \pm 0.9$  kg,  $r=0.69$ ,  $SEE=0.7$  kg,  $p<0.001$ ) moderately well in the whole group. An equation predicting ALST from weight, 7SKF and gender cross-validated well ( $R=0.97$ ,  $SEE=1.5$  kg,  $p<0.001$ ) as did equations based on weight, sum of 3 SKF (triceps, abdomen and thigh), and gender ( $R=0.97$ ,  $SEE=1.6$  kg,  $p<0.001$ ), and weight, suprailiac, and gender ( $R=0.96$ ,  $SEE=1.7$  kg,

p<0.001). In all these prediction equations, the slope and intercept did not differ from the line of identity (p>0.05). The final prediction equations were based on the whole sample: 1)  $ALST = -0.7638 + 0.3763 \times \text{weight} - 0.0423 \times 7SKF + 2.9097 \times \text{gender}$ , 2)  $ALST = 0.9065 + 0.3608 \times \text{weight} - 0.0741 \times 3SKF + 2.3748 \times \text{gender}$ , and 3)  $ALST = -1.7776 + 0.3628 \times \text{weight} - 0.1649 \times \text{suprailiac} + 3.8679 \times \text{gender}$ . The error scores from all the final equations were normally distributed, homoscedastic, and not related to predicted scores ( $r=0$ ,  $p>0.997$ ).

**CONCLUSION:** Although the Frisancho equation does indicate ALST and whole body SM, simple anthropometric measurements better predict ALST, which can then be used to estimate whole body SM.

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**1445 Board #47 May 27 9:30 AM - 11:00 AM**  
**Equations For Estimating Dxa Percent Fat Of Diverse Young Men And Women: The Tiger Study**

Daniel P. O'Connor<sup>1</sup>, Molly S. Bray<sup>2</sup>, Brian K. McFarlin<sup>1</sup>, Mary H. Sailors<sup>2</sup>, Andrew S. Jackson, FACSM<sup>1</sup>. <sup>1</sup>University of Houston, Houston, TX.  
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(No relationships reported)

The Jackson-Pollock-Ward (JPW) generalized equations for men and women (1978, 1980) were developed primarily with lean, non-Hispanic white (NHW) subjects. Our research (2008) confirmed that the JPW equations give biased percent fat (BF%) estimates when applied to ethnically diverse young men and women with higher levels of obesity.

**PURPOSE:** To develop valid prediction equations to estimate BF% measured with dual-energy X-ray absorptiometry (DXA) in diverse, contemporary young adults.

**METHODS:** The subjects included 435 men and 712 women from the TIGER study who ranged in age from 17 to 35 y. The racial/ethnic composition for men and women, respectively, was: NHW, 43.5% and 32.9%; Hispanic, 28.1% and 30.8%; and African-American (AA), 39.0% and 25.7%. The subjects BF% was measured from 1 to 3 times over 9 months (total observations = 701 for men and 1,144 for women). Linear mixed models (LMM) regression was used to develop two different equations using DXA BF% as the dependent variable. Model 1 included sum of skinfolds (SS; chest, abdomen, and thigh for men; triceps, suprailium and thigh for women). Model 2 included BMI and waist (WC, men) or hip circumference (HC, women). Race/ethnic group was included as a categorical variable in each model with NHW as the referent.

**RESULTS:** For men, both the SS and BMI equations resulted in a regression weight for AA men that was statistically significant compared to NHW men, while the regression weight for Hispanic men was within chance variation of NHW men. The standard errors of estimate were 3.08% for the SS model and 3.98% for the BMI model in men. For women, DXA BF% of Hispanic women was 2.5% higher than NHW for a given SS, while the regression weight for AA women was within chance variation of NHW women. The relation between BMI and BF% was quadratic, and hip circumference was related to BF% independent of BMI. Controlling for BMI and HC, the BF% of AA women was 1.7% lower and the Hispanic BF% was 1.7% higher compared to NHW women. The standard errors of estimate were 4.0% for the SS model and 3.8% for the BMI model in women.

**CONCLUSIONS:** The LMM results confirmed that race/ethnicity accounted for significant BF% variance beyond that accounted for by SS or the combination of BMI and WC or HC. The developed SS and BMI equations provide accurate models to estimate DXA BF% in ethnically diverse young men and women.

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**1446 Board #48 May 27 9:30 AM - 11:00 AM**  
**Does Body Mass Index Effectively Categorize Body Composition In American Men And Women?**

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(No relationships reported)

Over the last 30 years, obesity, typically assessed by body mass index (BMI), has increased steadily in Americans. A major question is whether or not the increase represents an increase in body fat?

**PURPOSE:** Therefore, the purpose of this study was to evaluate the relationship between BMI and body fat in American men (M) and women (W).

**METHODS:** One hundred and forty-two adult volunteers with a mean age of 36.1 years (69 M; 73 W) were measured for height, weight, ten skinfolds, waist (WC) and hip circumferences (HC) and percent body fat (%fat) using a Lunar DPX-L dual-energy X-ray absorptiometer (DXA). Data analyses included descriptive assessment, correlations and multiple regression analyses (stepwise).

**RESULTS:** The M and W differed on measures of BMI (W 23.0 and M 25.3 kg/m<sup>2</sup>), DXA %fat (W 30.0, M 19.3%), skinfolds (SF) %fat (W 23.6, M 20.9%), and waist C (W 73.5, M 85.5 cm), but not abdomen SF (W 22.4, M 23.5 mm). When BMI was included in a stepwise regression equation to estimate DXA %fat, an R of 0.75 was observed for the W. Adding abdomen SF to the equation increased R to 0.85 and the SEE decreased from 5.5 to 4.4%. When BMI was used to estimate DXA %fat for the M the R was 0.74. When abdomen SF was added to the equation the R increased to 0.87 and the SEE decreased from 4.7 to 3.5 %. When BMI was used to estimate body fat, it accounts for approximately 55% of the variability in %fat in both M and W with a prediction error of 4.7 to 5.5%. When abdomen SF was added to the regression equation with BMI, the prediction equation accounted for approximately 74% of the variability and the error of estimate decreased by approximately 20%.

**CONCLUSIONS:** These data indicate that adding a simple anthropometric variable (abdomen SF) to BMI increases its prediction of body fat and thus improves estimates of obesity with an inexpensive and easy to use procedure.

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**1447 Board #49 May 27 9:30 AM - 11:00 AM**  
**Effects Of Three Months Of Pilates-based Exercise In Women On Body Composition**

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C. Pereira Presenting  
(No relationships reported)

**PURPOSE:** Body Composition is one of the indicators of the health problems. The role of physical activity on the effects on Body Composition has been investigated. However, studies regarding Pilates, a popular physical activity, are rare. The purpose is to analyze the effects of three months of the Pilates-based mat exercise program (PME) on Body Composition.

**METHODS:** Sixty eight women, aged 25-55 yrs, were randomly assigned to either an exercise group (n=43, 41.0±7.2 yrs) to participate in a PME in a 12-week classes of 60 minutes, 2 times per week, or to a control group (n=25, 40.0±7.7). Dual-energy x-ray Absorptiometry (DXA), evaluated Fat Mass (g) (FM), the Lean Mass (g) (LM) and the Percentage Fat Mass (%) (PF) from upper and lower limbs, and Total Body Mass (g) were measured variables. All variables were measured at baseline and again after 12 weeks. Repeated measures of ANOVA, were run in SPSS version 15.0.

**RESULTS:** Comparison revealed significant increases on LM: upper body left limb (63.8 g, p=0.001), upper body right limb (75.4g, p=0.002), lower body left limb (88.6 g, p=0.030), lower body right limb (116.3g, p=0.014) with significant decreases on FM: upper body right limb (-75.8 g, p=0.045) and on PF: upper body right limb (-2 %; p=0.008), lower body right limb (-0.9 %; p= 0.015) on the exercise group. Related to Total Body Mass, the exercise group did not show statistically significant differences. Control group did not showed significant differences between baseline and after 12 weeks in any variables. There were no statistically significant differences between exercise group and control group at baseline.

**CONCLUSION:** This study demonstrates that the exposure of women to PME during 12 weeks, for two 60-minutes sessions per week improve Body Composition, namely



**1448 Board #50 May 27 9:30 AM - 11:00 AM**

**The Relationship Between Ethnicity And Abdominal Adiposity: The Tiger Study**

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(No relationships reported)

Previous research has shown that body mass index (BMI), waist circumference (WC) and race were independent sources of abdominal adiposity variation measured by computed tomography. When BMI and WC are controlled for, African-Americans had less abdominal adiposity than Caucasian men and women.

**PURPOSE:** We examined as a function of gender the relationship between race/ethnicity (White-W, Hispanic-HH, and African-American-AA) and abdominal adiposity.

**METHODS:** Subjects (age 18-30 y) were randomly selected from the Training Interventions and Genetics of Exercise Response (TIGER) Study. The sample included 128 subjects split into six groups based on gender and race/ethnicity (W, H and AA men and women). Dual energy x-ray absorptiometry (DXA) was used to measure both whole body fat and abdominal fat (L1 to L4) using a whole body scan. Data was analyzed using general linear models (GLM). The dependent variable was DXA abdominal fat and the independent variables were gender, race/ethnicity and gender by race/ethnicity interaction. WC and BMI were covariates.

**RESULTS:** The full GLM accounted for 87% of DXA abdominal fat. An examination of the GLM results showed that gender, WC and BMI were significantly related ( $p < 0.001$ ) with DXA abdominal fat. Using W subjects as the referent group, an analysis of race/ethnicity showed that the H ( $p = 0.643$ ) and H by gender interaction ( $p = 0.215$ ) terms were not statistically significant. In contrast, both the AA ( $p < 0.001$ ) and AA by gender interaction ( $p = 0.041$ ) were statistically significant. The GLM analysis showed that, controlling for WC and BMI, DXA fat was significantly lower in AAs compared to W men and women, and the difference tended to be greater for females.

**CONCLUSIONS:** These results are consistent with the published data from The HERITAGE Family study. With WC and BMI statistically controlled, the adiposity of AA men and women is less than W men and women. These results extend the generalizability to H men and women and show they are not different from W men and women in abdominal adiposity. The consistency between the TIGER and HERITAGE results with W and AA subjects supports the value of using DXA to measure abdominal adiposity.

Supported by NIH Grant DK062148

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**1449 Board #51 May 27 9:30 AM - 11:00 AM**

**The Effects Of Jogging Versus Walking Training On Bone Mineral Density In Obese Japanese Men.**

Hiroyuki Ohkubo<sup>1</sup>, Hiroyuki Sasai<sup>1</sup>, Yasutomi Katayama<sup>2</sup>, Miki Eto<sup>1</sup>, Takehiko Tsujimoto<sup>1</sup>, Kiyoji Tanaka, FACSM<sup>1</sup>. <sup>1</sup>University of Tsukuba, Tsukuba, Ibaraki, Japan. <sup>2</sup>Kogakkan University, Ise, Mie, Japan.

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**BACKGROUND:** Jogging is more effective for increasing bone mineral density (BMD) than walking, even though both modes can increase BMD. High-impact exercise is known to be beneficial for bone health. A previous study has reported that seven-months of walking with exercise intensities above the anaerobic threshold (AT) is more effective than below-AT intensity in preventing bone loss among postmenopausal women. However, it remains unclear whether shorter-term (3 months) exercise is effective for maintaining BMD in men.

**PURPOSE:** The purpose of this study was to compare the effects of 3 months jogging versus walking training on BMD in obese men.

**METHODS:** Twenty-eight Japanese men participated in this study. They were non-randomly divided into a jogging group ( $n = 14$ , age:  $44.3 \pm 9.6$  yr, body mass index [BMI]:  $28.9 \pm 2.0$  kg/cm<sup>2</sup>) or walking group ( $n = 14$ , age:  $49.0 \pm 8.1$  yr, BMI:  $28.2 \pm 1.7$  kg/cm<sup>2</sup>). Both groups participated in 90-minute supervised exercise sessions (mild jogging or brisk walking plus light strength training) on 3 d/wk for 3 months. The participants attempted to keep exercise heart rate above the AT (jogging group) or near the AT (walking group). Fat mass, lean mass and BMD were measured using dual-energy X-ray absorptiometry (DXA) at pre and post exercise training. A limitation of this study is that DXA instruments used were QDR4500 (Hologic) for the jogging group and DPX-NT (Lunar) for the walking group.

**RESULTS:** Attendance rate at the exercise sessions was 74.4% in jogging group and 79.3% in walking group (no significant difference). Exercise training significantly reduced body weight (jogging group:  $-2.8 \pm 2.6$  kg, walking group:  $-2.5 \pm 2.6$  kg), BMI (jogging group:  $-1.0 \pm 0.9$  kg/cm<sup>2</sup>, walking group:  $-0.8 \pm 0.9$  kg/cm<sup>2</sup>) and fat mass (jogging group:  $-2.6 \pm 1.8$  kg, walking group:  $-2.5 \pm 1.7$  kg). Although BMD remained unchanged in both groups, two-way (group by time) repeated ANOVA revealed a significant interaction in BMD (jogging group:  $0.01 \pm 0.02$  g/cm<sup>2</sup>, walking group:  $-0.01 \pm 0.02$  g/cm<sup>2</sup>,  $P < 0.05$ ). Similar results were found by using analysis of covariance (ANCOVA) even after adjustments for age, baseline BMI, fat mass and lean mass ( $P < 0.01$ ).

**CONCLUSIONS:** These results suggest that jogging is a more effective mode of exercise for maintaining BMD than walking, despite the short duration of only 3 months.

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**1450 Board #52 May 27 9:30 AM - 11:00 AM**

**Differences In Physical Activity Levels Of Young Adults Using Percent Fat Cut-points Versus Body Mass Index**

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(No relationships reported)

**PURPOSE:** Use of universal cut-points to categorize overweight and obesity based on the body mass index (BMI; in kg·m<sup>-2</sup>) is controversial. The BMI assumes that after adjusting weight for height, all individuals have the same relative body fatness independent of age, gender, race, and level of physical activity (PA). The purpose of this study was to examine self-reported levels of PA using percent body fat (%BF) cut-points versus BMI cut points in college students.

**METHODS:** Subjects ( $n = 278$ ; 50% male, 60% White) completed the International Physical Activity Questionnaire (IPAQ), were measured for height and weight, and completed a total body DXA scan to determine percent body fat. Physical activity levels were quantified in total, vigorous, moderate, and walking MET-minutes per week (MET-min·wk<sup>-1</sup>). Excess body fatness was defined as  $\geq 25\%$  in males and  $\geq 39\%$  in females. Overweight/obesity was defined as a BMI  $\geq 25$  kg·m<sup>-2</sup>. Descriptive statistics were calculated for males and females separately. Independent  $t$  tests were used to compare means by %BF or BMI category. Level of significance was set at  $p < 0.05$ .

**RESULTS:** Mean values of BMI, %BF, and MET-min·wk<sup>-1</sup> were:  $26.1 \pm 3.9$ ,  $18.4 \pm 7.6$ , and  $2927 \pm 1513$  in males; and  $23.2 \pm 3.9$ ,  $30.5 \pm 7.4$ , and  $1873 \pm 1150$  in females. When PA levels were compared using %BF cut points, significant differences were observed in total activity (males only) and vigorous activity in males and females. Conversely, when categorized by BMI, no differences were observed between groups.

**CONCLUSION:** These results suggest that %BF cut-points, rather than BMI, should be used to more accurately reflect PA levels of young adults.

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**1451 Board #53 May 27 9:30 AM - 11:00 AM**

**Who Attempts To Lose Weight? A Study Using The Health Information National Trends Survey (hints)**

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**PURPOSE:** In 2001, the Surgeon General issued a "Call to Action to Prevent and Decrease Overweight and Obesity." Yet in 2007, an estimated 37% Americans were overweight and 26% obese. Identifying the characteristics of individuals who attempt weight loss and those who do not may provide important information for weight loss interventions.

**METHODS:** Data from the 2005 HINTS was used to explore weight loss attempts among the general population. Participants with BMI  $\geq 25$  (N=3193) were stratified by their report of weight loss attempts in the past year (73% Yes vs. 27% No). We used t-tests and chi-square analysis to compare group characteristics and logistic regression to identify independent predictors of weight loss attempts.

**RESULTS:** Participants were primarily white (83%), obese (Mean BMI  $30.3 \pm 5.2$ ) and middle-aged (Mean age:  $53.12 \pm 16.7$  years.) Groups did not differ in weight loss behaviors such as hours of weekly exercise, fruits or vegetables consumed per day, or time spent watching television (all p values  $> .05$ ). Logistic results suggested that those more likely to report weight loss attempts were 1) younger (OR 1.79 for those 18-34; OR 1.77 for those 35-49; OR 1.80 for those 50-64, and OR 1.51 for those 65-74 compared to those 75+); 2) spoke to friends/family about their health (OR 2.20; CI 1.83-2.66); 3) had a college degree (OR 1.64 CI 1.23-2.19 compared to those with  $<$  high school); and reported poorer health (OR 2.16 for those in poor health; 2.54 for fair health; 2.27 for good health; and 1.82 for very good health, compared to those in excellent health) and 5) were separated (OR 2.09 CI 1.02- 4.29 compared to widowed). Additional marital status categories were not significant. Minorities were less likely than whites (OR 0.70; CI 0.59-0.84) to report weight loss attempts.

**CONCLUSIONS:** Although reporting attempts to lose weight, overweight and obese individuals did not show any difference in weight loss behaviors compared to those who do not attempt. Weight loss programs may be especially needed for minority, less educated, older individuals, and those who perceive better health. Social support for health may also play a key role.

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## A-25 Free Communication/Poster - **Carbohydrate Metabolism**

MAY 27, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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### 1452 Board #54 May 27 11:00 AM - 12:30 PM Impact Of Gender On Substrate Utilization During Treadmill Walking At A Self-selected Pace

Cosme F. Buzzachera<sup>1</sup>, Hassan M. Elsangedy<sup>2</sup>, Heriberto Colombo<sup>2</sup>, Kleverton Krinski<sup>2</sup>, Bruno V. Santos<sup>2</sup>, Wagner Campos<sup>2</sup>, Carlo Baldari<sup>3</sup>, Laura Guidetti<sup>3</sup>, Sergio G. DaSilva<sup>2</sup>, Fredric L. Goss, FACSM<sup>4</sup>. <sup>1</sup>Università Degli Studi di Roma "Foro Italico", Rome, Italy. <sup>2</sup>Federal University of Parana, Curitiba, Brazil. <sup>3</sup>Università Degli Studi di Roma, Rome, Italy. <sup>4</sup>University of Pittsburgh, Pittsburgh, PA.  
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**PURPOSE:** To determine the impact of gender on substrate utilization during exercise at a self-selected pace.

**METHODS:** Healthy male (n = 17) and female (n = 17) subjects performed a maximal exercise grade test and a 20-min bout of treadmill walking at a preferred pace in order to determine fat and carbohydrate (CHO) oxidation rates. Gas exchange measurements were performed throughout the tests and stoichiometric equations were used to calculate substrate oxidation rates. For each individual, a best-fit polynomial curve was constructed of fat oxidation rate ( $\text{g} \cdot \text{min}^{-1}$ ) vs exercise intensity ( $\% \text{VO}_{2\text{max}}$ ) and used to obtain the following variables: (a) the maximal rate of fat oxidation (MFO) measured over the entire range of exercise intensities; (b) the exercise intensity at which the MFO was observed ( $\text{Fat}_{\text{max}}$ ); and (c)  $\text{Fat}_{\text{max}}$  zone, a range of exercise intensities with fat oxidation rates equal to  $\pm 10\%$  of  $\text{Fat}_{\text{max}}$ . Independent t-tests were used to examine gender differences in substrate oxidation rates during the maximal exercise test and 20-min bout of walking at a preferred pace.

**RESULTS:** The MFO was similar between men ( $0.41 \pm 0.22 \text{ g} \cdot \text{min}^{-1}$ ) and women ( $0.39 \pm 0.14 \text{ g} \cdot \text{min}^{-1}$ ). However, the  $\text{Fat}_{\text{max}}$  was lower ( $P < 0.01$ ) in men ( $36.7 \pm 6.5\% \text{VO}_{2\text{max}}$ ) than in women ( $44.5 \pm 5.4\% \text{VO}_{2\text{max}}$ ). Similarly, the "low" ( $28.4 \pm 5.2$  and  $33.3 \pm 3.6\% \text{VO}_{2\text{max}}$ ) and "high" ( $45.1 \pm 8.2$  and  $56.0 \pm 7.5\% \text{VO}_{2\text{max}}$  for men and women, respectively) borders of the  $\text{Fat}_{\text{max}}$  zone were lower ( $P < 0.05$ ) in men than in women. During treadmill walking at a preferred pace, the CHO oxidation rates were greater ( $P < 0.01$ ) in men ( $1.40 \pm 0.65 \text{ g} \cdot \text{min}^{-1}$ ) than in women ( $0.87 \pm 0.51 \text{ g} \cdot \text{min}^{-1}$ ), but there were no gender differences in the fat oxidation rates ( $0.24 \pm 0.13$  and  $0.24 \pm 0.08 \text{ g} \cdot \text{min}^{-1}$  for men and women, respectively). However, the contribution of fat oxidation to total energy expenditure (EE) was greater ( $P < 0.05$ ) in women ( $45.5 \pm 12.6\%$ ) than in men ( $32.7 \pm 16.4\%$ ), despite no differences in the relative exercise intensity between the men ( $37.5 \pm 10.7\% \text{VO}_{2\text{max}}$ ) and women (and  $40.3 \pm 7.2\% \text{VO}_{2\text{max}}$ ).

**CONCLUSION:** Although men and women self-selected similar relative exercise intensity, the contribution of fat oxidation to total EE is significantly greater in women than in men. Interestingly, both genders self-selected an exercise intensity that falls within the  $\text{Fat}_{\text{max}}$  zone.

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### 1453 Board #55 May 27 11:00 AM - 12:30 PM Effects Of Exercise Intensity On Post-prandial Glucose Disposal In Abdominally Obese Adults

Nathan Y. Weltman, Corey A. Rynders, Glenn A. Gaesser, FACSM, Eugene J. Barrett, Arthur Weltman, FACSM. *University of Virginia, Charlottesville, VA.*  
(No relationships reported)

**INTRODUCTION:** The effects of acute exercise on post-prandial glucose disposal are equivocal.

**PURPOSE:** To examine the impact of exercise intensity on the blood glucose and insulin responses to an oral glucose tolerance test (OGTT).

**METHODS:** Eleven abdominally obese adults (n=11; age,  $25.2 \pm 1.3$  yrs; BMI,  $38.5 \pm 1.5 \text{ kg/m}^2$ ; % body fat,  $43.9 \pm 2.1\%$ ; waist circumference,  $114.2 \pm 4.1 \text{ cm}$ ;  $\text{VO}_{2\text{peak}}$ ,  $17.7 \pm 1.1 \text{ ml/kg/min}$ ) completed a  $\text{VO}_{2\text{peak}}$ /lactate threshold (LT) protocol plus 4 randomly assigned exercise sessions; 1) rest (C; no exercise); 2) low, (L; 50% of difference between LT and rest); 3) moderate (M; @ LT); and 4) high, (H; 50% of difference between LT and  $\text{VO}_{2\text{peak}}$ ). Sessions were calorically equivalent to 200kcal, calculated from min-by-min energy expenditure by open circuit spirometry. One hour after the onset of exercise, subjects received a 75-g OGTT. Glucose and insulin were assayed from blood samples collected before (-30 to 0 min), during (0 to 60min) and after exercise (60 to 240min) at 5-10min intervals.

**RESULTS:** There were no significant differences among conditions in post OGTT 1) area under the glucose concentration curve ( $\text{mg/dl}/180\text{-min}$ ; C,  $21690 \pm 1288$ ; L,  $21691 \pm 1192$ ; M,  $22502 \pm 1369$ ; H,  $21748 \pm 1152$ ;  $p=.80$ ) and 2) area under the insulin response curve ( $\mu\text{IU/ml}/180\text{-min}$ ; C,  $9936 \pm 1091$ ; L,  $10222 \pm 778$ ; M,  $9823 \pm 876$ ; H,  $9771 \pm 894$ ;  $p=.97$ ,  $n=9$ ). Blood glucose concentrations returned to baseline by 180-min after OGTT in all experimental conditions ( $\text{mg/dl}$ ; baseline, C=89, L=92, M=94, H=93; 180-min, C=84, L=94, M=90, H=89;  $p=.887$ ).

**CONCLUSIONS:** In abdominally obese adults a single bout of exercise did not affect post-prandial glucose and insulin responses.

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### 1454 Board #56 May 27 11:00 AM - 12:30 PM

## Effects Of Carbohydrate Supplementation On The Ratings Of Perceived Exertion- Blood Lactate Relationship

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(No relationships reported)

**PURPOSE:** To examine the effects of carbohydrate (CHO) ingestion on the RPE-blood lactate relationship during incremental and constant effort exercise.

**METHODS:** Six male and three female subjects (mean age=27.2±8.2yrs; ht=174.5±13.5cm; wt=68.9±12.5kg; body fat=18.5±8.3%), completed two incremental cycling LT/VO<sub>2</sub>peak tests followed by two 45-minute production trials. Either ~240 ml of a carbohydrate or placebo (PL) was ingested before and every 15 min during exercise.

**RESULTS:** No differences were observed between conditions at LT, 2.5 and 4.0 mM and peak. Within the CHO condition: VO<sub>2</sub>= 25.0, 32.6, 37.5, 47.2 ml/kg\*min<sup>-1</sup>; poweroutput=123.3, 170.7, 200.1, 241.7 watts; RPE= 12.8, 15.4, 17.2, 19.3; and HR= 137.4, 156.8, 168.7, 187.7 bpm at LT, 2.5mM, 4.0mM and peak, respectively. Within PL VO<sub>2</sub>= 24.7, 32.5, 36.8, 45.7 ml/kg\*min<sup>-1</sup>; power output= 130.0, 175.4, 201.9, 240.0 watts; RPE= 12.1, 15.0, 17.0, 19.3; and HR= 134.9, 157.9, 169.6, 187.2 bpm, respectively. In the CHO condition blood glucose was higher (P < 0.001) and a trend was observed for lower RPE over time (P = 0.07). During the production trials (RPE of 16) in the CHO condition higher blood glucose area under the curve (AUC) (PL: 204.1±79.3; CHO: 220.6±18.5 mM, P=0.039) and a trend for greater total work (PL: 448.5±73.8; CHO 470.5±65.6 kJ, P=0.089) were observed.

**CONCLUSION:** We conclude that: 1) CHO ingestion does not alter the blood lactate-RPE relationship during incremental LT/VO<sub>2</sub>peak cycling; and 2) carbohydrate supplementation during exercise eliciting high RPE may increase work output during training sessions.

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1455 Board #57 May 27 11:00 AM - 12:30 PM

### Maltodextrin Supplementation Enhanced Performance In Elite Athletes Of Mountain Biking During Competition

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(No relationships reported)

The observed improvements in performance with CHO ingestion have been attributed to maintenance of plasma glucose and glycogen availability. However, the supplementation with maltodextrin-induced modifications in heart rate intensity and performance in different moments of competition for Mountain Biking has not been reported.

**PURPOSE:** Therefore the aim of this study was to analyze the effect of maltodextrin supplementation in heart rate intensity and time competition spent in each lap; cardiorespiratory and blood glucose response in maximal test performed in laboratory in elite Mountain Biking athletes. **METHOD:** A total of seven male bikers [age (years): 28.4 ± 10.6; body fat (%): 9.46 ± 3.76; VO<sub>2</sub>max (mL/kg/min): 61.13 ± 8.4], participated in double-blind type study. The athletes received supplementation with maltodextrin (1g/kg) or placebo (light tangerine juice) dissolved in distilled water 20 min before competition (7 laps with 2 Km each) or laboratory maximal test. A incremental exercise test on a cyclo-ergometer at 60 rpm, starting at 50 W with increases by 25 W every 3 min until exhaustion with maltodextrin or placebo use was performed (cycloergometer Biotec 1800-CEFISE®) to determined alterations in maximal heart rate, Wattsmax, VO<sub>2</sub>max, VEmax, VO<sub>2</sub> in the ventilatory threshold (VT) using a gas exchange analyzer (ParvoMedics TrueOne® 2400). The heart rate was monitored each 5 s during the entire competition (Polar Team System®). The comparisons between time spent in each lap (7 laps) during competition and laboratory variables comparisons (maltodextrin vs. placebo) were made using two-way ANOVA.

**RESULTS:** In the competition, the maltodextrin supplementation enhanced performance, reducing 26 s in mean time spent for all laps (CHO: 549 ± 56.3 s vs. Placebo: 575 ± 69.5 s; p<0.05). In laboratory test, maltodextrin increase the blood glucose during exercise (CHO: 104.1 ± 20.9 mg/dL vs. Placebo: 88.2 ± 5.3 mg/dL; p<0.05) but has no effect in cardiorespiratory variables.

**CONCLUSION:** Maltodextrin enhanced performance during Mountain Biking competition, showing that maltodextrin supplementation is a good strategy for these competitors. The maintenance in blood glucose associated with maltodextrin use suggests improvements in performance through reduction of muscle glycogen use.

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1456 Board #58 May 27 11:00 AM - 12:30 PM

### Carbohydrate Oxidation From A Carbohydrate Gel Compared To A Drink During Exercise

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(No relationships reported)

Studies investigating exogenous carbohydrate (CHO) oxidation from CHO drinks during exercise have revealed that ingestion of a mixture of glucose (GLU) and fructose (FRU) leads to 20-50% higher CHO oxidation rates as compared to GLU alone. However, athletes often ingest CHO in the form of gels (semi-solid form). It is currently not known if CHO ingested in the form of a gel is oxidised as effectively as a drink.

**PURPOSE:** To investigate exogenous CHO oxidation from CHO provided in either semi-solid (GEL) or solution (DRINK) form, when delivered at relatively high rates during cycling exercise.

**METHODS:** Eight well trained cyclists (34±3yrs; 76±3kg; 1.78±0.02m; VO<sub>2</sub>max: 61±3ml/kg/min) performed three exercise trials in random order. The trials consisted of cycling at 59±1% VO<sub>2</sub>max for 180min while receiving one of the following three treatments: GEL plus plain water, DRINK, or plain water. Both CHO treatments delivered GLU plus FRU in a ratio of 2:1 at a rate of 1.8g/min. Fluid intake was matched between treatments.

**RESULTS:** Exogenous CHO oxidation from both treatments showed a similar time course with peak exogenous CHO oxidation rates being reached at the end of 180min exercise. Peak exogenous CHO oxidation rates were not different between GEL and DRINK (1.44±0.1g/min vs. 1.42±0.08g/min, respectively, p=0.40). Oxidation efficiency was also similar between the GEL and DRINK trial (71±5% vs. 69±5%, respectively, p=0.36).

**CONCLUSIONS:** This study demonstrated that a GLU+FRU mixture is oxidised to the same degree when administered as a semi-solid GEL or liquid DRINK. Both forms of CHO administration led to similarly high peak oxidation rates and showed similar oxidation efficiencies.

*This study was Supported by a Research Grant from Nestec Ltd., Nestlé Nutrition, Vevey, Switzerland.*

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1457 Board #59 May 27 11:00 AM - 12:30 PM

### Gastrointestinal Discomfort In Moderate Running: Effect Of Body Mass Adjusted Carbohydrate-electrolyte Drink Volume

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(No relationships reported)

Especially in endurance exercise such as marathon and triathlons, is not uncommon to see an increased incidence of GI symptoms associated with food and beverage intake before and during exercise.

**PURPOSE:** To investigate the effect of two volume of carbohydrate-electrolyte (CHO) drink according to the body mass (BM) during one-hour running performance on the gastrointestinal (GI) tract and to verify if BM could be an optional parameter of fluid replacement.

**METHODS:** Thirty-two individuals; 16 men ( $23.3 \pm 1.3$  years) and 16 women ( $21.7 \pm 1.7$  years) performed three runs on a treadmill at 75%  $\dot{V}O_{2max}$  during 60 min. In this time, the subjects drank a 6% CHO solution in set volumes of 2 or 3 mL  $\cdot$  kg<sup>-1</sup> BM (LV and HV; respectively) every 15 minutes. GI complaints were evaluated by a short questionnaire requested to verbally answer at every 15 minutes. Glycemia, ratings of perceived exertion (RPE), and thirst sensation were also evaluated at this same period of time.

**RESULTS:** The most occurrences of GI complaints were observed in men than women. The most frequency of GI complaints was related at 45 and 60 min. The most frequent symptom in HV was urging to urinate indicated by 75% men at 60 min and 81.2% women at 45 min. In LV this perceptual were of 62.5% and 50% for men and women respectively. There were no register of severe symptoms for women in all the trials and for men during LV trial. Only one man in HV indicated a score 6 for severe symptoms (stomach problems, bloated feeling and stomach cramps) from 30 minutes. At 15 min both in HV and in LV was observed the lower glycemic mean for men ( $5.19 \pm 0.57$  mmol.L<sup>-1</sup>;  $5.16 \pm 0.72$  mmol.L<sup>-1</sup> respectively) and women ( $5.06 \pm 0.61$  mmol.L<sup>-1</sup>;  $4.83 \pm 0.46$  mmol.L<sup>-1</sup>). At 60-min LV women presented a light lower thirst sensation than men ( $p = 0.02$ ). In all the trials RPE was higher ( $p < 0.001$ ) at 60 min than at 15 min and at 45 min than at 30 min.

**CONCLUSION:** The data demonstrate that ingestion of 2 or 3 mL.kg<sup>-1</sup> BM of a 6% CHO drink at every 15-min during 60-min run is effective in maintenance of blood glucose and did not caused severe GI symptoms that would compromise performance and health, presuming that, the use of body mass as an optional parameter of fluid replacement is rising such as practical and nonaggressive method for studies involving the GI tract.

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**1458 Board #60 May 27 11:00 AM - 12:30 PM**  
**Effect Of Issued Meals On Muscle Glycogen Levels In Wildland Firefighters**

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(No relationships reported)

Wildland fire suppression offers a unique opportunity to study physiological stress during arduous job tasks (hiking steep terrain, digging, sawing, and watering) in extreme environmental conditions with low food availability. The energy demands of wildland firefighters (WLFF) during fire suppression have been well documented. However, previous studies have yet to determine the effect of laborious wildfire suppression on muscle substrate use.

**PURPOSE:** The purpose was to determine the effects of wildfire suppression on muscle glycogen utilization in WLFFs.

**METHODS:** Interagency Hot Shot WLFFs (n=12) participated in the study (n=6 on two separate days, days 1, 2). Muscle biopsies were obtained from the *vastus lateralis* pre and post work shift. Activity was measured using activity monitors strategically positioned on the chest and boot. Food was consumed *ad-libitum*, and recorded using a food log.

**RESULTS:** Body weight decreased on Day 1 ( $89.6 \pm 8.4$  to  $89.0 \pm 8.3$  pre and post, respectively,  $p < 0.05$ ), but was similar pre to post work shift on Day 2 ( $83.3 \pm 9.0$  to  $83.5 \pm 8.9$  pre and post work shift, respectively). Muscle glycogen decreased on Day 1 ( $115 \pm 14$  to  $82 \pm 23$  mmol.kg<sup>-1</sup> wet wt.,  $p < 0.05$ ), but was similar pre to post work shift on Day 2 ( $83 \pm 16$  and  $82 \pm 14$  mmol.kg<sup>-1</sup> wet wt.). Muscle glycogen was higher pre-shift Day 1 compared to pre-shift Day 2 ( $115 \pm 14$  versus  $83 \pm 16$  mmol.kg<sup>-1</sup> wet wt., respectively,  $p < 0.05$ ). Activity patterns were similar between the two days. Total energy and carbohydrate intake was greater on Day 1 compared to Day 2.

**CONCLUSION:** Muscle glycogen was different at the beginning of the work shift on consecutive days when participants self-selected work and energy intake patterns. These data suggest that the availability and palatability of provisions, and the potential of inadequate rations may compromise muscle performance during multiple work shifts.

Supported by Air Force Research Laboratories, FA8650-06-1-679

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**1459 Board #61 May 27 11:00 AM - 12:30 PM**  
**Effect Of Hyperoxia Recovery After Different Intensity Training On Glucose Tolerance.**

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(No relationships reported)

**PURPOSE:** To investigate the effects of hyperoxia recovery on glucose tolerance and insulin response after high intensity interval training (HIIT) and moderate aerobic training (MIT).

**METHODS:** The exercise intervention period was 20 min. Subjects ( $20.3 \pm 1.3$  yrs,  $182.5 \pm 5.8$  cm,  $76.6 \pm 13.8$  kg) were exercised at two different intensities on separated days: HIIT (repeating 2 min under 90%  $\dot{V}O_{2max}$  - 1 min rest for 7 times) and MIT (repeating 5 min under 70%  $\dot{V}O_{2max}$  - 5 min under 50%  $\dot{V}O_{2max}$  for 2 times), respectively. After training, each subjects recovered under either normoxic (21%O<sub>2</sub>) or hyperoxic (100%O<sub>2</sub>) conditions for 90 min. Oral glucose tolerance test, insulin, and cortisol were measured at baseline and during the recovery phase. Heart rate variability was recorded at baseline and 30 min after exercise.

**RESULTS:** A significant lower glucose level was noted under HIIT condition with hyperoxia recovery comparing to normoxia ( $p < .05$ ). Insulin levels during OGTT were not different under all conditions. For those subjects after HIIT, but not MIT, lower cortisol level with hyperoxia was found at 60 and 90 min after exercise. Vagal activity significantly decreased at 30 min after both exercises, yet no group difference was found.

**CONCLUSION:** This study demonstrated that hyperoxia can improve insulin sensitivity for glucose disposal during post-exercise recovery. This effect appears to be due to a reduced cortisol response during recovery, and was not associated with autonomic nervous activity.

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**1460 Board #62 Abstract Withdrawn**

**1461 Board #63 May 27 11:00 AM - 12:30 PM**  
**Insulin-assisted Glycogen Supercompensation Abolished The Exercise-induced Increase In Glut4 Protein**

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**PURPOSE:** The purpose of the study was to investigate the interactive effect of exogenous insulin on post-exercise glycogen supercompensation in skeletal muscle.

**METHODS:** Forty eight rats were weight-matched and divided into following 6 groups: control (C), insulin treated (INS), immediately after exercise with previous glycogen supercompensation by exercise (EX0), immediately after exercise with previous glycogen supercompensation by exercise and insulin injection (EX0+INS), exercise followed a 16-hr recovery (EX16), and exercise followed a 16-hr recovery with insulin injection (EX16+INS).

**RESULTS:** Glucose intubation with insulin treatment (INS groups) significantly elevated glycogen storage in various skeletal muscles. Insulin treatment further elevated exercise-induced glycogen supercompensation level (EX16+INS). We also found that residual glycogen content in EX0+INS group was significantly greater than EX0 group after exercise. In addition, we also observed that exercise-increased GLUT4 protein expression was attenuated by insulin-assisted glycogen supercompensated muscle during recovery.

**CONCLUSIONS:** We demonstrated that our glycogen supercompensation protocol by exogenous insulin treatment further elevated glycogen supercompensation in exercised rats. This result has ensured a greater residual muscle glycogen when they performed the same exercise protocol. Furthermore, the amount of intramuscular glycogen storage appears to be a



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**1462 Board #64 May 27 11:00 AM - 12:30 PM**

**Effect Of Resistance Exercise On Dehydroepiandrosterone Sulfate Concentration And Glycemia During Recovery**

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Serum dehydroepiandrosterone sulfate (DHEA-S) concentration is known to associate with the whole-body insulin sensitivity.

**PURPOSE:** The main purpose of the study was to investigate the effect of resistance exercise on DHEA-S concentration during a 72-h postexercise recovery, and its relation to glucose tolerance and insulin sensitivity.

**METHODS:** Serum samples was obtained from 19 male volunteers (aged  $21.2 \pm 0.4$  years) 24 h before the onset of exercise and 24 h, 48 h, and 72 h following exercise for measurements of DHEA-S, cortisol, and TNF- $\alpha$ . Oral glucose tolerance test (OGTT) and insulin response were determined 24 h before and 48 h after exercise.

**RESULTS:** We found that exercise significantly suppressed serum DHEA-S levels during recovery (48 h and 72 h). The resistance exercise did not affect glucose tolerance, but insulin response during OGTT was significantly elevated. The increased insulin level was not associated with serum levels of cortisol and TNF- $\alpha$ .

**CONCLUSIONS:** The present study found that resistance exercise has a DHEA-S lowering effect persisted for 72 h. This change appears to be related to the elevated insulin concentrations during OGTT.

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**1463 Board #65 May 27 11:00 AM - 12:30 PM**

**Influence Of Mouth-rinsing A Carbohydrate Solution On 1 Hour Running Performance**

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(No relationships reported)

**PURPOSE:** The aim of this study was to investigate the influence of mouth-rinsing a CHO solution on 1 h running performance.

**METHODS:** Following a prolonged fast (13-15 h), ten endurance-trained male runners completed two 1 h performance runs on an automated treadmill that allowed changes in running speed without manual input. Runners either mouth-rinsed a 6.4% carbohydrate (C) or placebo (P) solution immediately before and at 15 min intervals during the 1 h run. Solutions were rinsed for 5 s before being expectorated into pre-weighed containers.

**RESULTS:** The mean running speed was  $13.1 \pm 1.6$  km/h for trial P and  $13.3 \pm 1.6$  km/h for trial C. Running speed was significantly faster between 25-30 min, 35-40 min and 55-60 min on trial C ( $p < 0.05$ ). Total distance covered for trial P was  $13063 \pm 1638$  m; and  $13328 \pm 1596$  m for trial C ( $p = .052$ ). Carbohydrate oxidation and RER were no different between trials ( $P > 0.05$ ). No difference was reported in perceived exertion (RPE), felt arousal (FAS) or pleasure-displeasure (FS) between trials ( $p > 0.05$ ).

**CONCLUSIONS:** In conclusion mouth-rinsing a 6.4% CHO solution significantly increased self-selected running speed during a 1 h performance run.

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**1464 Board #66 May 27 11:00 AM - 12:30 PM**

**Effect Of The Glycemic Index Of A Pre-exercise Meal On Metabolism And Cycling Time Trial Performance**

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**PURPOSE:** The aim of this study was to investigate the effects of low or high glycaemic index (GI) foods consumed prior to a 40-km time trial (TT) on metabolism and subsequent endurance performance.

**METHODS:** Ten male cyclists consumed either a high GI or low GI meal, providing  $1 \text{ g} \cdot \text{kg}^{-1}$  body mass of carbohydrate, 45 min prior to a 40 km TT on a Velotron cyclePro $\text{\textcircled{C}}$ .

**RESULTS:** The TT performance was significantly improved in the low GI trial ( $93 \pm 8$  min) compared to the high GI trial ( $96 \pm 7$  min) ( $p = 0.009$ ). Whole blood glucose concentration at the point of exhaustion was significantly higher in the low GI trial ( $5.04 \pm 0.97 \text{ mmol} \cdot \text{L}^{-1}$ ) compared to the high GI trial ( $4.90 \pm 0.75 \text{ mmol} \cdot \text{L}^{-1}$ ) ( $p = 0.001$ ). Low GI carbohydrate oxidation rate ( $2.51 \pm 1.71 \text{ g} \cdot \text{min}^{-1}$ ) was significantly higher ( $p = 0.003$ ) than the HGI carbohydrate oxidation rate ( $2.14 \pm 1.5 \text{ g} \cdot \text{min}^{-1}$ ). Fat oxidation rate was significantly higher ( $p = 0.002$ ) for the high GI trial ( $0.27 \pm 0.17 \text{ g} \cdot \text{min}^{-1}$ ) than the low GI trial ( $0.16 \pm 0.14 \text{ g} \cdot \text{min}^{-1}$ ). Insulin rose significantly following the high GI meal compared to the low GI meal ( $p = 0.008$ ) but dropped significantly to similar values throughout the TT. No significant differences in either TGA or FFA concentration were observed between the trials.

**CONCLUSION:** The greater carbohydrate oxidation and glucose concentration in the low GI trial may have produced a glucose-sparing effect, maintaining energy production towards the end of exercise and a subsequent improvement in time trial performance in the low GI trial.

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**1465 Board #67 May 27 11:00 AM - 12:30 PM**

**Insulin Sensitivity And Heart Rate Variability For Former Elite Basketball Player With Regular Exercise**

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(No relationships reported)

**PURPOSE:** Insulin sensitivity is known to reduce with advancing aging. This age-dependent metabolic deterioration, to some extent, is associated with reduced vagal activity and increased sympathetic activity. The present study was undertaken to determine insulin sensitivity and heart rate variability (which reflects the autonomic activity) for former elite basketball players.

**METHODS:** Oral glucose tolerance test (OGTT), insulin response, and heart rate variability were determined for both young basketball players (Young, age  $17.88 \pm 0.42$ ,  $N = 9$ ) and former basketball players with regular recreational exercise training (Middle aged, age  $57.23 \pm 1.22$ ,  $N = 13$ ).

**RESULTS:** We found that HF (vagal activity) and LF/HF was not different between the young and middle-aged groups. Weight, BMI, waist circumference, and glucose concentration on OGTT for the middle aged group were significantly greater than the young subjects. Insulin level was not significantly different between groups.

**CONCLUSIONS:** Previous study reported that insulin sensitivity and vagal activity was concurrently reduced with age. The present study demonstrated that vagal activity was well maintained, but glucose tolerance was lower for the middle-aged basketball players with regular exercise.

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**1466 Board #68 May 27 11:00 AM - 12:30 PM**

**Effects Of Carbohydrate-peptide Sports Drink Use On Performance, Blood Glucose And Insulin Level**

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(No relationships reported)

**PURPOSE:** To determine whether endurance exercise performance and blood glucose, insulin were altered when consuming a carbohydrate-soypeptide beverage.

**METHODS:** Using a crossover balanced design, 12 Elite Chinese male cycling athletes (22.6±2.8 yrs, 73.5±5.7 kg, 184.6±4.2 cm, 69.3±6.4 VO<sub>2</sub>max) after signing informed consent were randomly divided into 2 groups, consuming carbohydrate-soypeptide (6% and 1 %) beverage and commercial carbohydrate-containing (6%) sports beverage at the same rate during 4 weeks. After 2-week washout, two groups were crossed and supplemented with two beverages for another 4 weeks. During the performance test, each athlete was asked to ride on a cycling training facility for 2h at average 60% VO<sub>2</sub>max, then to exert oneself to ride for 20min (time trial). The cycling distance, pedaling rate, etc.were recorded. Venous blood samples were drawn for biochemical tests.

**RESULTS:** The results showed that no significant difference was observed in the cycling distance, Pedaling rate, average speed, total energy expenditure and power output between two groups. Blood glucose level at different time points (before, 60min, 120min, 135min of performance test) showed no significant difference in both groups, but blood glucose and insulin level elevated in CHO-Peptide group immediately post-exercise compared to CHO group (93.4±22.8 vs 84.6±17.4, 13.9±18.3 vs 4.6±2.1 respectively). Blood glucose level of CHO-Peptide group were higher than that of CHO group before and after training at different training type (from 100 to 210 km cycling distance), but no statistically significant difference.

**CONCLUSION:** Our data indicated that carbohydrate-soypeptide and carbohydrate treatment showed no statistically significant difference in the cycling performance, but appeared to increase blood glucose and serum insulin levels at immediately post-exercise.

*Supported by The Coca-Cola Beverages Institute for Health & Wellness*

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1467    **Board #69    May 27    11:00 AM - 12:30 PM**

**Sitting Can Rapidly Trigger Postprandial Hyperinsulinemia In Healthy Humans**

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**INTRODUCTION:** Inactivity physiology studies have raised the concern that too much sitting is a distinct and increasingly prevalent health hazard, including associations between sitting and risk for metabolic syndrome, type 2 diabetes, and coronary heart disease. Excessive postprandial plasma insulin and impaired insulin action are potentially induced by sitting down for too long independent of body fat or obesity.

**PURPOSE:** To determine if inactivity caused by prolonged sitting directly increases postprandial plasma insulin.

**METHODS:** Nine men (n=5) and women (n=4) who were relatively lean (22 ± 6% body fat) were studied on 3 different days preceded by a similar baseline. Plasma glucose and insulin were measured before and after the exact same standardized mixed supper on the 3 days of testing. Two of the trials involved a day of routine sedentary activities most commonly associated with sitting, with the only difference being the caloric intake during the breakfast and lunch preceding the test meal. A third trial consisted of less sitting (~25% of the day) and more physical activity due to upright non-exercise activities.

**RESULTS:** Despite no difference in plasma glucose concentrations, plasma insulin concentration after the test meal was significantly greater (32-41%, p<0.05) after both of the sitting trials than the low sitting trial.

**CONCLUSION:** Sitting can rapidly trigger postprandial hyperinsulinemia in healthy humans.

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1468    **Board #70    May 27    11:00 AM - 12:30 PM**

**Energy Status And Amp-activated Protein Kinase In Human H460 Lung Cancer Cells**

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(No relationships reported)

According to the Warburg Effect, glucose provides a major source of energy at a high rate of glycolysis in cancer cells. However, serum which includes many growth factors also plays a crucial role in supporting the proliferation of cancer cells. AMP-activated protein kinase (AMPK), a key energy sensor in energy homeostasis, in regulating ATP levels and enzyme expression is involved in the proliferation of cancer cells. Thus to find a strategy to treat cancer, it would be beneficial to determine the different patterns between energy metabolism and the signaling system in cancer cells.

**PURPOSE:** To investigate the effects of glucose or serum on the energy status and AMPK activity in H460 cancer cells.

**METHODS:** H460 cancer cells were starved with glucose-free or serum-free medium for 16 h. Then glucose and serum, respectively, were added to analyze for levels of ATP and Lactate, and the activities of AMPK and LDH at 1, 3, 6, 12, 24 h.

**RESULTS:** In the glucose treatment, the activity of AMPK was activated by glucose and showed a biphasic phenomenon with a peak at 1 h and a maximal activity at 24 h. The intracellular ATP was gradually increased up to 2 fold at 24 h and the intracellular lactate was decreased to approximately 60%. The activity of LDH also showed a biphasic phenomenon which was increased to a peak at 6 h and raised at 24 h. In the serum treatment, the phosphorylation of AMPK was suppressed which started at 1 h and sustained to 12 h. The intracellular ATP showed a dramatic increase of 50 % at 1 h, and the intracellular lactate was gradually increased to a peak at 3 h and then decreased to the background level at 24 h. The activity of LDH was decreased at 12 h and returned to normal levels at 24 h.

**CONCLUSION:** The activation of AMPK by glucose showed a biphasic phenomenon, and the levels of ATP were gradually increased in accordance with the decrease in lactate. Serum inhibited the phosphorylation of AMPK, but the levels of ATP were persistently increased. It is suggested that cancer cells show a different pattern in energy status in response to serum and glucose and that exercise might change the supply of energy to cancer cells, thus affecting the characteristics of cancer cells.

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1469    **Board #71    May 27    11:00 AM - 12:30 PM**

**Muscle Metabolic Status During Repeated Very Short Work-to-Rest Transitions**

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Little is known about the muscle metabolic status during repeated bouts of very short work-to-rest transitions.

**PURPOSE:** : In the present study, we measured gastrocnemius muscle [PCr] and [H<sup>+</sup>] using phosphorus-31 magnetic resonance spectroscopy (<sup>31</sup>P-MRS) during repeated bouts of 10 s heavy-intensity exercise and 5 s rest compared to continuous (i.e. no rest) heavy-intensity exercise.

**METHODS:** Recreationally active male subjects ( $n=8$ ,  $27\text{yr}\pm\text{SE}3.3$ ) performed on separate occasions 12 min of isotonic plantar flexion (contraction rate 0.75 Hz) continuously (CON) and intermittently (INT) 10 s exercise 5 s rest. Heavy-intensity exercise workload in both CON and INT was set at 150% of the power output associated with the onset of intracellular acidosis determined from a prior incremental plantar flexion exercise protocol. Intracellular concentrations of  $[\text{H}^+]$  and  $[\text{PCr}]$  were calculated at 4 s and 9 s of the work period and 4 s of the rest period in INT, and at similar intervals during CON. ATP synthesis and oxidative flux were estimated from changes in those concentrations.

**RESULTS:** Metabolite concentrations (mean  $\pm$ SE) were increased at 4 s of the rest periods vs 9 s of exercise averaged over the course of the intermittent exercise bout:  $[\text{PCr}]$  ( $19.09\text{ mM}\pm0.59$  vs  $17.33\text{ mM}\pm0.5$ ;  $p<0.01$ );  $[\text{H}^+]$  ( $324.5\text{ nM}\pm13.50$  vs  $284.0\text{ nM}\pm13.6$ ;  $p<0.05$ ). Average  $[\text{H}^+]$  was greater for continuous exercise vs interval exercise ( $252.6\text{ nM}\pm5.6$  vs  $217.18\text{ nM}\pm6.5$ ,  $p<0.001$ ) during the exercise bout.

**CONCLUSIONS:** A 5 s recovery period is sufficient duration to increase  $[\text{PCr}]$  and  $[\text{H}^+]$  between repeated 10 s bouts of heavy-intensity exercise. We therefore suggest a rapid shift of the creatine kinase reaction occurs during a very short rest period ( $<5$  s) following a brief bout of heavy intensity exercise. We also observe that the lower average  $[\text{H}^+]$  during short interval exercise suggests reduced production or increased buffering vs continuous exercise of a similar duration and intensity.

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## A-26 Free Communication/Poster - Cardiac

MAY 27, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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### 1470 Board #72 May 27 9:30 AM - 11:00 AM

#### Antioxidative Effect Of Exercise Training Combined With Losartan Treatment In The Infarcted Rat Hearts

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Increased oxidative stress and decreased antioxidant capacity are involved in myocardial remodeling after myocardial infarction (MI). Angiotensin II (AngII) plays a major role in oxidative stress. Our previous study demonstrated that exercise training reduced MI-induced elevation of AngII. Whether exercise training and losartan treatment would reduce MI-induced oxidative stress and improve antioxidant status needs to be elucidated.

**PURPOSE:** To investigate post-MI exercise and losartan treatment induced changes in enzymatic antioxidants and oxidative stress.

**METHODS:** MI was surgically induced in 7-wk-old rats. The survivors were assigned to 5 groups: Sham (no MI, no exercise), MISed (MI, no exercise), MI+Ex (MI with exercise), MISed+Los (MI treated with losartan), and MI+Ex+Los (MI treated with losartan and exercise). Treadmill exercise training (16m/min, 50min/d, 5d/wk) and losartan treatment (20 mg/kg/d) began 1 wk post-MI and lasted for 8 wks.

**RESULTS:** Glutathione peroxidase (GPx) and catalase mRNA levels of the surviving left ventricle were comparable among all the groups, while the mRNA level of superoxide dismutase (SOD) was significantly increased in exercise training with/without losartan treatment ( $2.95\pm0.82/1.75\pm0.4$  fold compared to the control) as compared to MISed rats ( $1.40\pm0.18$ ,  $P<0.05$ ). The protein levels for MnSOD and GPx were not significantly different among all the groups. However, the protein level for catalase was significantly increased in MI+Ex+Los rats ( $1.51\pm0.18$ ) compared to Sham group ( $1.0\pm0.16$ ,  $P<0.05$ ). Thiobarbituric acid-reactive substances (TBARS) in plasma were significantly increased in the MI rats, but robustly decreased by exercise training and/or losartan treatment ( $P<0.05$ ), indicating that both exercise and losartan may reduce lipid oxidative damage. In addition, cardiac function (fractional shortening) was significantly improved in rats receiving exercise training and/or losartan treatment compared to the MI rats without the treatments ( $p<0.05$ ).

**CONCLUSION:** Our results suggest that exercise training and losartan treatment exert antioxidative effects and reduce oxidative stress in the MI rats. These improvements may, in turn, attenuate the adverse myocardial remodeling and improve post-MI cardiac function.

Supported by NIH grant R01-HL074273.

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### 1471 Board #73 May 27 9:30 AM - 11:00 AM

#### Exercise Ameliorates The Adhesiveness Of Bone Marrow-derived Endothelial Progenitor Cells Post Acute Myocardial Infarction.

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(No relationships reported)

Previously it has been shown that exercise stimulate the production and the availability of Bone-marrow derived endothelial progenitor cells (BM-EPCs) and thus may contribute to cell surface reparation and angiogenesis.

**PURPOSE:** To investigate the role of exercise training initiated either prior to or post acute myocardial infarction (AMI) on BM-EPCs production, properties, and bioavailability.

**METHODS:** Sprague Dawley male rats ( $n=56$ ) were randomly assigned to 7 weeks of swimming exercise and sedentary groups. At the end of the exercise program, both groups were subjected to AMI, and there after were again divided into sedentary or exercise groups for the following 4 weeks period. Upon sacrificing, femur bone marrow were flushed out, washed and centrifuged for the isolation of mononuclear cells. The cells were resuspended in growth medium, plated on dishes coated with human fibronectin, and incubated in  $37^{\circ}\text{C}$ . Following 10 days of incubation, cells were phenotyped by Dil-acLDL and BS-1 lectin and FLK-1 and CD-31. For the EPC adhesion assay, cells were detached from origin culture dishes, and placed again onto fibronectin coated cultured dishes. After incubation, adherent cells were stained and evaluated by Elisa.

**RESULTS:** Immunostaining with Dil-acLDL and BS-1 lectin showed that prior-AMI exercised rats had more, yet, not countrified BM-EPC than the prior-AMI sedentary group. Fibronectin adhesion assay indicated a significantly greater adherence potential of BM-EPC originated from prior-AMI exercised and/or continued post-AMI compared to prior-AMI sedentary and/or sedentary-non AMI groups ( $p<0.001$ ).

**CONCLUSIONS:** Exercise training enhanced BM-EPC's adhesive properties. The greater adhesiveness seen in the exercise continued post-AMI group, signify the role of exercise training in both preventive and rehabilitation of cardiac disease.

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### 1472 Board #74 May 27 9:30 AM - 11:00 AM

#### The Effects Of Endurance Exercise Training On Cardiac-related Factors In Type 2 Diabetic Mice

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(No relationships reported)

Type 2 diabetes is rapidly becoming a major health threat in the United States. The disease, if not controlled, alters energy metabolism and frequently leads to the development of a diabetes-specific cardiomyopathy and increased oxidative stress levels in the heart. Endurance exercise training has been reported to improve cardiac function as well as reduce oxidative stress.

**PURPOSE:** To examine the effects of endurance exercise training on cardiac left-ventricular function and cardiac oxidative stress level in type 2 diabetic mice.

**METHODS:** 28 db/db mice and 29 control mice were randomly assigned to either endurance (ED) (EC) or sedentary groups (SD) (SC). Trained mice ran on the treadmill at 18-24 m/min, 30 min. per day, 5 days per week for 5-8 weeks, while sedentary animals were limited to cage activity. Data collection following the training period included measurement of cardiac dimensions using echocardiography and isolation of cardiac whole homogenate for measurement of oxidative stress through GSH:GSSG measurement.

**RESULTS:** Ejection fraction (%) and fractional shortening (%) respectively, were greater in endurance trained groups ( $0.89 \pm 0.012$  vs.  $0.85 \pm 0.012$ ,  $p < 0.05$ ) and ( $54.5 \pm 1.7$  vs.  $49.0 \pm 1.5$ ,  $p < 0.05$ ). Lower cardiac oxidative stress was observed in the endurance trained mice represented by higher GSH:GSSG ratios ( $0.261 \pm 0.09$  vs.  $0.122 \pm 0.08 \mu\text{M} \cdot \text{g} \cdot \text{min}^{-1}$ ,  $p = 0.05$ ).

**CONCLUSIONS:** Endurance exercise training had a positive effect on both cardiac function and cardiac oxidative stress levels in db/db and control mice

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**1473 Board #75 May 27 9:30 AM - 11:00 AM**  
**Heart Rate Recovery Following Maximal Arm And Leg Ergometry**

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(No relationships reported)

**INTRODUCTION:** Heart rate recovery (HRR) has been shown to be a predictor of mortality and morbidity. HRR is a reflection of autonomic nervous system (ANS) function and particularly of vagal reactivation. Maximal heart rate and aerobic capacity ( $\text{VO}_2\text{max}$ ) differs between arm and leg exercise. However, it is unknown if heart rate recovery pattern are similar between arm and leg exercise.

**PURPOSE:** The main purpose of the present study is to examine the difference in the heart rate recovery pattern following maximal arm and leg ergometry.

**METHODS:** 9 healthy subjects (5 males and 4 females;  $26 \pm 5.8$  yrs) performed graded maximal arm and leg ergometry tests in a randomized, crossover design. Breath by breath gas was collected to measure  $\text{VO}_2\text{max}$ . After the maximal tests HR at 1 and 2 mins of recovery was recorded. HRR was calculated from each graded maximal exercise test, as maximal HR attained during the test minus the HR at 1 min (HRR1) and maximal HR minus the HR at 2 min after exercise (HRR2). HR reserve was calculated as maximum HR - resting HR

**RESULTS:** The HRR1 following arm ergometry was significantly higher than HRR1 post leg ergometry ( $p < 0.05$ ). The HRR % as function of maximum HR in 1<sup>st</sup> min. after arm test was also significantly lower than HRR% following leg ergometry ( $p < 0.05$ ).

**CONCLUSION:** HRR following maximal arm ergometry was greater than HRR following maximal leg ergometry, suggesting that ANS function differs between exercise modes. Based on our results it appears that vagal reactivation is greater in the first minute following arm compared to leg ergometry. This finding may have implications for the clinical utility of HRR following arm ergometry.

Table:

Variable	Arm	Leg
$\text{VO}_2\text{max}$ (ml/kg/min)	30.67 (7.01)	43.12* (5.98)
HRR1 (bpm)	37 (14.41)	26.44* (8.3)
HRR2 (bpm)	49.89 (16.28)	47.11 (12.50)
HRR% 1 min	77.67 (7.95)	85.59* (4.17)
HRR % 2 min	70 (8.69)	74.26 (6.7)

\* Significantly different from arm ergometry ( $p < 0.05$ )

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**1474 Board #76 May 27 9:30 AM - 11:00 AM**  
**Circadian Variation In The Reactivity Of The Rate-pressure Product To Everyday Physical Activities In Hypertensive Patients**

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It has been suggested that the exercise-related response of the rate-pressure product (RPP) is a prognostic marker of cardiovascular mortality. Given that out-of-hospital sudden cardiac events are more common in the morning and, to a lesser extent, in the late afternoon, it is pertinent to examine whether RPP and its reactivity to physical activity vary with time of day.

**PURPOSE:** To use a novel RPP 'reactivity index' to investigate whether the RPP response to everyday physical activities changes over a normal sleep-wake cycle.

**METHODS:** Two hundred and eighteen male, and 222 female, hypertensive patients (aged 15-81 yrs) underwent 24-h monitoring of systolic blood pressure and heart rate (both recorded every 20 min). Wrist movement was recorded every 10 s and summed over the 15 min that preceded a BP measurement. The product of systolic BP and HR was calculated, and RPP reactivity indices were derived by regressing the change in RPP against the change in activity for twelve 2-h data bins. These indices were then analysed for time-of-day differences using a covariate-controlled general linear model.

**RESULTS:** The RPP showed circadian variation ( $P < 0.0005$ ), with a peak of  $11004$  (95%CI =  $10757$  to  $11250$ )  $\text{beat} \cdot \text{min}^{-1} \cdot \text{mmHg}$  occurring at 10:00 h. The reactivity of RPP to physical activity showed two distinct peaks between 08:00-10:00 and between 18:00-20:00 ( $P < 0.0005$ ) which were  $>3$  times greater than the RPP reactivity during the nocturnal period. This circadian variation in RPP reactivity was not moderated by wake-time, medication use, age or gender ( $P > 0.30$ ).

**CONCLUSION:** Under conditions of normal living, the reactivity of the rate-pressure product to a given unit change in physical activity is substantially higher in the morning and early evening compared with other times of day. These times are consistent with the peak times of day for out-of-hospital sudden cardiac events and, therefore, add weight to the notion that the response of the rate-pressure product to exercise could be a useful prognostic marker of cardiovascular mortality.

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**1475 Board #77 May 27 9:30 AM - 11:00 AM**  
**Effect Of Voluntary Exercise On Bcl-2 And Bax In Rat Cardiac And Skeletal Muscles**

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Regular physical activity is an effective lifestyle factor that reduces the risk of many chronic diseases. However, the underlying mechanisms of this protective effect have not been fully understood. It is demonstrated that apoptosis plays a role in aging, cardiovascular diseases, skeletal muscle insulin resistance, muscle wasting.

**PURPOSE:** To examine the effect of 2-month voluntary exercise on the expression of Bcl-2 and bax in cardiac and skeletal muscles in a rat wheel running model.

**METHODS:** Eighteen young adult female Sprague Dawley rats were randomly assigned to sedentary control (CON) and exercise (EX) groups. The EX animals were housed individually in cages with 24h free access to a running wheel. The daily running distance for each rat was recorded by a magnetic digital counter equipped with the running wheel. The CON animals were housed in cages without the running wheel. The bodyweight gain and amount of food intake of rats were recorded weekly. After 8 weeks exercise training, rats were sacrificed and the cardiac ventricle and soleus muscles were harvested and processed for real time PCR and Western blot analyses.

**RESULTS:** The average daily running distance of EX animals was 4-6 km during the 8-week experimental period. EX animals showed higher weekly food intake than CON animals but similar change in bodyweight was observed in EX and CON animals. According to RT-PCR analysis, the gene expression of apoptotic signaling factors Bax, Bcl-2 did not show significant change between EX and CON groups in ventricle and soleus muscles ( $P>0.05$ ). In the Western analyses, although Bax protein content was similar in soleus muscles of EX group compared with CON group ( $P>0.05$ ), Bcl-2 protein content in the ventricle of EX group significantly increased by 19% ( $P<0.05$ ) when compared with CON group. No difference was found in Bax protein content in both ventricle and soleus muscles between CON and EX groups ( $P>0.05$ ).

**CONCLUSIONS:** These results showed that two months voluntary exercise can up-regulate Bcl-2 protein expression level in rat heart. These finding suggested that short-term voluntary mode of exercise, which is a more usual and practical form of physical activity in humans can induce anti-apoptotic Bcl-2 adaptation in cardiac muscle.

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1476 Board #78 May 27 9:30 AM - 11:00 AM

### Effects Of Exercise Training On Cardiac Fas-dependent Apoptosis In Ovariectomized Rats

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(No relationships reported)

**BACKGROUND:** Cardiac apoptosis were found in ovariectomized rats but very limited information regarding the effects of exercise training on cardiac apoptosis in menopausal or bilateral oophorectomized women was available. The purpose of this study was to evaluate the therapeutic effects of exercise training on cardiac Fas-dependent apoptotic pathways. Method. Nine sham-operated rats and nine ovariectomized rats at 7-8 months of age were served as negative (Sham) and positive (OVX) control. Nine ovariectomized rats underwent treadmill running exercise 1 hour daily for 10 weeks. After exercise training or sedentary status, the excised hearts were measured by heart weight index, positive TUNEL assays and Western Blotting. Result. The whole heart weight, the left ventricular weight, the ratios of whole heart weight to tibia length, and the ratios of left ventricle to tibia length were significantly increased in OVX relative to Sham. Abnormal myocardial architecture and more cardiac TUNEL-positive apoptotic cells were observed in OVX. Cardiac Fas ligand, Fas death receptors, FADD, activated caspase 8, and activated caspase 3 in OVX were significantly increased, compared to Sham. Exercise training decreased OVX-induced cardiac TUNEL-positive apoptotic cells. Exercise training decreased OVX-induced Fas ligand, Fas death receptors, Fas-associated death domain (FADD), activated caspase 8, and activated caspase 3.

**CONCLUSION:** Exercise training suppressed ovariectomy-induced cardiac Fas-dependent apoptotic pathways in rat models. The findings may provide one of possible therapeutic approaches for preventing cardiac apoptosis in menopausal or bilateral oophorectomized women.

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1477 Board #79 May 27 9:30 AM - 11:00 AM

### Heart Rate Behavior During 24h Cycle Ergometer Exercise Is Dependent On Total Body Water

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**PURPOSE:** The aim of this case study was to examine changes in hemodynamic variables in a single trained male cyclist during a 24h cycle ergometer exercise test.

**METHODS:** The subject was monitored throughout 24h at a constant workload at the first lactate turn Point (200 Watt). Heart rate (HR) and respiratory gas exchange measures were analyzed continuously [oxygen consumption ( $\text{VO}_2$ ), carbon dioxide production ( $\text{CO}_2$ )]. Every hour systolic blood pressure (SBP), cardiac output (CO) and stroke volume (SV) were determined non-invasively (Innocor) as well as 2-D echocardiograms over the left parasternal area. Using VINGMED's Anatomical M-Mode it was possible to extract M-mode sweeps from stored 2-D-loops and perform the M-mode measurement [left atrial (LAD), ventricular end-diastolic (EDD) and end-systolic (ESD) diameters]. In addition, we also measured N-terminal pro-brain natriuretic peptide (NT-proBNP). Venous blood sample collection and body weight were obtained every 6 h.

**RESULTS:** After an initial increase after 1 h,  $\text{VO}_2$  was ( $41 - 43 \text{ ml} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$ ) and CO ( $19 - 18.7 \text{ l} \cdot \text{min}^{-1}$ ) were unchanged during 24h. HR increased at the end of the 5<sup>th</sup> h from 58-143 bpm and decreased constantly during the following 19 h (125 bpm). From the 5<sup>th</sup> h on SV (109 ml) increased steadily throughout the 24<sup>th</sup> h exercise test up to 150 ml. ESD was unchanged (32 mm) but EDD increased from 47 to 51 mm. LAD increased from 37 mm to 45 mm and body weight increased from 71 kg to 74 kg. Hematocrit decreased from 44% to 41%. NT-proBNP increased from 23 at rest to 306  $\text{pg} \cdot \text{ml}^{-1}$  at the end of exercise.

**CONCLUSIONS:** Our study suggests that the decrease in HR during a 24 h aerobic exercise was due to hypervolemia and the associated ventricular workload that resulted in SV increase as a consequence of increases in left ventricular diastolic dimensions.

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1478 Board #80 May 27 9:30 AM - 11:00 AM

### Effects Of Enalapril On Ventilatory Responses To Exercise In Older Diastolic Heart Failure Patients

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**BACKGROUND:** The primary chronic symptom of diastolic heart failure in the elderly (DHF) is severe exercise intolerance. There are several measures acquired from metabolic exercise stress testing that can help guide treatment and evaluate prognosis. Specifically, measures of ventilatory efficiency have been shown to significantly predict morbidity and mortality in heart failure patients. Therefore, it was the purpose of this study to determine if the ACE-Inhibitor, enalapril, will improve measures of ventilatory function and prognosis in older patients with DHF.

**METHODS:** Seventy-two patients over age 60 with DHF were enrolled in a randomized, double-blind trial of enalapril 20mg per day (E) vs. placebo (P). DHF was defined by HF symptoms with a normal ejection fraction ( $>50\%$ ) with exclusion of other co-morbidities (ischemia, anemia, pulmonary, or valvular disease). Maximal exercise testing was

conducted on an upright cycle ergometer using a staged protocol. Metabolic gas exchange values were collected continuously during exercise and peak values were averaged from the final 30 seconds of exercise. Outcomes were collected and analyzed by staff members blinded to study drug assignment. Assessments were completed at baseline, prior to randomization, and at 4 and 12 month follow-up. Repeated measures ANOVA with adjustments for age, gender, and baseline values were employed to detect statistical changes.

**RESULTS:** Compliance by pill count was 94% in the enalapril group and 96% in the placebo group. At 12-month follow-up, there was no significant difference observed in  $V_E/V_{CO_2}$  ( $31.2 \pm 3.3$  vs.  $31.5 \pm 4$ ;  $p=.845$ ), OUES ( $1.29 \pm .33$  vs.  $1.36 \pm .35$ ;  $p=.603$ ), nor in  $V_E/V_{CO_2}$  slope ( $33.1 \pm 4.5$  vs.  $33.3 \pm 5.2$ ;  $p=.606$ ).

**CONCLUSION:** Enalapril was well tolerated with minimal side effects and adverse events in this population. There was no significant improvement in  $V_E/V_{CO_2}$ ,  $V_E/V_{CO_2}$  slope, or OUES at the 12 month follow-up.

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**1479 Board #81 May 27 9:30 AM - 11:00 AM**

**Effects Of Endurance Training On Amp-activated Protein Kinase (ampk) Activity In The Heart**

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(No relationships reported)

AMPK phosphorylation (p-AMPK) in the heart in response to the physiologic stress of an acute bout of exercise has been documented previously. Phosphorylation of the AMPK  $\alpha_2$  subunit at the Thr<sup>172</sup> residue is thought to be responsible for the majority of cardiac AMPK activation. However, whether exercise training modulates either total AMPK or phosphorylation of its two catalytic  $\alpha$  subunits ( $\alpha_1$ ,  $\alpha_2$ ) in response to exercise has not been documented.

**PURPOSE:** To measure and compare the effects of 8 wk daily treadmill exercise on total left ventricular (LV) AMPK levels and AMPK activation (p-AMPK) to an identical bout of exercise between sedentary (SED) and trained (TR) mice.

**METHODS:** TR adult (4-7 mo) C57B6 mice were ramp-test exercised for ~ 17 min, which corresponded to the point of exhaustion for SED mice. Immediately post-exercise, LV tissue from both groups was rapidly excised, freeze-clamped, homogenized, and proteins were extracted for immunoblotting analysis. LV tissue was also obtained from resting controls.

**RESULTS:** Maximal treadmill running speed was increased 28% in TR vs. SED mice ( $46 \pm 1$  vs.  $36 \pm 1$  m/min;  $P < 0.001$ ). Changes in the ratio of p-AMPK/ total AMPK in response to exercise were not significantly affected by training. However, exercise increased AMPK activity associated with the  $\alpha_2$ -catalytic subunit in both SED and TR animals, but to a greater degree in the TR group (40 vs. 86%  $\uparrow$ ;  $P < 0.1$ ,  $P < 0.02$  vs. resting controls respectively).

**CONCLUSION:** Training results in significantly greater exercise-induced activation of AMPK in the mouse LV even at an exercise workload that is sub-maximal for the TR animals. This finding suggests cardiac AMPK activation may be enhanced by chronic endurance exercise.

\*This work was Supported by grants from NIH, University of Wyoming Northern Rockies Regional IDeA Networks for Biomedical Research Excellence (INBRE), 5P20RR016474 and American Federation for Aging Research (AFAR) 08007.

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**1480 Board #82 May 27 9:30 AM - 11:00 AM**

**Global And Regional Ventricular Function In Ultra-marathon Runners.**

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(No relationships reported)

The description of left ventricular morphology in athletes is common place but the assessment of ventricular function is more limited. Further, with recent advances in ultrasound imaging we can interrogate both local and regional cardiac function.

**PURPOSE:** To assess global and regional cardiac function during systole and diastole in ultra-marathon runners compared to age matched sedentary controls.

**METHODS:** A total of 89 [22 female] ultra-marathon runners at the 2007 and 2008 Western States 100 mile race (UM: mean $\pm$ SD age =  $41 \pm 5$  years, range 24-76 years) and 19 age-matched sedentary controls (CON: mean $\pm$ SD age =  $44 \pm 10$  years, range 23-72 years) underwent M-mode, 2D and Doppler echocardiography to assess global systolic (ejection fraction [EF]) and diastolic function (early/atrial filling velocity ratio [E/A]). 2D speckle-tracking echocardiography facilitated the assessment of longitudinal, radial and circumferential strain and peak systolic and early diastolic strain rates (data reported are septal wall at mitral annulus). Participants with known cardiovascular disease were excluded.

**RESULTS:** On average, the UM ran  $92 \pm 32$  km/week and had trained for  $15 \pm 10$  yrs whereas CON performed less than 120 min of recreational activity per week. EF was  $67 \pm 4$  % in UM and  $64 \pm 6$  % in CON ( $P > 0.05$ ). E/A was  $1.66 \pm 0.36$  in UM and  $1.34 \pm 0.53$  in CON ( $P < 0.05$ ). Longitudinal peak strain (UM:  $-21.2 \pm 3.5$  %, CON:  $-16.3 \pm 3.7$  %), peak systolic strain rate (UM:  $-1.63 \pm 0.34$  .s<sup>-1</sup>, CON:  $-0.94 \pm 0.23$  .s<sup>-1</sup>) and peak diastolic strain rate (UM:  $1.86 \pm 0.39$  .s<sup>-1</sup>, CON:  $1.29 \pm 0.32$  .s<sup>-1</sup>) were significantly augmented in athletes. There were no differences between groups for strain and strain rates assessed in radial and circumferential planes.

**CONCLUSIONS:** Global diastolic function was augmented in UM as was regional strain and strain rates in the longitudinal plane. These changes in deformation likely underpin the global Doppler-flow data.

Support: GE Healthcare, Western States Endurance Run, MSFHR, CIHR, CFI, NSERC

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**1481 Board #83 May 27 9:30 AM - 11:00 AM**

**Determinants Of Peak Work Capacity Reduction Following 5 Weeks Of Head-down Tilt Bed Rest**

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Without an exercise counter measure, 5 weeks of head-down tilt bed rest (HDTBR) results in a dramatic reduction in peak work capacity.

**PURPOSE:** Examine the contributing factors to the reduction of work capacity during sedentary HDTBR and its preservation with exercise training using rowing ergometry.

**METHODS:** 26 subjects (23 m/3 f, age 20-55 yr) were studied before and after 5 weeks of -6° HDTBR. The subjects were divided into 2 groups: (1) HDTBR without exercise, but sitting upright 45 min/d quietly on the ergometer (n=9); (2) HDTBR with exercise (30-45 min/d, 6 d/wk of exercise on a rowing ergometer plus 2 d/wk of supine resistance training; n=17). Endurance training included 3 days of exercise at a moderate, base pace and 2 days of high intensity interval training followed by a low intensity, longer duration recovery day.  $VO_2$  was measured via Douglas Bags and cardiac output (Qc) by C<sub>2</sub>H<sub>2</sub> rebreathing. LV mass and volume were measured via MRI and muscle strength using an isokinetic dynamometer.

**RESULTS:** (see table): Trained subjects experienced virtually no change in work capacity; a small decrease in maximal Qc was balanced by a small increase in a-vO<sub>2</sub>diff; sedentary subjects suffered reductions of 15% in peak work rate and 21% in  $VO_{2max}$ ; (both  $p < 0.01$ ). The sedentary group experienced a 31% reduction in maximal SV after

HDTBR compared to only a 11% decrease among the exercisers. Knee extension peak torque decreased by 14% only in the sedentary group, though this was not clearly related to the reduction in maximal exercise capacity (same peak a-vO<sub>2</sub> diff).

**CONCLUSIONS:** The marked reduction in work capacity following 5 weeks of HDTBR is due principally to cardiac atrophy and a diminished LV mass, chamber volume, and maximal Q<sub>c</sub>.

Group	Exercisers				Sedentary			
Variable	Pre	Post	%chg	p	Pre	Post	%chg	p
Peak Work Rate (Watts)	183 + 49	186 + 44	+2	0.25	173 + 42	147 + 38	-15	<0.01
VO <sub>2</sub> max (L/min)	2.4 + 0.5	2.4 + 0.5	0	0.178	2.4 + 0.5	1.9 + 0.4	-21	<0.01
VO <sub>2</sub> max (ml/kg/min)	32 + 7	31 + 5	-3	0.43	34 + 6	27 + 6	-21	<0.01
Q <sub>c</sub> max (L/min)	17 + 5	16 + 4	-6	0.02	17 + 4	12 + 2	-29	<.001
SVmax (L/min)	95 + 32	85 + 26	-11	0.02	93 + 27	64 + 15	-31	<0.01
Max a-vO <sub>2</sub> diff	147 + 29	160 + 32	+9	0.07	143 + 17	161 + 27	+13	0.08
LVEDV (ml)	144 + 23	137 + 25	-5	0.05	147 + 16	122 + 15	-17	<0.01
LVmass (g)	128 + 38	137 + 34	+7	<0.01	125 + 23	115 + 20	-8	<0.01

Supported by NASA grant CA00701.

#### 1482 Board #84 May 27 9:30 AM - 11:00 AM

##### Effects Of Short-term Exercise Training On Autonomic Circulatory Control In The Postural Orthostatic Tachycardia Syndrome

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**BACKGROUND:** Postural Orthostatic Tachycardia Syndrome (POTS) is characterized by excessive tachycardia during orthostasis. It affects ~500,000 young American women, but the underlying mechanisms are unclear, though such patients are presumed to have a “dysautonomia”. We tested the hypothesis that patients with POTS have impaired autonomic circulatory control, while short-term exercise training normalizes their autonomic function.

**METHODS AND RESULTS:** Seventeen female POTS patients aged 30±10 (mean±SD) yr underwent an “optimized” exercise training program for 3 mo. Autonomic circulatory control was assessed by spectral and transfer function analysis of R-R interval (RRI) and beat-to-beat blood pressure (BP) variability in the supine position during spontaneous and fixed breathing (0.2 Hz, 12 breaths/min) for 6 min each, before and after training. Data were compared with those obtained in 16 healthy sedentary women matched for age and body mass index. We found that indexes of RRI variability did not differ between patients and healthy women. Transfer function gain (BP to RRI), used as an index of arterial-cardiac baroreflex sensitivity was similar between patients and healthy women in both low- (0.05-0.15) and high-frequency (HF, 0.15-0.30) ranges. Short-term exercise training increased baroreflex gain modestly in POTS patients (GainHF 20.4±15.0 pre- vs 23.7±19.6 ms/mmHg post-training, *P*=0.06), though the gain remained within the normal range compared with healthy women (13.4±9.4 ms/mmHg, *P*=0.10).

**CONCLUSION:** These data suggest that patients with POTS have normal autonomic circulatory control in the supine position with no evidence of dysautonomia, and short-term exercise training can improve the arterial-cardiac baroreflex sensitivity in these patients.

Supported by NIH K23 (HL0752 83) and the GCRC grant (RR00633).

#### 1483 Board #85 May 27 9:30 AM - 11:00 AM

##### Physiological Responses To Resistance Training In Cardiac Patients: Impact Of Differing Warm-up Procedures

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Resistance training (RT) is typically performed following aerobic exercise in the cardiac rehabilitation setting.

**PURPOSE:** To determine the physiological responses to performing moderate intensity RT following a stretching (ST) versus an aerobic exercise (AE) warm-up.

**METHODS:** Low-risk cardiac patients (n = 17) in a Phase 3 exercise program performed 6 resistance exercises at 70% of their estimated 1-repetition maximum following either an aerobic exercise bout at 60-80% of heart rate reserve or a stretching warm-up. Subjects were randomized to treatment order, with a ≥ 3-day recovery period between sessions. Heart rate, rhythm and electrocardiographic (ECG) responses were monitored via telemetry, and blood pressure and rating of perceived exertion (RPE; 6-20 scale) were assessed during the completion of each resistance exercise. Muscle soreness was rated after each session and 24 hours post-exercise.

**RESULTS:** Heart rate was significantly higher during all resistance exercises following AE. Conversely, systolic blood pressure was significantly lower during 4 of 6 resistance exercises, generally resulting in comparable rate pressure products (RPP) for the two warm-up procedures. Somatic demands (RPE) were slightly higher following 2 resistance exercises after AE. Mean ± SD for the RPP and RPE responses for the 6 resistance exercises are summarized in the table. There were no differences in the frequency of ischemic ECG responses, ectopic activity, or muscle soreness between the two warm-up procedures.

	RPP-AE	RPP-ST	p-value	RPE-AE	RPE-ST	p-value
Leg Press	14379 ± 3764	12854 ± 3980	0.028	12.2 ± 1.6	11.1 ± 1.5	0.043
Chest Press	15254 ± 4292	14302 ± 4710	0.313	12.5 ± 1.5	12.0 ± 1.8	0.144
Leg Extension	16390 ± 4344	16083 ± 5549	0.651	13.0 ± 1.8	12.5 ± 1.6	0.165
Seated Row	17699 ± 4694	16976 ± 5439	0.280	12.5 ± 1.7	12.1 ± 1.8	0.253
Shoulder Press	16040 ± 3485	15068 ± 4920	0.170	13.0 ± 1.7	12.2 ± 1.7	0.045
Lat Pull Down	15530 ± 3633	15172 ± 4856	0.590	12.3 ± 1.2	11.8 ± 1.5	0.123

**CONCLUSION:** Low-risk coronary patients can safely perform RT following a stretching warm-up. Findings suggest that the type of warm-up has little influence on the cardiac and somatic demands of RT in selected cardiac patients.

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**1484 Board #86 May 27 9:30 AM - 11:00 AM**  
**Heart Rate Complexity During Upright Tilt Throughout the Normal Menstrual Cycle**

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(No relationships reported)

Autonomic neural control of the circulation is fundamental for maintenance of orthostatic stability. Because reproductive hormones influence a wide variety of variables that may affect autonomic function, circulatory control during orthostasis may be altered by menstrual phase. To our knowledge, the effects of menstrual phase on complex interactions among various autonomic regulatory variables and their impact on orthostatic responses have not been studied.

**PURPOSE:** To test the hypothesis that heart rate complexity varies during the normal menstrual cycle during upright tilt.

**METHODS:** Nine healthy eumenorrheic women (mean age  $24 \pm 1$  yr, height  $166 \pm 3$  cm, weight  $68 \pm 2$  kg; mean  $\pm$  SE) were studied during the early follicular (EF; days 1-2 determined by end of menses), late follicular (LF; days 12-13), early luteal (EL; day 22), and late luteal (LL; days 27-28) phases of the menstrual cycle. Blood plasma concentrations were analyzed for estradiol, progesterone, luteinizing hormone (LH), and follicle stimulating hormone (FSH). Subjects were instrumented for ECG and breathed in time with a metronome for 10 min in the supine position (15 breaths/min). Subjects were then tilted head-up to  $70^\circ$  for an additional 10 min of controlled breathing. Heart rate complexity was assessed with non-linear statistics including sample entropy (SampEn; a measure of complexity, or the degree of randomness within a signal) and short-term detrended fluctuations (DFA-s; quantifies fractal-like correlation properties).

**RESULTS:** Progesterone was elevated during EL compared with LF ( $14.3 \pm 7$  vs  $.8 \pm .3$  pg/ml;  $P=.03$ ), and FSH was elevated during EL compared with LL ( $4.1 \pm .9$  vs  $2.6 \pm .3$  pg/ml;  $P=.05$ ). Estradiol tended to be higher during LF and EF ( $P=0.1$ ). No tendencies were detected for LH across menstrual phases ( $P=.4$ ). SampEn decreased ( $P<.03$ ) and DFA increased ( $P<.001$ ) with tilt, but these changes were not different between menstrual phases (all  $P>.05$ ).

**CONCLUSIONS:** These findings suggest that female reproductive hormones do not affect heart rate regulation during an orthostatic challenge. Specifically, the degree of randomness, as well as the fractal nature of cardiac rhythms during orthostasis are not affected by menstrual phase.

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**1485 Board #87 May 27 9:30 AM - 11:00 AM**  
**Cardiac Denervation Does Not Effect Exercise Limitation After Heart Transplant**

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It has been well documented that for heart transplant recipients (HTRs), post-transplantation physical work capacity (PWC) normally does not exceed 60% of the value for healthy age-match controls and peak HR is significantly reduced (66% of predicted). The reduced PWC has been linked to the blunted HR at peak exercise due to complete denervation of the heart causing a loss of autonomic innervation of the SA node. **CASE SUMMARY:** A 37 year-old, professionally trained male cyclist suffered an AMI immediately following a road race and received a heart transplant four months following the AMI. The participant resumed training one month following surgery.

**METHODS:**  $VO_{2max}$  was determined during a symptom-limited graded exercise test on an electronically-braked cycle ergometer, starting at 75 Watts and increasing by 25 Watts / 3 min. at 6 and 12 months post surgery.

**RESULTS:** Peak PWC ( $33.8 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ , 250 Watts;  $44.2 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ , 275 Watts) and peak heart rates (165 bpm and 163 bpm).  $VO_2$  was 92% and 121% of predicted and HR was 97% and 96% of max pre AMI, respectively. These results were similar to the participants in a study (Richard et al., 1999) who had been training regularly for  $36 \pm 24$  months prior to testing and PWC evaluations occurred  $43 \pm 12$  months following HTR.

**CONCLUSION:** This individual showed a normal HR response to workload at 6 months and 12 months post HTx. This is likely due to the short duration in heart failure prior to transplantation. This unique case suggests that maximum HR cannot be a limiting factor to the exercise tolerance of HTRs and chronotropic competence can return to normal. The limiting factor to exercise capacity is likely due to peripheral function (vascular and muscular). Thus, lifestyle prior to HTR positively affects post-transplantation PWC and a more aggressive approach to heart transplant recovery focusing on peripheral dysfunction would benefit patients.

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**1486 Board #88 May 27 9:30 AM - 11:00 AM**  
**Therapeutic Effect Of Exercise Training On Cardiac Apoptosis In Streptozotocin-induced Diabetic Rats**

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(No relationships reported)

**BACKGROUND:** Cardiac apoptosis was found in diabetes but very limited information regarding the effects of exercise training on cardiac apoptosis in diabetes was available. The purpose of this study was to evaluate the therapeutic effects of exercise training on cardiac apoptotic pathways.

**METHODS:** Eight Wistar rats and Streptozotocin-induced diabetic rats at 4 months of age were served as negative (Control) and positive (DM) control. Eight Streptozotocin-induced diabetic rats underwent running exercise on treadmill 1 hour daily, 5 sections per week, for 8 weeks (DM-EX). After exercise training or sedentary status, the excised hearts were measured by positive TUNEL assays and Western Blotting.

**RESULTS:** Citrate synthase activity in skeletal muscle in DM-EX is significantly increased compared with sedentary group (Control and DM). Protein levels of mitochondria dependent pathway, including cytochrome c, activated caspase 9, and activated caspase 3 were increased in DM group compared with control. Protein levels of death receptor dependent pathway, including TNF-alpha, Fas ligand, Fas death receptors, Fas-associated death domain (FADD), activated caspase 8, and activated caspase 3 were increased in DM group compared with control. Exercise training decreased diabetes-induced cardiac TUNEL-positive apoptotic cells. Exercise training decreased protein levels of cytochrome c, activated caspase 9, activated caspase 3 (mitochondria pathway) and TNF-alpha, Fas ligand, Fas death receptors, FADD, activated caspase 8, and activated caspase 3 (Fas pathway) in DM-EX group compared with DM group.

**CONCLUSIONS:** Exercise training suppressed diabetes-induced cardiac mitochondria and Fas receptor dependent apoptotic pathways. The findings may provide one of possible therapeutic approaches for preventing cardiac apoptosis in diabetes.

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**1487 Board #89 May 27 9:30 AM - 11:00 AM**



## Influence Of Left Ventricular Diastolic Function On Ventilatory Responses During Exercise In Healthy Individuals

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Healthy aging is associated with changes in left ventricular (LV) diastolic function, namely a prolongation of LV relaxation and increased filling pressures. This could influence ventilation through afferent cardiac pulmonary receptors sensitive to stretch or pressure and/or to changes in lung compliance. Such cardio-pulmonary interdependence may be accentuated with exercise.

**PURPOSE:** To determine if indices of LV diastolic function influence ventilation, breathing pattern and gas exchange during exercise in healthy adults, and to determine if these associations are age related.

**METHODS:** 103 adults (age:  $50 \pm 2$ , range 22-76yr, 42 females,  $VO_{2peak}$ :  $34.8 \pm 0.8$  ml/kg/min,  $FEV_1$ :  $105 \pm 1$  %pred) underwent echocardiography and cardiopulmonary exercise testing. Isovolumic relaxation time (IVRT) and the ratio of peak early mitral inflow velocity to peak early mitral annular velocity ( $E/E'$ ) were used as indices of LV relaxation and filling pressure. Respiratory rate (RR), tidal volume ( $V_T$ ), ventilation ( $V_E$ ), all indexed to individual vital capacities (VC), as well as ventilatory efficiency ( $V_E/VCO_2$ ) and  $V_T/Ti$ , an index of  $V_E$  drive, were obtained during exercise.

**RESULTS:** Age was positively correlated with IVRT and  $E/E'$  ( $r=0.32$ ,  $0.58$ ,  $p<0.001$ ). An increase in LV filling pressure was positively associated with  $V_E/VC$  at a matched submaximal workload ( $r=0.21$ ,  $p<0.05$ ), and with RR/VC and  $V_E/VCO_2$  at peak exercise ( $r=0.21$ ,  $0.26$ ,  $p<0.05$ ). Prolonged LV relaxation was associated with  $V_E/VC$ ,  $V_E/VCO_2$  and  $V_T/Ti$  at the matched workload ( $r=0.35$ ,  $0.26$ ,  $0.21$ ,  $p<0.05$ ), and with RR/VC,  $V_T/VC$  and  $V_E/VCO_2$  at peak exercise ( $r=-0.22$ ,  $0.23$ ,  $0.22$ ,  $p<0.05$ ). The relationship between diastolic function and ventilatory function was not independent of age at the submaximal workload. The associations between RR/VC and LV filling pressure and relaxation, as well as the association between  $V_E/VC$  and filling pressure were independent of age at peak exercise.

**CONCLUSION:** Resting measures of LV diastolic function are associated with breathing pattern, gas exchange and ventilation, however only measures of breathing pattern at peak exercise appeared to be associated with diastolic function independently of age. NIH Grant HL71478.

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### 1488 Board #90 May 27 9:30 AM - 11:00 AM

#### Cardiorespiratory Responses To Aquatic Vs. Traditional Treadmill Exercise: Implications For Exercise Prescription

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**PURPOSE:** Recently, there has been an increased use of aquatic treadmills (AT) for injury rehabilitation, however little is known regarding the response of the cardiorespiratory system to this modality of exercise. The purpose is to determine the cardiorespiratory responses of AT vs. traditional treadmill (TT) exercise, particularly with respect to the heart rate/oxygen consumption (HR/ $VO_2$ ) relationship.

**METHODS:** Eleven Wake Forest University student-athletes ( $20.8 \pm 0.6$  years, 6 females and 5 males), completed similar exercise testing protocols on the AT and TT. Both protocols began with 5 minutes of standing rest followed by four exercise stages of increasing belt speed (1.5, 3.0, 4.5, and 6.0 mph). Thereafter, the AT protocol incorporated three exercise stages at 6.0 mph with water jet resistance (@ 30, 40, and 50% of jet capacity) while the TT protocol included three exercise stages at 6.0 mph with incline gradients of 1.0, 2.0, and 4.0% grade. A Cosmed K4b2 device with Polar monitor was used to collect heart rate (HR), ventilation (VE), tidal volume (TV), breathing frequency (Bf), and oxygen consumption every minute. Ratings of Perceived Exertion (RPE) were also obtained each minute.

**RESULTS:** There was no significant differences between AT and TT for  $VO_2$  at rest or during any stage of exercise, with exception to stage 3. Furthermore, there were no significant differences between AT and TT for HR, VE, Bf, and RPE on any exercise stage. Tidal volume was significantly lower during AT than TT at stage 3 only. Furthermore, bivariate plots of HR and  $VO_2$ , across all stages of exercise, indicates a similar relationship in these variables during AT ( $r = .94$ ,  $y = .269x - 10.86$ ) and TT ( $r = .95$ ,  $y = .291x - 12.98$ ).

**CONCLUSION:** These data indicate that AT and TT exercises elicit similar cardiorespiratory responses in collegiate athletes. Furthermore, the similarity in the relationship between HR and  $VO_2$  observed in AT and TT suggests that HR can be used to regulate appropriate levels of exercise intensity on AT.

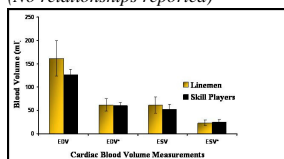
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### 1489 Board #91 May 27 9:30 AM - 11:00 AM

#### Assessment Of Cardiac Structure/function And Risk Factors In Collegiate Football Players: Does Body Size Matter?

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(No relationships reported)



More than fifty thousand men play American football at the collegiate level. The unique demands of this sport may alter cardiac function and increase risk for cardiovascular disease (CVD). Interior lineman (IL) may be especially vulnerable due to ingestion of hypercaloric diets to support heavy frames or facilitate additional weight gain.

**PURPOSE:** To evaluate cardiac structure/function and CVD risk factors in collegiate football players.

**METHODS:** Twenty-six players from Wake Forest University were recruited to participate; including interior lineman ( $n=13$ ) and skill position (SP) players ( $n=13$ ). BMI, % body fat and resting blood pressure were measured according to established guidelines. Fasting blood samples were obtained to determine serum lipids and glucose levels. End-diastolic volume (EDV) and end-systolic volume (ESV) were evaluated using echocardiography.

**RESULTS:** In addition to higher mean ( $\pm$  SD) BMI ( $36.0 \pm 3.6$  vs.  $26.3 \pm 1.5$  m/kg<sup>2</sup>) and % body fat ( $24.9 \pm 4.6$  vs.  $9.9 \pm 2.7$  %) IL showed significantly elevated Triglycerides and VLDL, with a corresponding decrease in HDL ( $37.8 \pm 3.2$  vs.  $48.6 \pm 5.8$  mg/dl) compared to SP. Mean SBP ( $134 \pm 12$  vs.  $121 \pm 5$  mmHg) and DBP ( $79 \pm 6$  vs.  $72 \pm 7$  mmHg) was significantly higher in IL. Interior linemen also demonstrated significantly greater EDV and ESV compared to SP, although there is no difference between groups after adjusting for body size (fig. 1).

**CONCLUSION:** These results suggest that collegiate IL may be at considerable risk for developing CVD compared to SP due to potential abnormalities in cardiac structure/function. Future research is necessary expand on these observations including the inclusion of an age & size matched "control" group of non-football players.

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### 1490 Board #92 May 27 9:30 AM - 11:00 AM

#### Assessment Of Cardiac Inflammation And Injury Following Prolonged Exercise Using Cardiovascular Magnetic Resonance (CMR) Imaging

Mathew Wilson<sup>1</sup>, Rory O'Hanlon<sup>2</sup>, Gill Smith<sup>2</sup>, F Alpendurada<sup>2</sup>, J Wong<sup>2</sup>, Dave Oxborough<sup>3</sup>, Richard Godfrey<sup>4</sup>, Keith George, FACS<sup>5</sup>, Dave Gaze<sup>6</sup>, Sanjay Prasad<sup>2</sup>, Gregory Whyte, FACS<sup>5</sup>. <sup>1</sup>University of Wolverhampton, Walsall, United Kingdom. <sup>2</sup>Royal Brompton Hospital, London, United Kingdom. <sup>3</sup>University of Leeds, Leeds, United Kingdom. <sup>4</sup>Brunel University, London, United Kingdom. <sup>5</sup>Liverpool John Moores University, Liverpool, United Kingdom. <sup>6</sup>St Georges Hospital, London, United Kingdom.

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G. White Presenting

(No relationships reported)

**PURPOSE:** Myocardial inflammation may be a potential mechanism for the release of troponin and NTproBNP following a Marathon. CMR has not been previously used to detect and quantify myocardial inflammation and fibrosis pre- and post-Marathon.

**METHODS:** CMR was performed in 18 athletes 24hrs pre and 6 hours post a Marathon run. Each scan was performed on a 1.5T Siemens Avanto scanner using a 4 channel body array coil. Myocardial structure and function was assessed using breath hold SSFP cine imaging in long and short axis views. The presence of myocardial inflammation and oedema was assessed using STIR imaging and a 3-4 minute spin echo sequence immediately post 0.1mmol intravenous gadolinium-DTPA to assess relative gadolinium enhancement. Inversion recovery segmented-FLASH imaging with TI adjusted to null normal myocardium to highlight regions of fibrosis was used to image delayed enhancement. Each participant had bloods drawn for TnI, NT-proBNP, and CRP at baseline, immediately post and 6 hours after the run. Each CMR scan was analyzed for wall thickness per segment, volumes and function, myocardial oedema. Delayed enhancement images were analysed using Medis software.

**RESULTS:** Biventricular volumes, stroke volume, ejection fraction, and mass were unchanged pre and 6 hrs post marathon. The majority of subjects were found to have a rise in BNP levels immediately and 6 hours after the race as well as elevations in TnI above the level of cut off for myocardial infarction (P=0.001). There were no focal regions of visual signal increase on the STIR images in any of the 18 subjects. Global myocardial oedema was predefined using a cut off ratio of 1.9 comparing SI of myocardium to skeletal muscle on STIR imaging, and a relative 45% increase in the SI myocardium/skeletal muscle immediately post intravenous gadolinium on relative gadolinium enhancement imaging (rGE). No subject reached these cut off values. None had any visual myocardial fibrosis on late enhancement imaging or using automated software.

**CONCLUSIONS:** Serum markers of myocardial cell damage post ultra endurance exercise are not associated with CMR detectable levels of myocardial oedema, inflammation or scarring, suggesting lower degrees of myocardial damage than in patients with acute myocardial infarction, in spite of similar levels of troponin elevation.

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**1491 Board #93 May 27 9:30 AM - 11:00 AM**

**Parasympathetic Modulation Of The Autonomic Nervous System In Individuals With Down Syndrome**

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(No relationships reported)

Individuals with Down syndrome (DS) are known to have autonomic dysfunction at rest and exercise in comparison to a healthy population. Autonomic dysfunction has been associated with early mortality.

**PURPOSE:** To examine the autonomic responses to perturbations in persons with Down syndrome in comparison to similar non-disabled controls.

**METHODS:** Static hand-grip (HG) was performed by 38 participants (controls: n=13; DS: n=25) were examined. Autoregressive power spectral analysis was used to investigate R-R interval variability during 2 min of rest and 2 min of HG exercise at 30% of maximum. 29 participants (controls: n=11, DS: n=18) also performed head-up upright tilt. Autoregressive power spectral analysis was used to investigate R-R interval variability during 5 min of rest and 5 min of tilting, and all data were log transformed before analyses. Total power, LF, HF and LF/HF were analyzed using 2x2 (group by condition) ANOVA.

**RESULTS:** There were interactions for total power, low frequency (LF), high-frequency (HF) and the LF/HF ratio (p<0.05), showing that individuals with DS exhibited a lesser change in response to both HG and upright tilt. For the HG, HF decreased from 6.25 at rest and to 5.04 during exercise, but the persons with DS went from 5.84 to 5.43. The LF/HF ratio increased during HG, from 5.55 to 5.95 for controls, whereas the persons with DS changed from 5.45 to 5.62. During the tilt test, HF decreased from 6.45 to 4.99 in controls, and from 5.77 to 4.01 in subjects with DS. The LF/HF ratio went from 4.80 at rest to 6.65 during tilt in controls, whereas the persons with DS changed from 5.52 to 6.35.

**CONCLUSIONS:** Individuals with DS exhibited reduced heart rate variability responses to both HG and upright tilt, suggesting global autonomic dysfunction in response to sympathetic stress. This is manifested by both reduced vagal withdrawal, and reduced alteration in sympathovagal balance.

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**1492 Board #94 May 27 9:30 AM - 11:00 AM**

**Histologic Evaluation Of Doxorubicin-induced Cardiotoxicity In Exercise Trained Rats**

Traci L. Parry<sup>1</sup>, Greg Wilkerson<sup>2</sup>, David S. Hydock<sup>1</sup>, Brock T. Jensen<sup>1</sup>, Chia-Ying Lien<sup>1</sup>, Carole M. Schneider, FACS<sup>1</sup>, Reid Hayward<sup>1</sup>. <sup>1</sup>University of Northern Colorado, Greeley, CO. <sup>2</sup>Colorado State University, Fort Collins, CO.

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(No relationships reported)

The value of exercise in attenuating doxorubicin (DOX)-induced cardiotoxicity is becoming increasingly evident. While exercise has been shown to attenuate DOX-induced declines in cardiac function, little is known about the effects of exercise training on the formation of myocardial lesions that accompany DOX treatment.

**PURPOSE:** To evaluate the effects of exercise training on the myocardial lesions associated with DOX exposure using a qualitative/quantitative scale specifically designed for the assessment of anthracycline toxicity.

**METHODS:** Female Sprague Dawley rats were randomly assigned to one of four experimental groups: sedentary (SED)+saline (SAL), SED+DOX, wheel run (WR)+SAL, WR+DOX. SED animals remained sedentary for the entire study. Animals in WR groups were individually housed in cages equipped with running wheels and allowed to voluntarily exercise. Animals in DOX groups received a 15 mg/kg cumulative dose of DOX (2.5 mg/kg/wk, i.p.) and animals in SAL groups received saline injections of equivalent volume using the same dosing schedule. DOX/SAL injections began on day one of the protocol. After the 10 week period, hearts were removed, flushed using an isolated working heart system, fixed in 10% buffered formalin. Myocardial lesions were scored on two categories: severity degree (0 - 2 scale) and extension degree (0 - 5 scale). The product of the severity and extension scores gave the total cardiotoxicity score (0 - 10 scale).

**RESULTS:** DOX treatment significantly increased the mean total score from 0.1 in SED+SAL to 5.6 in SED+DOX (p<0.01), which is consistent with previous studies showing that DOX elicits myocardial lesions at this dose. However, while similar exercise protocols have shown to preserve cardiac function, this does not appear to be the case in terms of the histologic appearance of myocardial lesions. Mean total score for WR+DOX (6.0) was significantly different from SED+SAL (p<0.01) and not different from SED+DOX.

**CONCLUSIONS:** Utilizing a well-established scoring system for DOX cardiotoxicity in rodent models, pathologic changes to the myocardium were clearly evident between saline-treated groups and those receiving DOX. No significant differences were noted, however, between the myocytes in sedentary versus exercised hearts utilizing the parameters of this scoring system.

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**1493 Board #95 May 27 9:30 AM - 11:00 AM**

## Therapeutic Effect Of Exercise Training On Cardiac Fibrotic Pathway In Obesity

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(No relationships reported)

**Background.** No information regarding transforming growth factor beta (TGF $\beta$ ) and connective tissue growth factor (CTGF) in obese heart as well as no information regarding the effects of exercise training on cardiac fibrosis in obesity was available. The purpose of this study was to evaluate TGF- $\beta$ -CTGF-related fibrotic pathway in obese heart and the effects of exercise training on cardiac fibrosis. **METHODS:** Twelve lean Zucker rats (LZR) and twelve obese Zucker rats (OZR) at 5-6 months of age were served as sedentary lean group and sedentary obese group as well as twelve obese rats underwent swimming exercise 3 hour daily for 1 month (OZR-EX). After exercise training or sedentary status, the excised hearts were measured by Hematoxylin and Eosin (H&E) staining, Terminal deoxynucleotidyl transferase dUTP nick end labeling (TUNEL) assay, Masson trichrome staining and Western Blotting. **RESULTS:** Myocardial architecture abnormality, more cardiac TUNEL-positive apoptotic cells, and minor cardiac fibrosis were found in OZR, compared to LZR. The protein levels of TGF- $\beta$ , mitogen-activated protein kinase/extracellular signal-regulated kinase (MEK), extracellular signal-regulated kinase (ERK), CTGF, matrix metalloproteinase (MMP)-9, and MMP2 were significantly increased in OZR relative to LZR. Exercise training decreased OZR-induced myocardial architecture abnormality, cardiac TUNEL-positive apoptotic cells, and cardiac fibrosis as well as exercise training decreased OZR-induced fibrosis-related protein levels of TGF- $\beta$ , MEK, ERK, CTGF, MMP-9, and MMP2.

**CONCLUSIONS:** Exercise training prevented cardiac fibrosis and cardiac TGF- $\beta$ -CTGF fibrotic pathway in obese models. Our findings imply that exercise therapy could be one of possible therapeutic approaches to prevent delirious cardiac fibrosis in obesity.

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### 1494 Board #96 May 27 9:30 AM - 11:00 AM Does Bariatric Surgery Reverse Obesity-associated Sympathoexcitation?

Cornelius B. Groenewald, Nisha Charkoudian, Nicholas A. Strom, Jessica R. Sawyer, Timothy B. Curry. *Mayo Clinic, Rochester, MN.*

(No relationships reported)

Obesity is associated with an increase in resting levels of muscle sympathetic neural activity (MSNA) and a decrease in reflex sympathetic neural and cardiovascular responsiveness. Exercise and diet induced weight loss reverse these changes, however the potential effects of bariatric surgery induced weight loss are unknown.

**PURPOSE:** We hypothesize that bariatric surgery will decrease baseline levels of MSNA and increase baroreflex sensitivity.

**METHODS:** We measured MSNA (peroneal microneurography), R-R interval (ECG) and arterial pressure (arterial catheter) in three groups of subjects: (1) subjects > 12 months post bariatric surgery (N = 2) (2) obese subjects BMI > 35 kg/m<sup>2</sup> (N = 7) (3) lean control subjects BMI < 25 kg/m<sup>2</sup> (N = 5). MSNA, ECG and arterial blood pressure were measured continuously during intravenous vasodilator (sodium nitroprusside) and pressor (phenylephrine) boluses. Baroreflex control of sympathetic outflow and of the heart were determined by the relationships of arterial pressure with MSNA and R-R interval, respectively, during blood pressure fluctuations (modified Oxford technique).

**RESULTS:** Our preliminary results indicate that chronic resting levels of MSNA were lower in post bariatric subjects [19 +/- 4 (SE) bursts/min vs 28 +/- 4 bursts/min in obese subjects] with values no different from non-obese control individuals (21 +/- 3 bursts/min). Bariatric surgery also appeared to increase the responsiveness of baroreflex control of the heart [14.23 msec/mmHg (RRI) vs 8.50 msec/mmHg for obese subjects (p < 0.004)].

**CONCLUSION:** Preliminary results indicate bariatric surgery may reverse both obesity associated increases in chronic resting levels of MSNA and improve sensitivity of the baroreflex.

Supported by NIH UL1 RR024150 (to the Mayo Clinic).

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## A-27 Free Communication/Poster - Clinical Exercise Testing

MAY 27, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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### 1495 Board #97 May 27 11:00 AM - 12:30 PM Clinical Measurement Of Sit-to-stand Performance In People With Painful Vertebral Degenerative Disease

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(No relationships reported)

**PURPOSE:** People with painful vertebral degenerative disease are characterized as having difficulty with transitional movements, such as the sit-to-stand movement. A valid and feasible tool is needed to help clinicians quantify the ability of people with painful vertebral degenerative disease to perform transitional movements. Few studies have been conducted to evaluate patients' performance during different phases of sit-to-stand. The purpose of this study was to develop a three-phase sit-to-stand testing (3PSST) instrument for PVDD patients and to investigate the PVDD impacts on the elderly subjects.

**METHODS:** Forty-one elderly subjects (67.1 $\pm$ 9.0 years) from an orthopedic clinic with PVDD were examined before the surgery or other treatments. Thirty age-matched community healthy elderly dwellers (72.5 $\pm$ 5.4 years) were included in this study as control group volunteers (CG). Sit-to-stand performance tests were conducted using a force plate to measure the ground reaction force (GRF) and center of pressure (COP). Switches mounted on chair back and chair seat were used to separate the whole sit-to-stand course into three phases: (1) reaction time (RT), from start signal (SS) to trunk left chair back (TL), (2) trunk movement time (TMT), from TL to buttock left the chair seat (BL), and (3) stand movement time (SMT), from BL to the maximum GRF (MGRF). MGRF were normalized with individual body weight (BW) before group comparison.

**RESULTS:** The results demonstrated that PVDD group subjects had significant poor sit-to-stand performance than the CG subjects: slower RT (0.89 $\pm$ 0.49 vs. 0.70 $\pm$ 0.30 sec, P<.05), slower TMT (0.90 $\pm$ 0.97 vs. 0.40 $\pm$ 0.12 sec, P<.05), and slower SMT (0.40 $\pm$ 0.95 vs. 0.10 $\pm$ 0.12 sec, P<.05). PVDD subjects also demonstrated significant smaller MGRF than CG (1.20 $\pm$ 0.08 vs. 1.29 $\pm$ 0.10BW, p< 0.05).

**CONCLUSIONS:** The 3PSST displays validity properties at discriminating between subjects with and subjects without PVDD that make this test potentially useful in clinical decision making. The subjective variables from the 3PSST could be established to identify RT, TMT and SMT physical function impairment for treatment planning and effectiveness evaluation.

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### 1496 Board #98 May 27 11:00 AM - 12:30 PM Is Hand Grip Strength A Valuable Tool In Order To Assess Physical Performance In Athletes?

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(No relationships reported)

The assessment of physical performance in elite athletes is very important in order to design an optimal training protocol for the athlete. The assessment tools must have high reliability and high validity for the sport activity. Hand grip strength is used to evaluate hand function and may be used to assess generalized upper extremity strength. However, reliability values for younger subjects and test-retest reliability of hand grip strength is scarce in the literature.

**PURPOSE:** The study aimed to investigate hand grip strength in elite athletes and to evaluate test-retest reliability of hand grip strength.

**METHODS:** Sixty-nine elite athletes between 20-34 years (29 women (W)) and 75 control subjects (61 W) participated in the study. Ice hockey (17 men (M)), soccer (16 W, 18 M), sailing (3W, 5M) and high jumpers/throwers (10W) participated. Hand grip strength was measured with the Grippit® instrument recording MVC (maximal voluntary strength). Body composition (fat mass (FM), fat free mass (FFM), lean mass (LM), bone mineral density/content (BMD/C)) was assessed using the DEXA® apparatus.

**RESULTS:** Women throwers showed hand grip strength values of 458 N/395 N for right and left hand respectively, the high jumpers showed 413 N/342 N, soccer players showed 402 N/358 N and women sailors 407 N/360 N. The women athletes did not show any significant differences in hand grip strength between sport activities. The women control subjects showed 331 N/303 N. Male soccer players showed 529 N/479 N, ice hockey players 614 N/563 N and sailors 680 N/655 N being significantly ( $p < 0.05$ ) different between sport activities. The men control subjects registered 542 N/518 N. Test-retest reliability was very high ( $ICC = 0.94$ ). Whole body FFM correlated very well with hand grip strength ( $r = 0.62-0.67$ ) as well as FFM for the right and left hand respectively ( $r = 0.72$ ). BMC showed very high correlation with hand grip strength ( $r = 0.69-0.71$ ).

**CONCLUSIONS:** Hand grip strength values give important information when assessing the overall physical performance. Hand grip strength values show very high reliability and correlate very well with body composition, especially fat free mass and bone mineral content of the athlete. Being easy to perform, hand grip strength can be highly recommended as a measuring tool when assessing overall performance.

1497 Board #99 May 27 11:00 AM - 12:30 PM

### Comparing The Shuttle Walk Test And Chester Step Test In Cardiac Rehabilitation Patients In Scotland

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(No relationships reported)

**PURPOSE:** Cardiac rehabilitation involving exercise reduces all cause mortality following a cardiac event. Current guidelines recommend initial assessment of baseline cardiovascular fitness prior to exercise-based cardiac rehabilitation. The shuttle walk test (SWT) and Chester step test (CST) are currently used in the UK for this **PURPOSE**: This study aims to compare the physiological responses to the CST and SWT in order to determine which test is more effective at measuring cardiovascular fitness.

**METHODS:** 10 cardiac rehabilitation patients were subjects in this randomized cross-over study. The submaximal CST and SWT were extended linearly to maximal tests to ensure true  $VO_{2PK}$  was achieved. The tests were extended (E-CST and E-SWT) by adding levels to each test.  $VO_{2PK}$  was the primary outcome; measured by a portable breath-by-breath cardiorespiratory gas analyzer. Peak heart rate ( $HR_{PK}$ ), peak perceived exertion ratings ( $RPE_{PK}$ ), subjects' preferences and reasons for stopping the tests were recorded as secondary outcomes.

**RESULTS:**  $VO_{2PK}$  measurements were higher in the E-SWT than in the E-CST in 60% of subjects ( $p < 0.607$ ). Mean  $VO_{2PK}$  values were 24.9 and 24.4 ml/kg/min for the E-SWT and E-CST respectively.  $HR_{PK}$  measurements were higher in the E-SWT than in the E-CST in 80% ( $p < 0.199$ ). Mean  $HR_{PK}$  values were 130 and 128 bpm for the E-SWT and E-CST respectively.  $RPE_{PK}$  values were higher in the E-CST than the E-SWT in 60% ( $p < 0.057$ ). 60% of subjects preferred the E-SWT to the E-CST ( $p < 0.022$ ). The commonest reason for terminating the E-CST was leg pain. The commonest reason for terminating the E-SWT was shortness of breath.

**CONCLUSIONS:** The trend for a higher  $VO_{2PK}$  in the E-SWT suggests that it provides a more accurate assessment of aerobic capacity than the E-CST in cardiac rehabilitation patients. The CST exercises an individual muscle group where as the SWT involves the use of several muscle groups throughout the body, reducing the likelihood of local muscle fatigue. Walking is generally a more familiar activity than stepping. As patients are more likely to have higher  $VO_{2PK}$  values in the SWT than in the CST we conclude that the SWT is more suitable for use in cardiac rehabilitation.

1498 Board #100 May 27 11:00 AM - 12:30 PM

### Utility Of The RPE To Assess Walking Intensity Following Traumatic Lower Extremity Amputation

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(No relationships reported)

#### PURPOSE:

The purpose of this preliminary study was twofold: 1) to establish the test-retest reliability of the Rating of Perceived Exertion (RPE) as a measure of walking intensity in persons with or without traumatic lower extremity amputation; 2) to confirm validity of the RPE through its association with energy cost (EC).

**METHODS:** Eight men and women (26.4±3.9 yr) with (n=3) and without (n=5) a traumatic lower extremity amputation volunteered to complete a multiple speed treadmill walking test with a repeat test an average of 12 days later. Each participant walked at 5 height-normalized walking speeds and one matching the overground self-selected walking velocity (SSWV). Perception of walking intensity [modified Borg RPE scale (6-20)] and steady state EC (mlO<sub>2</sub>/kg/min) were assessed at each speed. Reliability of the RPE between tests 1 and 2 was analyzed using two-factor (test, speed) ANOVA and, at each speed, an Intraclass Correlation Coefficient (ICC). Pearson correlation coefficients between the RPE and EC were used to determine validity.

**RESULTS:** RPE values (see below) were not different between tests for either group. ICCs for both groups demonstrated good reliability ( $ICC > 0.75$ ) for walking speeds above 1.2 m/s for persons with an amputation and 1.3 m/s in non-amputees. Slower walking speeds produced ICC values in the moderate to poor range ( $ICC < 0.53$ ) for each group. Strong associations ( $r > 0.85$ ) between RPE and EC were observed for each test except test 1 in the amputee group ( $r = 0.78$ ).

RPE					
Amputee			Non-Amputee		
Speed (m/s)	Test 1	Test 2	Speed (m/s)	Test 1	Test 2
0.7	9.7±2.8	8.0±1.0	0.7	7.0±0.0	6.8±0.5
1.0	11.7±0.6	10.7±0.6	1.0	9.0±1.2	7.6±1.1
1.2	12.7±0.6	13.0±1.0	1.2	10.8±0.8	9.6±1.5
1.4	14.3±1.2	15.3±1.5	1.4	12.2±1.6	11.6±2.1
1.6	17.0±0.0	17.0±0.0	1.7	13.4±1.5	12.8±1.9
SSWV (1.2)	12.5±0.6	12.6±0.6	SSWV (1.3)	11.2±1.5	10.8±1.8

**CONCLUSIONS:** Preliminary results suggest the RPE is reliable for measuring the walking intensity at speeds at or above SSWV in persons with or without lower extremity amputation. Reliability and validity may be reduced, however, at slower walking speeds.



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**1499 Board #101 May 27 11:00 AM - 12:30 PM**  
**Impact Of Painful Vertebral Degenerative Disease On The Elderly Subjects' Dynamic And Static Balance Performances**  
Ying Po Hsu<sup>1</sup>, Kung Chia Li<sup>2</sup>, Jin Jong Chen<sup>1</sup>. <sup>1</sup>National Yang-ming University, Taipei, Taiwan. <sup>2</sup>Chiayi Yang-Ming Hospital, Chiayi, Taiwan.  
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**PURPOSE:** Significant impacts of painful vertebral degenerative disease (PVDD) on the elderly subjects' physical function have been noted. But only few studies conducted before the surgery to evaluate patients' balance capacity due to severe intolerable pain. The purpose of this study was to investigate the impacts of PVDD on static and dynamic balance performance.

**METHODS:** Forty-one elderly subjects (67.1±9.0 years) from an orthopedic clinic with PVDD were examined before the surgery treatment. Thirty age-matched community healthy elderly dwellers (72.5±5.4 years) were included in this study as control group volunteers (CG). The following measurements were conducted: (1) dynamic balance tests: functional reach (FR), and 3m Timed-Up and Go (TUG), and (2) static balance tests: open eye sitting balance (OESB), close eye sitting balance (CESB), open eye standing balance (OESTB), and close eye standing balance (CESTB).

**RESULTS:** The results demonstrated that PVDD group subjects had significant poor dynamic balance performance than the CG subjects, lower FR (20.8±6.9cm vs. 28.9±4.5cm, p<0.001) and slower TUG (14.99±8.79s vs. 10.20±2.06s, p<0.05). PVDD subjects demonstrated significant lower center of pressure (COP) velocity of postural control than control group during four static balance tests, (38.9±13.6 vs. 62.3±13.3 cm/10sec, 35.3±12.4 vs. 59.2±14.9 cm/10sec, 44.0±17.1 vs. 61.2±10.0 cm/10sec, 48.1±22.0 vs. 64.6±10.7 cm/10sec, for OESB, CESB, OESTB and CESTB, respectively).

**CONCLUSIONS:** PVDD subjects had poor dynamic and static balance. COP velocities (cm/10sec) during four static balance tests are reliable variables for elderly balance function. Compare to dynamic balance tests, static balance tests are more tolerable, which can be conducted before and after the surgery, to evaluate the treatment effect for PVDD subjects.

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**1500 Board #102 May 27 11:00 AM - 12:30 PM**  
**The Effects Of Adapted Virtual Reality Driving Simulator Training For Subjects With Spinal Cord Injury**  
Ting-Ying Chiu<sup>1</sup>, Jin Jong Chen<sup>2</sup>, Wen-Hsu Sung<sup>2</sup>, Yun-An Tsai<sup>1</sup>, Henrich Chen<sup>1</sup>. <sup>1</sup>Taipei Veterans General Hospital, Taipei, Taiwan. <sup>2</sup>National Yang-ming University, Taipei, Taiwan.  
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Being able to drive is an important issue for subjects with spinal cord injury (SCI); the driving performance and seated posture control ability influence the ability of independent driving. However, only few studies concerned these two factors together. Furthermore, although being trained and getting license were important demands for SCI, and virtual reality driving simulator (VRDS) was suggested to be useful in training, the protocol and effects of training with VRDS for SCI have not been established.

**PURPOSE:** To develop a proper VRDS and training program and to evaluate the effects of VRDS training for SCI.

**METHODS:** Twelve SCI subjects were randomly assigned to either VRDS with moving base group (MB) or VRDS with stationary base group (SB). All subjects received ten 30 minutes VRDS training sessions, as well as driving performance in VRDS (total driving time, speed and speed variation, steering control, collisions, and traffic signal violation), balance control ability, cybersickness, enjoyment, workload and realism were measures as outcome variables. The variables between pre- and post- intervention were analysis by Friedman 2-way analysis of variances by ranks. And Wilcoxon Signed-Ranks test. Mann-Whitely U tests were then used to compare the difference between two groups. The a level of .05 was set for the statistical significance.

**RESULTS:** The VRDS training program was realistic and enjoyable without adverse effects of cybersickness. All subjects reported the VRDS training program decreases the fear of driving. Taking 5 sessions of VRDS training resulted in significant improvement on speed control (average speed: 34.08±2.99 vs. 37.15±2.18km/hr); the steering control is harder and takes more training times to improve. After 5 training sessions, MB had better driving performance training effects than SB (average speed: 38.62±1.27 vs. 35.67±1.91 km/hr). MB also had lower physical demands (1 vs. 7, p<.05) and lower frustration (1 vs. 6, p<.05) than SB in the 7-point scale. However, no significant improvement was found in balance control ability of both groups after VRSD training program.

**CONCLUSIONS:** This is the very first study as we know to investigate the effects of the VRDS training with multiple sessions. The VRDS program is effective tool and moving base has better training effects than stationary base.

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**1501 Board #103 May 27 11:00 AM - 12:30 PM**  
**Neuromuscular Capacity In Relation To Maximal Exercise Capacity During Incremental Bicycle Test In Healthy Sedentary Male Subjects**  
Asa Segerstrom<sup>1</sup>, Anna-Maria Holmback<sup>1</sup>, Targ Elzyri<sup>2</sup>, Karl-Fredrik Eriksson<sup>2</sup>, Karin Ringsberg<sup>2</sup>, Leif Groop<sup>2</sup>, Ola Thorsson<sup>2</sup>, Per Wollmer<sup>2</sup>. <sup>1</sup>Lunds University, Institute of Health science, Lund, Sweden. <sup>2</sup>Lunds University, Institute of Clinical Sciences, Malmoe, Sweden.  
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(No relationships reported)

In exercise testing work capacity (maximal oxygen uptake ( $VO_{2peak}$ ) and work rate ( $WR_{leg}$ )) is assessed using large muscles groups, generally by performing primary leg exercise. However the relationship between work capacity and neuromuscular capacity are seldom described when evaluating exercise response.

**PURPOSE:** To investigate the relation between work capacity during an incremental bicycle exercise test and neuromuscular capacities in sedentary healthy male subjects before and after six months of supervised group training.

**METHODS:** Thirty-two male sedentary healthy subjects (37.3+ 4.6 yrs) participated in a training period 3 times per week during 6 month, 1 session of spinning and 2 sessions of mixed exercise. Work capacity was assessed using an incremental bicycle test. Neuromuscular capacities of the knee extensors and flexors were assessed at 60°/s and 120°/s using isokinetic dynamometry. Trunk extensor and flexor strength was assessed using isometric dynamometry, and arm muscle endurance ( $WR_{arm}$ ) was evaluated with a bench press.

**RESULTS:** Maximal oxygen consumption ( $VO_{2peak}$ ) and work rate leg ( $WR_{leg}$ ) increased (0.34+ 0.28 l/min, 35+ 23 W, p<0.05). Work economy,  $VO_{2peak}/WR_{peak}$ , decreased (-0.35+1.0 l/min/W, p<0.05).  $WR_{arm}$  increased (13+5 number, p<0.05). Maximal voluntary contraction (MVC) trunk extension (TE) increased (47+20 N, p<0.05). MVC trunk flexion (TF) did not change. Peak torque (PT) 60°/s knee flexion (F) and 60°/s knee extension (E) did not change. Deceleration (D) 60°/s E decreased (-47.7+ 73.7 msec, p<0.05) and time to PT 60°/s F decreased (-103.8+ 176 msec, p<0.05).  $WR_{arm}$  correlated to  $WR_{leg}$  ( $r_p=0.46$ , p<0.005) at baseline and at 6 month. MVCTE correlated to  $WR_{leg}$  ( $r_p=0.53$ , p<0.005) at baseline and at 6 month. MVCT F correlated and to  $WR_{leg}$  (0.40, p<0.05) at 6 month. PT 60°/s E correlated to  $WR_{leg}$  ( $r_p=0.54$ , p<0.005) at baseline and at 6 month. PT 60°/s F correlated and to  $WR_{leg}$  (0.49, p<0.005) at 6 month.

**CONCLUSIONS:** Six months of combined exercise may relate to an increase in work economy due to improved co-ordination of the knee extensors and flexors as well as modification of the neuromuscular capacity via upper body position.

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**1502 Board #104 May 27 11:00 AM - 12:30 PM**

## Should Arm Exercise Test Follow The Traditional 8-12 Minutes Ramp Protocol?

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(No relationships reported)

Ramp protocol is the most used exercise test protocol, since the continuous increase in intensity allows for the achievement of maximal aerobic power in 10±2 minutes without precocious interruption due to muscle fatigue. When small muscle groups are exercised, as in arm ergometry (AE), local fatigue may be a limiting factor that interrupts test before the achievement of maximal aerobic effort. There is no consensus about the optimal duration of a ramp exercise test when AE is performed.

**PURPOSE:** To evaluate if AE exercise test should be programmed to achieve maximal effort at 10±2 minutes.

**METHODS:** Healthy individuals (n=16; 8 men; age=27±4 years; BMI=23.2±2.8 kg/m<sup>2</sup>) were submitted to two maximal cardiopulmonary (Ultima CardIO<sub>2</sub>, MedGraphics, USA) AE tests (Angio, LODE, Netherlands) following different ramp exercise protocols with different load increases each 6 sec: Fast (FP)=2W; Slow (SP)=1W. Tests were performed in two different days following a latin square randomized order. Eight individuals also performed a maximal cardiopulmonary exercise test in a cycle ergometer (CE) (Excalibur, LODE, Netherlands). Cardiopulmonary variables in both protocols were compared using paired Student t test.

**RESULTS:** FS was longer than FP (mean±SD): 10'08''±3'53'' vs FP: 07'26''±2'; p<0.01). During FP a higher load was achieved (FP: 120±40 vs. SP:103±39W; p<0.01), with the same peak oxygen consumption (FP:24.3±6.1 vs. SP:23.5±7.8 ml/kg/min; p=0.88). Exercise economy was higher at CE peak exercise (CE:98.8±9.1<FP:72.6±10.7<SP:64.5±8.9 W/L/min; p<0.01). There was no difference between other exercise variables in both protocols.

**CONCLUSION:** During AE, subjects achieved the same peak oxygen consumption with higher economy when the fast protocol was used, suggesting that there is no need for an AE exercise test to be as long as the usual bike and treadmill tests. The optimal duration of arm exercise test remains to be defined.

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### 1503 Board #105 May 27 11:00 AM - 12:30 PM

#### Cardiorespiratory Fitness In Women With Fibromyalgia: Hemodynamic Correlates

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(No relationships reported)

Fibromyalgia (FM) is a chronic painful disorder characterized by muscle tenderness as well as other systemic complaints including fatigue, sleep disturbance, and bowel irregularity. Recently, cardiopulmonary exercise testing has been suggested to determine if aerobic capacity (VO<sub>2</sub>max) is uniformly reduced in this patient population.

**PURPOSE:** To evaluate hemodynamic responses to symptom-limited exercise testing in patients with FM, with specific reference to those with normal and reduced levels of cardiorespiratory fitness.

**METHODS:** Female patients (n=20) with diagnosed FM were referred from a single physiatrists office on a voluntary basis. Patients exercised to volitional fatigue or adverse signs/symptoms on a treadmill using the standard Bruce protocol with simultaneous measurements of gas exchange. Heart rate (HR) and blood pressure (BP) values were obtained at rest, during submaximal and peak exercise, and 6 minutes after test termination.

**RESULTS:** Exercise tests on 20 of the 20 patients were terminated due to volitional fatigue. For the entire group (n=20), mean ± SD age and body mass index were 49.0 ± 11.3 years and 27.5 ± 7.1 kg/m<sup>2</sup>. Measured VO<sub>2</sub>max for the cohort was 24.1 ± 6.7 mL/kg/min, and the corresponding respiratory exchange ratio generally exceeded unity (mean, 1.06). Subjects were categorized into 2 groups: Group 1 (n=12), had normal fitness, that is, a functional aerobic impairment <20%; and, Group 2 (n=8), demonstrated a reduced level of cardiorespiratory fitness. Although the groups were comparable in age, mean VO<sub>2</sub>max values were 27.3 and 19.3 mL/kg/min for Groups 1 and 2, respectively. A comparison of hemodynamic responses also revealed that Group 2 had higher values for resting HR and systolic BP, lower peak systolic BP, and a steeper HR slope with progressive exercise. In contrast, there were no differences between the groups in the peak HR, recovery HR, and systolic BP.

**CONCLUSION:** Female patients with FM have varied levels of cardiorespiratory fitness, similar to those observed in the general population. Those with reduced VO<sub>2</sub>max values, however, demonstrate altered hemodynamics at rest and during exercise, responses that may be attributed to hormonal anomalies.

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### 1504 Board #106 May 27 11:00 AM - 12:30 PM

#### Fire Fighters Under Report Rpe During Maximal Treadmill Testing

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(No relationships reported)

**PURPOSE:** To determine if fire fighters under report their rating of perceived exertion (RPE) during VO<sub>2</sub> max testing.

**METHODS:** Maximal VO<sub>2</sub> values were determined for fire fighters (FF) (N=92) using the Bruce protocol as part of their annual health and fitness assessment. Criteria to determine if a maximal test was performed were: heart rate (HR) equal to or greater than 85% of age predicted maximum as monitored by EKG, RPE above 17, and RER values above 1.15. Completion of the test was volitional, but all FF were told that certain criteria needed to be met prior to termination in an effort to validate the test. However, they could stop at any time. HR and RER were monitored every 20 seconds throughout the test with RPE being assessed at minute two of each stage and a final RPE was assessed at the completion of the test. When criteria for HR and RER had been met, FF were told of this fact.

**RESULTS:** Forty-six FF met two criteria (HR and RER) with twenty-two additional FF meeting all 3 criteria for a total of sixty-eight. Of the remaining twenty-four FF, twenty-three met only the HR criteria and one FF didn't meet any of the criteria before terminating the test. Therefore, 67.6% of firefighters meeting physiological determinants of a VO<sub>2</sub> max test (HR and RER) under reported their RPE.

**CONCLUSIONS:** When utilizing RPE as a determinant of a valid VO<sub>2</sub> max test, caution should be used when subjects have been exposed to dangerous or high stress situations when performing job related duties. While only FF were used, similar results may be seen in police, military personnel or those working in high stress situations.

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### 1505 Board #107 May 27 11:00 AM - 12:30 PM

#### Estimation Error When Using The %HRR Method Compared To The Lactate Turn Point

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(No relationships reported)

Percent heart rate reserve (%HRR) is widely used for exercise training prescription. However, this method relies on a linear relationship between HR and exercise workload. Recently it has been shown that the HR Performance Curve (HRPC) is neither linear nor uniform in different groups of healthy subjects and patients.

**PURPOSE:** The aim of this study was to compare the target training HR of 70 and 80% HRR, and HR at the second lactate turn point (LTP<sub>2</sub>) an objective individual measure of submaximal aerobic performance.

**METHODS:** A set of data (N=186) from several groups of subjects was analyzed retrospectively. The groups consisted of young healthy males (N=60) and females (N=30) sports students, older healthy subjects (N=11), patients after myocardial infarction (N=44) and young obese male and female subjects (N=41). All subjects underwent incremental exercise tests and the first and the second lactate turn point were obtained in all subjects applying the same linear regression break point model. The degree and the direction of the HRPC were calculated by means of a second degree polynomial model ( $k_{HR}$ ). 70% and 80% HRR were calculated according to established standards. The error of estimate was calculated as  $[(HRR - HR \text{ at LTP}_2)/HR \text{ at LTP}_2] \times 100$ .

**RESULTS:** The range of error was found between -14.9% and +29.2% for 70%HRR and between -7.5% and +37.3% for 80%HRR. The error of estimate for the 70% and 80% HRR model was significantly related to the degree and the direction of the deflection of the HRPC ( $k_{HR}$ ) (70%HRR:  $r=-0.71$ ,  $p<0.001$ ; 80%HRR:  $r=-0.70$ ;  $p<0.001$ ) and %HRmax at the LTP<sub>2</sub> (70%HRR:  $r=-0.92$ ,  $p<0.001$ ; 80%HRR:  $r=-0.96$ ,  $p<0.001$ ).

**CONCLUSION:** The %HRR values underestimate most young healthy male and female subjects, however, they overestimate target training HR in patients and older subjects. The error of estimate is strongly dependent on the time course of the HRPC. The error of estimate may increase to an unacceptable level of up to 35% in subjects who generated a non regular inverted HRPC.

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**1506 Board #108 May 27 11:00 AM - 12:30 PM**  
**Does Negative Heel Shoes Alter A Person's Exercising Metabolism As Advertised**

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(No relationships reported)

**PURPOSE:** This study determined the effects negative heel (NH) shoes (3.7% negative heel design) had on walking metabolic efficiency, EMG, and gait in 17 subjects (13 male; 4 female). This abstract focuses on only the metabolic efficiency data.

**METHODS:** Each subject completed 2 trials in both the NH and standard running shoes (SR), respectively. Maximal and submaximal metabolic responses were measured comparing VO<sub>2</sub>, VCO<sub>2</sub>, RER, heart rate, substrate utilization and total steady-state energy expenditure after a 7-10 day accommodation period.

**RESULTS:** VO<sub>2</sub> max test-retest results showed exceptional reliability for each shoe (NH  $r$ -value= .97, SEE=1.1 ml,  $P$ = .0001; SR  $r$ -value= .98, SEE= 1.1ml,  $P$ = .0001). The VO<sub>2</sub> max correlation between NH and SR shoes showed a  $r$ -value=.89, SEE= 1.42ml, and  $P$ = >.0001. The VO<sub>2</sub> max results showed there were no significant differences observed, indicating equal max performances for each shoe and all trials. Steady-state VO<sub>2</sub> results indicated no significant differences between NH and SR shoes' oxygen uptake at 0% grade and 3.7% grade at 3.0 mph. These results repudiate the manufacturer's claim that NH shoes, due to 3.7% negative heel design, will increase a person's metabolic demand during walking exercise. Fat and carbohydrate (CHO) substrate utilization responses at steady state were also not significantly different between shoes when walking at 3.0 mph & either 0% or 3.7% grade. However, as expected, there were a greater total amount of kcals expended and CHO utilized when walking at 3.7 % compared to 0% grade in both shoes. Steady state heart rate results showed near significant increases while wearing NH compared to SR shoes when walking at both 0% and 3.7 % grades ( $p$  = .06) However, this may only be due to using untrained muscles not in use when walking in normal running shoes. As expected, total kcal expenditure between shoe types showed no significant differences after 20 minutes of walking at a 0% grade (NH = 258kcal; SR= 253kcal).

**CONCLUSIONS:** These results indicate negative heel shoe design did not alter a person's oxygen consumption, kcal expenditure, or substrate utilization usage (fat versus CHO) compared to standard exercise shoes as advertised by the NH shoe company.

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**1507 Board #109 May 27 11:00 AM - 12:30 PM**  
**Low Reproducibility Of Lactate Markers During Incremental Cycle Exercise**

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**PURPOSE:** Previous reports on reproducibility of lactate markers during incremental exercise have usually considered only two trials, and these predominantly in running. This study was undertaken to determine the reproducibility of power output at four different markers in a group of subjects over at least six repeated incremental cycling trials held under tightly controlled conditions.

**METHODS:** Ten subjects undertook six, and an eleventh undertook seven, repeated incremental exercises (50W start, +50W every 3-min to volitional exhaustion) on a cycle ergometer. At each trial blood lactate concentration was determined at rest and within the final 30s of each 3-min workload. The Rest+1 and 4.0 mMol.L<sup>-1</sup> markers were determined by interpolation, and the blood lactate vs. power output relationship was modelled using a quadratic function, from which the nadir (lactate minimum) and D-max markers were determined. Analyses of variance were utilised to partition inter- and intra-subject variation in power output at these markers. Intraclass correlation coefficients were evaluated to assess reproducibility. Standard calculations were performed for assessment of statistical power.

**RESULTS:** Power output at all markers differed significantly between subjects, but not between trials. Intraclass correlation coefficients were 0.799 for the Rest+1 point, 0.903 for D-max, 0.677 for the nadir, and 0.807 for the 4.0 mMol.L<sup>-1</sup> point. Standard errors of measurement were 11.9, 2.5, 9.2 and 9.1 W respectively. Corresponding pooled within-subject standard deviation estimates were 26.1, 7.9, 16.2 and 20.8 W, yielding 95% confidence intervals of width 105.2, 31.8, 65.3 and 83.8 W respectively. At a significance level of 0.05 the calculated powers of detecting a 30 W increment in these markers are 0.31, 0.98, 0.58 and 0.42 respectively.

**CONCLUSIONS:** These results suggest that during incremental cycling exercise the reproducibility of power output at lactate markers other than D-max are not as good as those previously reported for running. In addition, apart from D-max, their error margins are of such magnitude that in trained subjects only gross changes in training status can be identified with significant power.

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**1508 Board #110 May 27 11:00 AM - 12:30 PM**  
**Aerobic Capacity Testing With Sedentary Adults: Rates And Predictors Of Meeting Criteria For Valid VO<sub>2</sub>Max**

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(No relationships reported)

Maximal aerobic capacity (VO<sub>2</sub>max) testing is used in exercise interventions to establish baseline rates of cardiovascular function and as an objective measure of intervention effects. However, participants in exercise interventions are likely sedentary, and unaccustomed to pushing themselves to their maximum capacity, potentially leading to inaccurate assessments of VO<sub>2</sub>max.

**PURPOSE:** To determine rates and predictors of meeting a valid VO<sub>2</sub>max in sedentary individuals.

**METHODS:** 285 sedentary men and women participating in the Colorado STRIDE exercise intervention RCT completed a VO<sub>2</sub>max test. We tested three of the four criteria for

a valid  $\text{VO}_2\text{max}$  test: 1. Respiratory exchange ratio (RER)  $\geq 1.1$ ; 2. Achievement of age predicted maximum heart rate (HR); 3. Rating of perceived exertion (RPE)  $\geq 18$ . BMI, age, self-reported exercise frequency over the previous three months (EF3), and total minutes of at least moderate physical activity over the past week (MINWK) were examined as predictors of a valid  $\text{VO}_2\text{max}$ .

**RESULTS:** Preliminary results indicated that 50.2% of participants achieved all three criteria and 13.0% achieved one or none of the criteria tested. Age ( $OR = -1.06, p < 0.01$ ), EF3 ( $OR = -1.02, p < 0.01$ ), and MINWK ( $OR = -1.00, p = 0.03$ ) significantly predicted whether or not participants reached an RER  $\geq 1.1$ . BMI ( $OR = 0.91, p = 0.03$ ) predicted whether or not a participant reached an RPE  $\geq 18$ . There were no significant predictors of whether or not a participant came within 10bpm of age-predicted maximum HR. BMI ( $Adj. OR = -0.92, p = 0.05$ ), EF3 ( $Adj. OR = -0.34, p < 0.01$ ) and age ( $Adj. OR = 1.05, p = 0.07$ ) predicted whether or not a participant met all three criteria.

**CONCLUSIONS:** Most participants provided a valid  $\text{VO}_2\text{max}$  test. Older, less active individuals were more likely to achieve the RER threshold and to meet all three criteria. Individuals with higher BMI were more likely to achieve the RPE threshold but less likely to meet all three criteria.  $\text{VO}_2\text{max}$  testing may be particularly difficult for individuals with higher BMI, even for those that are more active. RPE may not be a good criterion for achieving a valid  $\text{VO}_2\text{max}$  in these individuals because subjectively they are experiencing greater exertion while, based on more objective physiological measures, they are not working as hard as those who have a lower BMI.

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**1509 Board #111 May 27 11:00 AM - 12:30 PM**  
**Accuracy Of The American College Of Sports Medicine Metabolic Equation For Predicting Oxygen Cost During Leg Ergometry.**

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(No relationships reported)

Measurement of submaximal oxygen consumption ( $\text{VO}_2$ ) is a pivotal part of any aerobic exercise prescription. Often,  $\text{VO}_2$  is not measured but rather estimated using different equations due to cost, required equipment and time constraints.

**PURPOSE:** To investigate the accuracy of the American College of Sports Medicine (ACSM) metabolic equation for leg cycling when compared to actual  $\text{VO}_2$  measures obtained during graded exercise testing (GXT) on a isokinetic cycle simulator with the participants own bike.

**METHODS:** Oxygen cost of cycling was obtained for 195 trained, healthy subjects (152 men; 47 women; age  $40.6 \pm 9.65$  yrs; body mass  $74.5 \pm 15.0$  kg; percent body fat  $16.7\% \pm 10.4$ ; mean  $\pm$ SD) during a GXT to exhaustion. Each GXT began with a 10-min warm-up at 100 watts (W) and utilized a continuous protocol that increased workload linearly by between 20 and 50 watts every 3-min until exhaustion (maximal workloads ranged between 200 and 450 W). During the GXT,  $\text{VO}_2$  was averaged during the last 30-sec of each stage utilizing a calibrated metabolic cart. Using the ACSM's leg cycling equation,  $\text{VO}_2$  ( $\text{ml/kg/min}$ ) =  $10.8 \times (\text{work rate in watts})/(\text{body mass}) + 7$ , an estimation for the oxygen cost of each workload was also determined. The predicted  $\text{VO}_2$  values from the equation were statistically correlated to the actual measured  $\text{VO}_2$ .

**RESULTS:** Examination of  $\text{VO}_2$  at each workload revealed a significant correlation; average measured  $\text{VO}_2$  of  $32.06 \pm 8.93$  vs. average estimated  $\text{VO}_2$  of  $32.14 \pm 8.68$ ;  $R = .932$ . The standard error of estimate for the prediction of  $\text{VO}_2$  was  $3.15 \text{ ml/kg/min}$ .

**CONCLUSION:** Based upon these findings the ACSM equation for leg ergometry is accurate for predicting  $\text{VO}_2$  over a wide range of workloads when using a isokinetic cycle ergometer.

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**A-28 Free Communication/Poster - Cold Stress Physiology**

MAY 27, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**1510 Board #112 May 27 11:00 AM - 12:30 PM**  
**Cold-induced Vasodilation At Various Water Temperature And Its Reproducibility During Cold Water Finger Immersion**

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(No relationships reported)

**PURPOSE:** Cold-induced vasodilation (CIVD) at various water temperatures was evaluated, and test-retest repeatability of the response was examined.

**METHODS:** Ten healthy collegiate men ( $21 \pm 3$  yrs,  $175 \pm 4$  cm,  $70 \pm 8$  kg,  $11 \pm 4\%$  fat) underwent two tests. At the first test (1ST), subjects repeated five cycles of a same procedure at ambient condition; 1) middle finger immersion at  $43^\circ\text{C}$  water for 5 min followed by 2) resting at ambient air for 25 min, then 3) cold water finger immersion at one of the five temperatures (5, 8, 11, 14, and  $17^\circ\text{C}$ ) at random order for 20 min. Once a cycle was completed, they immediately started the next cycle. The second test (2ND) was performed within a week after the first test with having an identical procedure except the order of water temperature. During the test, rectal temperature ( $T_{re}$ ), finger temperature from middle finger nail bed, and heart rate (HR) were measured every six second. CIVD was evaluated by the lowest ( $T_{fmin}$ ) and the highest ( $T_{fmax}$ ) temperatures recorded, the time period between min 0 and time at  $T_{fmin}$  ( $D_{tonset}$ ), time between at  $T_{fmin}$  and at  $T_{fmax}$  ( $D_{tpeak}$ ), and  $D_{tonset}$  plus  $D_{tpeak}$  ( $D_{tmax}$ ).

**RESULTS:** The urine specific gravity, HR, and  $T_{re}$  in 1ST and 2ND was  $1.021 \pm 0.004$  and  $1.022 \pm 0.004$  unit,  $70 \pm 8$  and  $71 \pm 8$  bpm, and  $37.0 \pm 0.2$  and  $37.0 \pm 0.2^\circ\text{C}$ , respectively ( $P > 0.05$ ).  $T_{fmax}$  at 1ST was  $10.2 \pm 1.0$ ,  $11.9 \pm 1.0$ ,  $13.7 \pm 1.0$ ,  $16.6 \pm 1.0$ , and  $19.3 \pm 0.8$  and at 2ND was  $9.9 \pm 1.3$ ,  $11.3 \pm 1.3$ ,  $13.7 \pm 1.2$ ,  $16.6 \pm 1.2$ , and  $18.9 \pm 0.9^\circ\text{C}$ , at 5, 8, 11, 14, and  $17^\circ\text{C}$  water, respectively. No differences were noticed in  $T_{fmax}$  in each water between 1ST and 2ND. The  $T_{fmax}$  minus water temperature was 5.2, 3.9, 2.7, 2.6, and 2.3 in 1ST and 4.9, 3.3, 2.7, 2.6, and  $1.9^\circ\text{C}$  in 2ND at 5, 8, 11, 14, and  $17^\circ\text{C}$  water, respectively. No differences were noticed in  $T_{fmin}$ ,  $D_{tonset}$ ,  $D_{tpeak}$ , and  $D_{tmax}$  at each water temperature between trials.

**CONCLUSIONS:** CIVD was highly reproducible in terms of variables tested in this study. A gradual reduction of value in  $T_{fmax}$  minus water temperature was apparent as water temperature increased.

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**1511 Board #113 May 27 11:00 AM - 12:30 PM**  
**The Effects Of Localized Cold Exposure On Proprioception**

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(No relationships reported)

Exposure to cold may lower intramuscular temperature and affect neuromuscular sensory receptors and neural pathways, possibly altering proprioception - awareness of body and limb position in space and time.

**PURPOSE:** The current study investigated effects of localized cold exposure (COLD) on three selected measures of proprioception.

**METHODS:** Using digital inclinometers, force transducers, and data acquisition system, proprioception was assessed by participant's ( $n = 8$ ) ability to actively replicate a target (actively-determined reference) angle and velocity of knee flexion and extension. Force gradation, the ability to produce a target sub-maximal isometric force (25%, 50%, or 75% maximal voluntary isometric contraction), was assessed via force transducer. All testing trials were conducted in random and repeated design and without immediate



visual or auditory feedback of performance. After establishing baseline, one leg was randomly chosen for cold exposure treatment (whole leg submersion at 5°C for 10 min) using contralateral leg as control. Posttesting followed. For each set of proprioceptive tests, constant error, absolute error, and percent error (from reference value) were calculated; percent error was used for analysis.

**RESULTS:** Two-way repeated measures ANOVA for repeated measures ( $\alpha=0.05$ ) revealed no difference for joint angle replication ( $F_{1,7} = 0.68$ ,  $p = 0.44$ ), joint velocity replication ( $F_{1,6} = 0.038$ ,  $p = 0.851$ ), or isometric grip force gradation ( $F_{1,6} = 1.31$ ,  $p = 0.295$ ).

	Control (CONT)	Cold-Exposure (COLD)
	Pre-test, Post-test	Pre-test, Post-test
Angle Replication (% error)	2.43 $\pm$ 2.15, 2.03 $\pm$ 0.88	2.27 $\pm$ 0.92, 2.01 $\pm$ 0.95
Velocity Replication (% error)	20.41 $\pm$ 15.52, 16.93 $\pm$ 10.74	18.26 $\pm$ 13.19, 22.23 $\pm$ 18.44
Grip Force Gradation (% error)	32.98 $\pm$ 5.66, 36.47 $\pm$ 14.11	31.12 $\pm$ 10.95, 38.12 $\pm$ 12.23

**CONCLUSION:** Localized lower-extremity cold exposure had no effect on ability to replicate a target joint angle, joint velocity (passively-presented reference target), or ability to scale submaximal force, as indicated by increased error.

## 1512 Board #114 May 27 11:00 AM - 12:30 PM

### Aging Augments Pressor Responses To Mild Skin Surface Cooling In Humans

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(No relationships reported)

Cardiovascular mortality increases during the cold winter months, particularly in older adults. Acute physiological responses to cold exposure, such as increases in blood pressure may contribute to these effects.

**PURPOSE:** To determine if the acute blood pressure-raising effect (pressor response) of acute non-hypothermic cold stress is augmented with age in humans.

**METHODS:** We measured acute physiological responses to skin surface cooling, induced by a water-perfused suit, in 12 young (25 $\pm$ 1 years old, mean $\pm$ SE) and 12 older (65 $\pm$ 2) adults. During cooling the temperature of the water perfusing the suit was reduced from 35 to 15-18° C for 20 min (cooling trial). During this time brachial blood pressure was measured at 2 min intervals and skin surface and sublingual temperature at 5 min intervals. Responses to a control trial in which water perfusion temperature was maintained at 35° C were also determined.

**RESULTS:** During the cooling trial skin surface temperature decreased similarly in young and older adults ( $\sim$ D-4° C) and sublingual temperature did not change in either group. Systolic, diastolic, and mean blood pressure increased during skin surface cooling (all  $P<0.05$ ) in young and older subjects although the magnitude of this response was at least 2-fold larger in older adults for systolic (D10 $\pm$ 1 vs. D26 $\pm$ 3 mmHg for young and older, respectively) and mean blood pressure (D7 $\pm$ 1 vs. D14 $\pm$ 2; both  $P<0.05$  young compared to older). Augmented pressor responses to skin surface cooling in older adults were associated with greater ( $P<0.05$ ) increases in indices of myocardial oxygen demand, such as rate-pressure product in older than in young adults. None of the measured variables changed during the control trial.

**CONCLUSIONS:** These data indicate that there is a greater pressor response to acute non-hypothermic cold stress with age in humans. This greater pressor response to cold stress results in significant increases in markers of myocardial oxygen demand in older, but not young adults. These responses may help to explain in part why cardiovascular mortality increases during the cold winter months in older adults.

Support: NIH AG24420, HL77670, M01 RR10732

## 1513 Board #115 May 27 11:00 AM - 12:30 PM

### Local Tetrahydrobiopterin Administration Augments Reflex And Tyramine-induced Cutaneous Vasoconstriction In Aged Human Skin

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(No relationships reported)

Reflex vasoconstriction (VC) is attenuated in aged skin resulting in greater heat loss during cold exposure. Reflex VC in young skin is comprised of both adrenergic ( $\sim$ 60%) and nonadrenergic (i.e. coreleased sympathetic neurotransmitters) components ( $\sim$ 40%); however, cotransmitter-mediated VC is functionally lost and responsiveness of adrenergic receptors are diminished in older subjects. Adrenergic function may be further compromised in aged skin due to depletion of an oxidant-sensitive essential cofactor for tyrosine hydroxylase, tetrahydrobiopterin (BH<sub>4</sub>), which is required for catecholamine synthesis.

**PURPOSE:** We hypothesized that local BH<sub>4</sub> supplementation would functionally augment reflex-induced and pharmacologically-induced VC elicited by gradual whole-body cooling ( $T_{sk}=30.5^{\circ}\text{C}$ ) and tyramine infusion (which displaces norepinephrine (NE) in storage vesicles), respectively.

**METHODS:** Three microdialysis (MD) fibers were placed in the forearm skin of 11 young (Y) and 11 older (O) human subjects for infusion of 1) Ringers solution (control), 2) 5 mM BH<sub>4</sub>, and 3) 5mM BH<sub>4</sub> + adrenoceptor blockade (5mM yohimbine + 1mM propranolol). Red blood cell flux (LDF) was measured by laser Doppler flowmetry over each MD site. Cutaneous vascular conductance was calculated ( $\text{CVC} = \text{LDF}/\text{MAP}$ ) and expressed as percent change from baseline ( $\text{DCVC}_{\text{base}}$ ).

**RESULTS:** VC was lower at the control site in O during cooling (Y:  $-34 \pm 2$ , O:  $-17 \pm 2\%$ ;  $\text{DCVC}_{\text{base}}$ ;  $P<0.001$ ) and tyramine infusion (Y:  $-33 \pm 4$ , O:  $-15 \pm 3\%$ ;  $\text{DCVC}_{\text{base}}$ ;  $P<0.001$ ). BH<sub>4</sub> infusion normalized VC to Y values in O during cooling (Y:  $-34 \pm 4$ , O:  $-34 \pm 2\%$ ;  $\text{DCVC}_{\text{base}}$ ;  $P<0.001$ ) and tyramine (Y:  $-38 \pm 4$ , O:  $-35 \pm 3\%$ ;  $\text{DCVC}_{\text{base}}$ ;  $P<0.001$ ), both of which were abolished with adrenoceptor blockade in aged skin ( $P<0.001$  versus control).

**CONCLUSION:** Local BH<sub>4</sub> supplementation augments reflex and tyramine-induced VC in aged skin, suggesting that reduced BH<sub>4</sub> bioavailability significantly contributes to the attenuated VC response.

Supported by NIH RO1-AG-07004-18 and the Carl V. Gisolfi Memorial Research Fund, ACSM

## 1514 Board #116 May 27 11:00 AM - 12:30 PM

### Does Hypoxia Affect Post-junctional Vasoconstrictor Responsiveness In Human Skin?

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We have previously shown that cutaneous vasoconstriction during 30 minutes of cold exposure is potentiated by hypoxia. The contributions to this response of changes in central integration and peripheral vascular responsiveness are unclear.

**PURPOSE:** To test whether post-junctional vasoconstrictor responsiveness is altered in the skin during hypoxia. We tested the hypothesis that cutaneous vascular responses to intradermal tyramine are increased during hypoxia, and this effect is at least partly explained by increased cotransmitter-mediated vasoconstriction.

**METHODS:** 6 men and 6 women had 3 microdialysis fibers placed in the ventral forearm. One fiber received lactated ringers, a second fiber received 5mM yohimbine ( $\alpha$ -adrenergic blockade), and a third received 10.5 $\mu$ M BIBP-3226 (to antagonize neuropeptide Y-Y<sub>1</sub> receptors). Skin blood flow was assessed at each site (laser-Doppler flowmetry) and cutaneous vascular conductance (CVC) was calculated (red blood cell flux/mean arterial pressure) and scaled to baseline. Vasoconstrictor responses to tyramine were tested during normoxia and steady state isocapnic hypoxia (SaO<sub>2</sub> = 80%) in random order, and trials were separated by > 90 minutes. For each infusion, 30  $\mu$ g/ml tyramine was delivered through each fiber at 4  $\mu$ l/min for 210 seconds.

**RESULTS:** During normoxia, tyramine reduced CVC by  $56.0 \pm 5.6$  and  $50.3 \pm 8.0$  % baseline in control and BIBP-3226 sites (both  $P < 0.05$  vs. pre-tyramine;  $P = 0.45$  vs. between sites) while CVC in the yohimbine site did not change ( $P = 0.40$  vs. pre-tyramine). During hypoxia, tyramine reduced CVC by  $55.9 \pm 5.1$  and  $54.2 \pm 5.4$  % baseline in control and BIBP-3226 sites (both  $P < 0.05$  vs. pre-tyramine;  $P = 0.81$  between sites) while CVC was unchanged in the yohimbine site ( $P = 0.73$  vs. pre-tyramine). Hypoxia did not affect vasoconstrictor responses at any site (all  $P > 0.05$  vs. normoxia).

**CONCLUSIONS:** Thus, tyramine does not stimulate cotransmitter-mediated vasoconstriction in human skin (at doses which match vasoconstriction observed during whole body cooling). We conclude that post-junctional  $\alpha$ -adrenergic vasoconstrictor responsiveness is not affected by hypoxia in non-acral skin, while the effect of hypoxia on cotransmitter-mediated vasoconstrictor responsiveness remains unknown.

*Supported by the Evonuk Memorial and ACSM Foundations*

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## **A-29 Free Communication/Poster - Exercise and Mental Health in Different Populations**

MAY 27, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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### **1515 Board #117 May 27 9:30 AM - 11:00 AM**

#### **Effects Of Sensory Integration Exercise Program On Cognitive Competence Of Children With Mental Retardation**

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(No relationships reported)

**PURPOSE:** To determine the effect of sensory integration exercise program on motor ability and cognitive competence of children with moderate mental retardation.

**METHODS:** Subjects were 24 children with mental retardation. The 24 children were randomly divided into two groups. One group (N=12) was an experimental group and the other group (N=12) was a control group. The experimental group performed a sensory integration exercise program 3 times a week, 40 minutes a day for 20 weeks. Before and after intervention, gross motor ability and cognitive competence for each group was measured by using the TGMD-2 (Test of Gross Motor Development) and K-WISC-III (Korean - Wechsler Intelligence Scale for Children-III), respectively. Paired t-test and independent t-test were used to examine within and between group effects using SPSS 10.0 program. The statistical significant level was at  $p < .05$ .

**RESULTS:** After 20 weeks of intervention, the experimental group significantly ( $p < .05$ ) improved scales of gross motor abilities, including locomotor skill ( $2.75 \pm 0.97$  vs.  $4.42 \pm 1.00$ ), object control skill ( $1.33 \pm 0.49$  vs.  $3.00 \pm 0.74$ ), and functional fitness ( $4.08 \pm 1.08$  vs.  $7.42 \pm 1.08$ ). The experimental group also significantly ( $p < .05$ ) improved cognitive competence, including picture completion ( $2.17 \pm 0.72$  vs.  $3.67 \pm 0.98$ ), coding ( $2.50 \pm 0.90$  vs.  $3.75 \pm 1.06$ ), picture arrangement ( $1.92 \pm 0.67$  vs.  $3.25 \pm 0.87$ ), block design ( $2.00 \pm 0.74$  vs.  $3.08 \pm 0.67$ ), object assembly ( $4.67 \pm 0.89$  vs.  $5.67 \pm 1.07$ ), symbol search ( $4.75 \pm 0.75$  vs.  $5.33 \pm 0.78$ ), and mazes search ( $1.17 \pm 0.39$  vs.  $1.67 \pm 0.65$ ). However, the control group did not change in these variables.

**CONCLUSIONS:** We found that the sensory integration exercise program improves gross motor ability and cognitive competence in children with moderate mental retardation. It suggests that the sensory integration exercise program can be very useful treatment for children with moderate mental retardation.

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### **1516 Board #118 May 27 9:30 AM - 11:00 AM**

#### **Effect Of Move Grow Learn Program On Improvements In Maladjustment Behavior In Mentally Disabled Individuals**

Young-Sung Hwang<sup>1</sup>, Jae-Sung Park<sup>2</sup>, Il-Hong Jeang<sup>1</sup>, Sang-Chul Lee<sup>1</sup>, Hyun-Woo Park<sup>3</sup>, Myung-Soo Kim<sup>4</sup>. <sup>1</sup>Pusan National University, Busan, Republic of Korea. <sup>2</sup>Yongsan University, Busan, Republic of Korea. <sup>3</sup>Chonnam National University, Gang-Ju, Republic of Korea. <sup>4</sup>Pohang University of Science and Technology, Pohang, Republic of Korea.

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(No relationships reported)

**PURPOSE:** This study was initiated to evaluate the effect of "Move Grow Learn" program on mentally disabled individuals.

**METHODS:** Thirty two mentally disabled individuals participated in this study. They were randomly divided into an experimental group (N=16) and a control group (N=16). The experimental group performed MGL (Move Grow Learn) program 60 min a day, 3 times per week for 8 weeks. The MGL program consisted of spatial movement exercise, non-spatial movement exercise, and coordination exercise. Before and after conducting MGL program, the K-WAIS (Korean Wechsler Adult Intelligence Scale) test was used to measure recognition ability and intelligence. Social adaptation was measured by Doll's Vineland Social Maturity Scale. Exercise adaptation was measured by using the Helmas automatic machine (Se woo System, Korea). Emotional adaptation was measured by EBC (Emotional Behavioral Checklist). A paired t-test and ANCOVA was carried out to analyze data and a statistical significant level was at  $p < 0.05$ .

**RESULTS:** With MGL program, the experimental group significantly ( $p < 0.05$ ) increased physical fitness, including muscular strength and endurance, flexibility, power, agility, and balance. The experimental group also significantly increased all items of recognition ability, intelligence, and social maturity. In emotional behavior, the experimental group significantly improved instigation, depression, attack, actuality, but not anxiety, socialization, and self-consciousness. The control group did not change any of these measurements.

**CONCLUSIONS:** This data indicates that "Move Grow Learn" program improves the maladjustment behavior of mentally disabled individuals, suggesting that a movement education program is very useful for them.

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### **1517 Board #119 May 27 9:30 AM - 11:00 AM**

#### **Associations Between Physical Activity And Depression By Weight Status Among U.S. Men And Women**

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**PURPOSE:** Recently the 2008 Physical Activity Guidelines for Americans concluded that physically active adults have lower risk of depression compared to inactive adults. The purpose of this study is to evaluate whether the associations between physical activity [PA] and depression are modified by body mass index [BMI] category.

**METHODS:** Depression is defined as self reported depression during the past 12 months (Yes or No). Using the 2008 Guidelines, respondents PA level was classified as: Active [A] ( $\geq 150$  minutes a week of moderate-intensity PA,  $\geq 75$  minutes a week of vigorous-intensity PA, or an equivalent combination of moderate- and vigorous-intensity PA), Insufficiently active [INSA] (some PA, but not enough to meet the active definition), and Inactive [INA] (no PA for at least 10 min/wk). BMI was classified as: Normal Weight =  $< 25$  kg/m<sup>2</sup>, Overweight =  $> 25$  -  $< 30$  kg/m<sup>2</sup>, and Obese =  $> 30$  kg/m<sup>2</sup>. Data of 21189 adults aged  $> 18$  years from the National Health Interview Survey, 2007, were analyzed. Multivariable logistic regression was used to estimate the gender-specific odds of depression by PA level stratified by BMI category.

**RESULTS:** The association between depression and PA was not significantly modified by BMI category (p-value for interaction: men,  $p = 0.30$ ; women,  $p = 0.97$ , Table 1). Overall, A and INSA women are at lower odds of depression compared to INA women (respectively, Adjusted Odds Ratio [AOR] = 0.54; 95% Confidence Interval [CI] = 0.45, 0.64 and AOR = 0.67; 95% CI = 0.56, 0.80). A and INSA men are at lower odds of depression compared to INA men [respectively, AOR = 0.48; 95% CI = 0.39, 0.59; AOR = 0.65, 95% CI = 0.50, 0.84].

**CONCLUSIONS:** Physical activity is associated with lower odds of depression among adults regardless of weight status.

Table 1. Prevalence and odds of depression with PA level by BMI category.				
PA	MEN Normal Weight		WOMEN Normal Weight	
	%	AOR* (95% CI)	%	AOR* (95% CI)
Inactive	12.8	1.00	12.9	1.00
Insufficiently Active	9.8	0.93 (0.60, 1.44)	9.2	0.76 (0.55, 1.06)
Active	6.3	0.58 (0.40, 0.84)	6.6	0.61 (0.46, 0.81)
	MEN Overweight		WOMEN Overweight	
	%	AOR* (95% CI)	%	AOR* (95% CI)
Inactive	10.1	1.00	16.0	1.00
Insufficiently Active	4.5	0.49 (0.31, 0.78)	10.1	0.70 (0.48, 1.01)
Active	4.2	0.51 (0.36, 0.73)	9.2	0.66 (0.48, 0.91)
	MEN Obese		WOMEN Obese	
	%	AOR* (95% CI)	%	AOR* (95% CI)
Inactive	14.8	1.00	27.2	1.00
Insufficiently Active	9.4	0.63 (0.41, 0.97)	18.7	0.62 (0.48, 0.80)
Active	5.5	0.38 (0.26, 0.57)	16.3	0.50 (0.37, 0.66)

\* Adjusted for age, race, education, smoking and alcohol use

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**1518 Board #120 May 27 9:30 AM - 11:00 AM**  
**Short-term Modified Tai Chi Exercise Improves Quality Of Life In Hemodialysis Patients**

Chwan-Li Shen<sup>1</sup>, Ming-Chien Chyu<sup>2</sup>, Sorot Phisitkul<sup>1</sup>, Jean-Michel Brismee<sup>1</sup>, Ke T. Xu<sup>1</sup>, Daphne Di-Fan Lo<sup>1</sup>, Sharma Prabhakar<sup>1</sup>. <sup>1</sup>Texas Tech University Health Sciences Center, Lubbock, TX. <sup>2</sup>Texas Tech University, Lubbock, TX.

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**INTRODUCTION:** Benefits of intradialytic exercise performed during outpatient hemodialysis (HD) therapy sessions have been demonstrated in End-Stage Renal Disease patients in previous studies. However, there is little evidence on the benefits of quality of life (QOL) as maintenance HD patients often show substantial reductions in QOL. Most studies used stationary cycling, strength and resistance training as modes of exercise. This is the first study that implemented an intradialytic mind-body exercise which has the advantages of requiring no equipment and little training or supervision.

**PURPOSE:** To test the feasibility and to determine the impact of an 8-week intradialytic modified Tai Chi (MTC) exercise intervention on QOL in HD patients.

**METHODS:** Maintenance HD patients ( $n=21$ , 9 females,  $52.2 \pm 12.1$  yr) were recruited from a local dialysis center and screened based on clinical criteria. All participants were encouraged to perform MTC for 1 hr within the first 2 hours of each 4-hr HD session, 3x/wk. The MTC was designed based on traditional Tai Chi for a patient to perform while sitting in a recliner with one arm connected to the dialysis machine. QOL was assessed at baseline, 4 wk, and 8 wk using the SF-36® scale. Time effects were assessed with repeated measures ANOVA.

**RESULTS:** Intradialytic MTC never caused any interference or inconvenience to hemodialysis treatment, and no adverse effect was observed or reported. Participants needed less than 3 hr to learn the exercise, and were then able to perform the exercise with complete independence following a written instruction. Three participants dropped out due to loss of interest or change of health condition unrelated to the current exercise intervention. MTC significantly improved mental health ( $P < 0.001$ ) after 4 wk and sustained to 8 wk. After 8 wk, significant improvements were observed in physical function ( $P = 0.023$ ), role-physical ( $P < 0.001$ ), vitality ( $P = 0.013$ ), and role-emotional ( $P < 0.001$ ), but no effect on bodily pain, general health, or social functioning.

**CONCLUSION:** MTC may be a feasible, low-cost, and effective exercise to improve QOL in maintenance HD patients. Our preliminary observations underscore the need for further long-term studies using larger sample size to establish the benefits of MTC in HD patients.

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**1519 Board #121 May 27 9:30 AM - 11:00 AM**  
**Effect Of A Defined In-hospital Sports Program On The Physical, Psychological And Sociological Aspects Of Patients Suffering From Cancer And Patients Suffering From Obesity**

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(No relationships reported)

**PURPOSE:** Regular physical exercise has positive effects on body composition and function as well as on mental aspects such as concentration, depression or self-esteem. The clinical course of many illnesses can also be improved by regular sports activity.

In obese patients sports activity is a crucial compound of an effective treatment. Many obese patients see their health problem as self-inflicted and consequent treatment requires

a high amount of an often lacking self-discipline.

In malignant disease, physical exercise is also an integrative part of cancer treatment. Cancer patients usually see their illness not as self-inflicted and their motivation to “fight the disease” is often very high. Because of the different motivational starting points we were interested in evaluating the effects of a defined sports program on each of the groups.

**METHODS:** In a retrospective study we asked 20 patients that completed the program to evaluate their physical, emotional, social and functional status by a quality of life questionnaire (QLQ-C30) after a course of 6 months of participation in a defined sports program. Training units consisted of 60-90 minutes 2-3 times per week.

**RESULTS:** Physical parameters throughout the course showed a constant and comparable improvement of physical performance in both groups.

However, significant differences in terms of changes in emotional, social and functional status could be detected. In obese patients the drop-out rate (64,2 %) was significantly higher than in cancer patients (14,6 %).

Patients that completed the program showed a significant improvement in the assessed global health status/quality of life, fatigue and physical function parameters in both groups. However, subgroup analysis showed highly significant improvements ( $p < 0,001$ ) only for cancer patients in role function and emotional function and significant changes in cognitive function and perception of pain or dyspnea.

In contrast, obese patients showed improvements in social function and the perception of financial problems.

**CONCLUSIONS:** Moderate physical activity as part of the therapy has an intrinsic effect on performance and quality of life for cancer and obesity patients. However, results especially concerning the psychological and sociological effects of the physical exercise differ between the two groups.

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**1520 Board #122 May 27 9:30 AM - 11:00 AM**  
**Mood Enhancement Persists For Up To 12 Hours Following Aerobic Exercise**

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(No relationships reported)

Although there is general agreement in the literature that mood is enhanced following aerobic exercise, studies have limited post exercise mood assessment to only a short period, with a majority evaluating mood for only 40-60 minutes following the exercise bout. Recommendations have been made for longer post exercise assessment periods as a way to determine optimal exercise frequency prescription for mood improvement.

**PURPOSE:** To determine the impact of aerobic exercise on mood at 1,2,4,8, 12, and 24 hours after exercise.

**METHODS:** Forty eight healthy adult men ( $n=13$ ) and women ( $n=35$ ) aged 18-25 ( $M=20.2$  yr;  $SD=3.4$ ) were randomly assigned to either control or exercise groups. Subjects completed the Profile of Mood States (POMS) before and after exercise at 60% of aerobic capacity on a cycle ergometer, or quiet rest. Additionally, all subjects completed the POMS at one, two, four, eight, twelve, and twenty four hours following either the exercise or control session. Repeated measures analysis of covariance was performed to determine the duration of mood change with  $VO_2$  Max entered as a covariate.

**RESULTS:** The exercise group showed significantly lower total mood disturbance acutely ( $F=15.408$ ,  $p=.000$ ,  $d=1.12$ ), as well as at four ( $F=6.939$ ,  $p=.011$ ,  $d=0.79$ ), eight ( $F=4.972$ ,  $p=.031$ ,  $d=0.658$ ), and twelve hours ( $F=4.481$ ,  $p=.040$ ,  $d=0.613$ ) following exercise. There were no observed differences due to gender or fitness level.

**CONCLUSIONS:** Based on this research, it is prudent to conclude that aerobic exercise improves mood acutely, and these improvements can be sustained for up to twelve hours following exercise. These results improve the ability of the practitioners in the field to prescribe exercise as a treatment modality for mood enhancement in healthy populations.

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**1521 Board #123 May 27 9:30 AM - 11:00 AM**  
**Health Behavior And Psychological Well-being Of Young Adults**

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**PURPOSE:** Healthy lifestyle and habitual physical activity (PA) are strongly and inversely related to all-cause mortality and in particular to coronary artery disease. While the impact of lifestyle on the physiological aspects is well documented in the literature, there appears to be limited attention given to the psychological health and well-being of young adults. Although stress amongst young adults has been associated with unhealthy behaviors, the nature of these relationships has yet to be clarified.

**PURPOSE:** To examine the relationship between behavioral aspects such as active lifestyle and health habits on psychological well-being amongst young adults; to explore possible differences in patterns of behavior and health habits between specific groups within the targeted population (e.g., gender, age, and ethnicity).

**METHODS:** 306 female and 104 male University students (mean =  $22.8 \pm 5.7$  yrs) from Central England completed a questionnaire that included self-report measures on health status, psychological well-being, PA, drinking and smoking habits, dietary intake and the barriers to healthy lifestyle.

**RESULTS:** Pearson's correlations revealed a significant negative relationship between PA and psychological stress ( $r = -.218$ ,  $p < .001$ ), PA and fat intake ( $r = -.138$ ,  $p = .005$ ) and PA and alcohol consumption ( $r = -.132$ ,  $p = .008$ ). Additionally, high alcohol consumption appeared to be positively associated with fat intake ( $r = .132$ ,  $p = .008$ ) and smoking behavior ( $r = .202$ ,  $p < .001$ ). Furthermore, ANCOVA revealed significant differences due to ethnicity on high intensity PA for males and females when controlling for perceived stress ( $F_{3,401} = 2.862$ ,  $p = .037$ ).

**CONCLUSIONS:** Regular PA was associated with better perceived psychological health. Those who exercised regularly reported less psychological stress, lower alcohol consumption and less fat intake. Generally, males reported significantly higher levels of PA than females across all ethnic groups with these differences being particularly marked in the South East Asian group. Improving our understanding of the factors that affect young adults' health behaviour provides much needed information for developing interventions. Hence, further studies are warranted to evaluate factors that may influence the uptake of unhealthy behaviors within this population.

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**1522 Board #124 May 27 9:30 AM - 11:00 AM**  
**Comparison Of The Cross-stressor Adaptation Between Exercisers, Athletes, And College Students To Mental Stress**

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(No relationships reported)

Sothmann and colleagues (1996) proposed that training aids the fit individual by affording a blunted cardiovascular response to stress when compared to their less fit counterparts. This phenomenon is known as the cross-stressor adaptation hypothesis.

**PURPOSE:** To examine physiological responses (i.e., cardiac and blood pressure response) to mental stressors during a 10-minute mental arithmetic challenge with noxious auditory feedback testing the cross stressor adaptation hypothesis.

**METHODS:** Cardiovascular responses were measured in a group of exercisers ( $N=35$ ), college athletes ( $N=14$ ), and non-exercising, college students ( $N=20$ ). Measures were taken at baseline, then in 2 minute intervals for the duration of the stressor. Perception of mental effort, stress, and attention were also assessed. Four subjects presented with



hypertension and were eliminated from the data analysis. Family history of cardiovascular disease, gender, perceptual measures were analyzed and were not statistically significant. Next, repeated measures ANOVAs were performed to examine the change of baseline Heart Rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) from each recording (taken every 2 minutes during the stressor).

**RESULTS:** HR, SBP, and DBP failed to significantly vary based on physical activity classification. Moreover, only the time variable was significant ( $P < 0.001$ ) for all measures except MAP.

**CONCLUSIONS:** Thus, no support was demonstrated for the cross-stressor adaptation hypothesis even though trends toward support were evident. Future studies should employ more sophisticated measures of cardiovascular function to detect changes to physiological stress response.

Means and Standard Errors Between Groups			
	Students	Athletes	Exercisers
HR	78.18±2.34	70.59±2.90	74.91±1.74
SBP	120.81±2.37	117.31±2.94	118.76±1.79
DBP	77.18±1.57	77.06±1.94	77.60±1.18
MAP	43.63±1.86	40.25±2.31	41.16±1.41

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**1523 Board #125 May 27 9:30 AM - 11:00 AM**  
**Television Viewing, Computer Use, And Sleeping Time In Relation To Depressive Symptoms Among Taiwanese Freshman**

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**PURPOSE:** To exam the effect of time spent in television watching (TV), computer use (CU) and sleeping (SL) on depressive symptoms (DS) in a college freshmen sample.

**METHODS:** Six hundred college freshmen were consented and surveyed by questionnaire and 408 valid cases (male=212, female=187, missing=9,  $20.0 \pm 3.5$  yo) were included in the study. DS was measured by the Beck Depression Inventory-II (BDI-II), and time spent in TV (min/wk), CU (min/wk) and SL (min/day) were collected by the self-administered questionnaire. Descriptive statistics and Pearson's Correlation Coefficient were used in this analysis.

**RESULTS:** Mean DS score as measured by BDI-II of the subjects was 10.3 with all subjects within normal range. The average time for TV was  $288.7 \pm 366.3$  min/wk, for CU was  $1399.3 \pm 1112.2$  min/wk and for SL was  $411.8 \pm 77.6$  min/day. There were no significant difference between sex in DS, TV, CU and SL. Also there were no significant relationships between DS and TV, and DS and CU respectively. There was, however, a significantly negative correlation between DS and SL for all subjects ( $r = -0.195, p < .05$ ).

**CONCLUSIONS:** In this study, TV and CU, as normally classified as sedentary behavior, were not related to depressive symptoms as measured by the BDI-II among the Taiwanese freshmen students. However, a significantly negative correlation was found between DS and SL indicating less sleeping time among freshmen in Taiwan may compromise their mental health. Recommendation of a more suitable sleeping time management should be encouraged to ensure psychological well-being for this young population.

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**A-30 Free Communication/Poster - Exercise Expenditure and Weight Control**

MAY 27, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**1524 Board #126 May 27 9:30 AM - 11:00 AM**  
**Validity Of Triaxial Accelerometer For Estimating Energy Expenditure In Non-athletes And Athletes**

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(No relationships reported)

**PURPOSE:** Energy requirements of athletes are dependent on daily activities as well as the practice quantity. Thus, the accurate estimation of 24-h total energy expenditure (TEE) of athletes is essential for sports nutritionists to assess energy balance. We examined the validity of a uniaxial accelerometer (ACCuni) and a newly developed triaxial accelerometer (ACCtri) for estimating 24-h TEE in non-athletes and long distance runners in comparison with doubly labeled water (DLW).

**METHODS:** A total of 15 young adults (18-34 years old) participated in this study. The TEE was measured using the DLW method over 7 and 14-day periods. The <sup>18</sup>O and <sup>2</sup>H dilution spaces and TBW were determined by dividing the dose of the tracer administered. The rate of CO<sub>2</sub> production (rCO<sub>2</sub>) was determined and TEE (kcal day<sup>-1</sup>) was calculated using a modified Weir's formula based on rCO<sub>2</sub> and the food quotient (FQ), which was calculated from the daily record of the food intake. ACCuni and ACCtri were worn were attached to an elastic belt and worn at the back of the waist for entire two weeks.

**RESULTS:** TEE estimated by ACCuni was significantly lower than TEE measure by DLW ( $2520 \pm 681$  kcal day<sup>-1</sup>) and showed wider limits of agreement. TEE estimated by ACCtri ( $2561 \pm 543$  kcal day<sup>-1</sup>) did not differ from TEE measured by DLW and showed narrower limits of agreement. No significant difference was observed between TEE estimated by ACCtri and TEE measured by DLW both in the long distance runners and non-athletes.

**CONCLUSIONS:** This study suggest the ACCtri could be applied to estimate the group mean of TEE in the long distance runners and to predict their energy requirements.

Supported by a research grant from the Ministry of Education, Culture, Sports, Science and Technology, Japan (18300218)

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**1525 Board #127 May 27 9:30 AM - 11:00 AM**  
**Validation Of The ReeVue™ And CardioCoachCo2™ Metabolic Systems For Measuring Resting Energy Expenditure**

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(No relationships reported)

**PURPOSE:** To examine the validity of the ReeVue™ (RV) and CardioCoachCO2™ (CC) metabolic systems to measure oxygen consumption by comparison to a reference

criterion, the MedicalGraphics CardiO2/CP™ (MG).

**METHODS:** Thirty subjects (10 men, 20 women;  $26.0 \pm 3.9$  years of age,  $168.5 \pm 9.6$  cm,  $66.0 \pm 11.9$  kg) completed two resting energy expenditure tests. The order of the RV and CC tests were randomly assigned. The MG system was simultaneously recorded during the RV or CC test to standardize the testing procedures. The MG mouthpiece and pneumotach were connected to the RV or CC one-way valve with disposable tubing using a rubber washer. Ten to twenty minutes of data were collected on each subject lying in a comfortable supine position before the metabolic systems (RV and CC) determined stabilization and subsequently terminated the test. One-way ANOVA ( $\alpha=0.05$ ) was utilized to compare absolute VO<sub>2</sub> values between the 3 devices and a paired t test was used to compare the two MG tests.

**RESULTS:** There were no statistical differences between the two MG tests. Therefore, MG VO<sub>2</sub> values were averaged and compared to the RV and CC. No significant differences were found between the RV ( $202 \pm 45$  mL O<sub>2</sub>/min), CC ( $209 \pm 51$  mL O<sub>2</sub>/min), and MG ( $226 \pm 57$  mL O<sub>2</sub>/min) systems.

**CONCLUSIONS:** These findings indicate that the ReeVue™ and CardioCoachCO<sub>2</sub>™ metabolic systems are comparable devices to the selected reference criterion for measuring oxygen consumption to assess resting energy expenditure.

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**1526 Board #128 May 27 9:30 AM - 11:00 AM**  
**Energy Expenditure Differences Between Running And Walking In College Aged Students**

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(No relationships reported)

According to the CDC, obesity continues to be a problem for adults and adolescents. It is important to find accessible activities that provide an opportunity for caloric expenditure. Running and walking are activities that most people can perform without great expense.

**PURPOSE:** To examine the differences between males and females on energy expenditure during a one mile walk and a one mile run.

**METHODS:** 15 males and 15 females between the ages of 18 - 30 years ( $21.90 \pm 2.52$  years) were recruited from college classes. The average height of the participants was  $168.89 \pm 11.20$  cm, the average weight was  $71.01 \pm 17.30$  kg, the average BMI was  $24.57 \pm 3.89$  kg/m<sup>2</sup>, and the average VO<sub>2max</sub> was  $41.51 \pm 6.31$  mL/kg/min. After signing an informed consent, each participant completed a VO<sub>2max</sub> test. Participants were randomly assigned to run one mile at 6 miles per hour (mph) and walk one mile at 3 mph on two separate days. Data collected included VO<sub>2max</sub>, energy expenditure (EE), and respiratory exchange ratio (RER). EE was collected for 15 minutes prior to exercise and during exercise.

**RESULTS:** There was no difference in age between males and females. Males were taller, weighed more, and had a higher maximal VO<sub>2</sub> than females. The average walk and run EE was higher for males than females (5.04, 12.86 kcal/min and 3.86, 9.66 kcal/min respectively). Total EE for running one mile was 128.6 kcal and 96.6 kcal and walking was 100.8 kcal and 77.2 kcal for males and females, respectively. Overall, the average (RER) was different for walk and run (0.89 and 0.98, respectively).

**CONCLUSION:** Fitness professionals are always attempting to identify the most effective modality to maximize energy expenditure. Running yields a greater number of kcal expended covering the same distance compared with walking in less time. At the level of EE in the current study, running at 6 mph would cause a total EE of 1,930 kcal for males and 1,458 kcal for females running 5 days a week for 30 minutes each day. Walking at 3 mph would cause a total EE of 755 kcal for males and 580 kcal for females walking 5 days a week for 30 minutes each day. Running will yield a higher caloric expenditure. During running, more of the calories expended are carbohydrates.

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**1527 Board #129 May 27 9:30 AM - 11:00 AM**  
**Effect Of A Seven-week Weight Training Course On Resting Energy Expenditure In Women**

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(No relationships reported)

Resistance training can potentially increase lean body mass which should lead to an increased resting energy expenditure (REE) and decrease the percentage of body fat.

**PURPOSE:** Our hypothesis was that students who attend an undergraduate weight training classes would have an increased REE over the period of the semester.

**METHODS:** Participants (n=12 females) college students with no previous weight training experience. Subjects participated in a seven-week resistance training program consisting of general conditioning exercises two times per week. Data collected included pre and post measures of REE, 1 rep max (1 RM) on bench press, total body weight, and percent body fat (%BF).

**RESULTS:** No significant differences were observed pre- and post-REE, 1RM, and %BF ( $1667.9 \pm 463$ ,  $1638.08 \pm 334$  kCal/day; 35.1 kg, 37.69 kg; and 27.06%, 26.55%  $\pm$  4.25 respectively).

**CONCLUSION:** The seven-week resistance training program was not of sufficient intensity or duration to observe a significant change in REE or %BF, however there was a significant difference in strength. Though researchers observed positive trends in the data, perhaps a longer training program, more subjects, or a higher intensity program would have led to a significant result REE and %BF.

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**1528 Board #130 May 27 9:30 AM - 11:00 AM**  
**Substrate Oxidation And Energy Expenditure During And After Isocaloric Exercise Bouts Of Different Intensity**

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(No relationships reported)

Physical activity contributes to reductions in body weight and body fat. Determining the optimal exercise intensity for fat reduction is important in order to design effective physical activity programs that are attractive to overweight individuals.

**PURPOSE:** To compare the effects of two different exercise intensities on fat and carbohydrate (CHO) contribution and total energy expenditure during and one hour after isocaloric exercise bouts in sedentary, healthy, overweight (BMI  $25-29.9$  kg/m<sup>2</sup>) males.

**METHODS:** In a random order, fifteen males (mean  $\pm$  SE; age:  $24.9 \pm 1.2$  y; mass:  $83.5 \pm 2.4$  kg; BMI:  $27.2 \pm 0.5$  kg/m<sup>2</sup>; VO<sub>2max</sub>:  $39.5 \pm 1.3$  mL/kg/min) volunteered to perform treadmill walking at 45% (moderate intensity) and 65% (high intensity) VO<sub>2max</sub> until they expended 300 kcal. On each occasion, exercise was followed by one hour of recovery in a seated, recumbent position. Expired gases were measured continuously during exercise and recovery, and substrate utilization was determined from the respiratory exchange ratio (RER). A two-way ANOVA with repeated measures was used to assess differences between trials and over time for both the exercise and recovery periods.

**RESULTS:** Exercise RER was significantly lower (main effect of trial,  $P < 0.05$ ) during the moderate ( $0.86 \pm 0.01$ ) than high intensity trial ( $0.92 \pm 0.01$ ). Recovery RER was similar between moderate and high intensity trials ( $0.85 \pm 0.01$  vs.  $0.84 \pm 0.01$ , respectively,  $P > 0.05$ ). Total energy expenditure during exercise was similar between trials. However, fat provided a greater energy contribution toward exercise on the moderate than high intensity trial (main effect of trial,  $P < 0.05$ ) while the reverse was true for CHO (main effect of trial,  $P < 0.05$ ). The energy contribution of fat and carbohydrate was similar during recovery, although the total energy expenditure was significantly higher

during recovery from the high than moderate intensity exercise ( $391.2 \pm 2.6$  vs.  $382.0 \pm 2.5$  kcal, respectively).

**CONCLUSION:** Sedentary, overweight males expended more calories from fat during moderate than high intensity exercise. However, total energy expenditure was greater during recovery from high intensity exercise. Training studies are needed to determine if these findings translate into differences in body composition and weight loss with long term exercise.

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**1529 Board #131 May 27 9:30 AM - 11:00 AM**  
**The Effect Of Consecutive Bouts Of Resistance Training On Resting Energy Expenditure**

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(No relationships reported)

**PURPOSE:** To investigate the influence of consecutive bouts (alternating upper and lower body) of resistance training (RT) on resting energy expenditure (REE) and the respiratory exchange ratio (RER).

**METHODS:** Eight men had REE and RER measured on 7 consecutive mornings. The mean of morning 1 and morning 2 for REE and RER represented baseline. Immediately following measurements on mornings 2 and 4, participants performed lower body RT. On mornings 3 and 5 they performed upper body RT. All workouts were performed using 6 exercises, 3 sets, at 70% of 1-repetition maximum until volitional fatigue. Finally, on days 6 and 7 REE and RER were evaluated to determine if there were any delayed responses as a result of the RT.

**RESULTS:** The coefficient of variation for baseline measures for REE (kcal/day, kcal/kg/day) and RER ( $\text{VCO}_2 / \text{VO}_2$ ) were 1.8%, 2.2%, and 2.8%, respectively. The results of a repeated measures ANOVA with a planned Bonferroni corrected t-tests are summarized in the table below (mean  $\pm$  SE).

Measure	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
kcal/day	1771 $\pm$ 77	1766 $\pm$ 69	1931 $\pm$ 72*	1859 $\pm$ 57	1899 $\pm$ 67*	1877 $\pm$ 77	1825 $\pm$ 61
kcal/kg/day	22.5 $\pm$ 9	22.4 $\pm$ 9	24.7 $\pm$ 1.3*	23.8 $\pm$ 1.2	24.2 $\pm$ 1.1*	23.9 $\pm$ 1.1	23.3 $\pm$ 1.1
RER	0.81 $\pm$ 0.02	0.81 $\pm$ 0.02	0.78 $\pm$ 0.02	0.77 $\pm$ 0.02	0.79 $\pm$ 0.03	0.80 $\pm$ 0.02	0.80 $\pm$ 0.01

\*p <0.01

**CONCLUSION:** Our findings suggest that significant elevations (~8%) in REE primarily occur the day after lower body RT. Consistent increases in REE can lead to elevated total daily energy expenditure and potentially facilitate a negative energy balance.

Supported by NSCA-GNC Nutritional Research Grant.

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**1530 Board #132 May 27 9:30 AM - 11:00 AM**  
**Comparison Of The Body Gem And The Harris Benedict Equation For Determining Resting Energy Expenditure**

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(No relationships reported)

The ability to accurately measure resting energy expenditure (REE) is essential in both the study of exercise science and human nutrition. The Harris Benedict equation (HBEq) is commonly used by nutritionists to estimate REE when developing weight loss programs. Relatively inexpensive portable indirect calorimeters for estimating REE have been developed which measure oxygen consumption but when estimating caloric expenditure rely on the Weir equation which assumes a respiratory exchange ratio of 0.85.

**PURPOSE:** to compare measurements of REE using the Body Gem (MicroLife, Dunedin, FL) and the Harris Benedict equation with measurements obtained via indirect calorimetry.

**METHODS:** Twenty-five adults (12 females: age  $26 \pm 5$  years, wt  $54.7 \pm 8.0$  kg, ht  $157.3 \pm 7.4$  cm, BMI  $22.1 \pm 3.3$ , body fat  $23.5 \pm 6.4$  %; 13 males: age  $26 \pm 4$  years, wt  $79.7 \pm 15.7$  kg, ht  $172.4 \pm 6.2$  cm, BMI  $26.7 \pm 4.4$ , body fat  $15.5 \pm 6.0$  %) were tested following a 12 hour fast. Anthropometric data were collected to estimate REE using the HBEq. Following a 30-minute rest in a semi-recumbent position, REE data were obtained via indirect calorimetry during the last 5 minutes of a 30 minute collection period. REE was then estimated for all subjects using the Body Gem portable indirect calorimeter by breathing through the device for 5-12 minutes until steady state was detected. The Body Gem was held in place by a rolled-up towel so that subjects were not required to hold the device during data collection.

**RESULTS:** Mean REE (kcal/day) for all subjects were: HBEq =  $1609.7 \pm 312.7$ , Body Gem =  $1280.5 \pm 255.9$ , Indirect calorimetry =  $1321.7 \pm 317.8$ . Mean REE (kcal/day) for males and females were: HBEq =  $1853.4 \pm 233.4$  and  $1345.7 \pm 88.1$ , Body Gem =  $1468.3 \pm 195.7$  and  $1077.1 \pm 119.2$ , Indirect calorimetry =  $1543.9 \pm 267.3$  and  $1081.0 \pm 144.4$ , respectively. REE estimated from HBEq was significantly higher compared to indirect calorimetry ( $p < 0.05$ ). No significant differences in REE were found between the Body Gem and indirect calorimetry.

**CONCLUSIONS:** The HBEq significantly overestimated REE in healthy young adults by 288 kcal/day (21.8%). The Body Gem provided valid estimates of REE and may be used as a substitute for indirect calorimetry to estimate REE in the development of weight loss programs. The HBEq should only be used when other, more accurate methods for estimating REE are not available.

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**1531 Board #133 May 27 9:30 AM - 11:00 AM**  
**Effect Of Moderate Altitude On Excess-Post Oxygen Consumption Following Maximal Exercise**

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(No relationships reported)

It has been well documented that oxygen consumption and thus energy expenditure is elevated following maximal exercise. However, no studies have examined the effect of altitude exposure on excess post-oxygen consumption (EPOC) following maximal exercise.

**PURPOSE:** To determine the effect of moderate altitude exposure on the excess post-oxygen consumption following maximal exercise.

**METHODS:** Twelve healthy, active subjects (age =  $23.7 \pm 10.1$  yrs., weight  $170.6 \pm 38.4$  lbs.) were asked to complete a graded-exercise test to exhaustion on a cycle ergometer at sea level (SL1), upon acute exposure to 3400m (ALT1), two weeks following acclimatization at 3400m (ALT2), and upon return to sea level (SL2). Workloads began at 420 kg.m/min and were increased by 420 kg.m/min for the men and 210 kg.m/min for the women and were increased every two minutes until volitional fatigue.  $\text{VO}_2$  measurements were determined via a Parvo TrueOne 2400 Metabolic Measurement System every 30 seconds during exercise and every minute after exercise until recovery to within 5% of resting  $\text{VO}_2$ . Lines of best fit were

determined for the data for each subject, and total O<sub>2</sub> consumption was calculated by integrating the equation for the line of best fit to find the total area under the curve for 10 (T10) and 20 (T20) minutes after exercise.

**RESULTS:** As expected, VO<sub>2max</sub> decreased from SL1 (3.7±0.8 L/min) to ALT1 (3.2±0.8 L/min) and remained lower at ALT2 (3.3±0.6 L/min). Also, VO<sub>2max</sub> was significantly higher at SL2 (3.8±0.8 L/min). Only T10 increased significantly ( $p<0.05$ ) during SL2 (10.3±3.1 L) relative to SL1 (8.0±1.8 L). T10 tended to increase during SL2 (10.3±3.1) relative to ALT2 (8.7±1.2), but was not statistically significant ( $p=0.09$ ). T20 did not show any significant differences.

**CONCLUSION:** The greater EPOC observed at SL2 relative to SL1 may be due to the higher VO<sub>2max</sub> values causing higher starting EPOC values. Furthermore, these data indicate that the lack of significant differences in total oxygen consumption observed at ALT1 and ALT2 could be due to the lower max VO<sub>2</sub> levels being compensated by higher resting VO<sub>2</sub> levels resulting from an altitude-induced increase in sympathetic stimulation.

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**1532 Board #134 May 27 9:30 AM - 11:00 AM**  
**Resting Energy Expenditure Of Overweight/obese And Non-obese Individuals Determined Using The Body Gem® And Oxycon Mobile®**

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(No relationships reported)

Assessment of resting energy expenditure (REE) may be useful for educating clients in weight management programs. In addition, regression equations commonly used to predict REE may not be accurate (Frankenfield et al., 2005). The BodyGem® and OxyCon Mobile® have been suggested as reliable devices to measure REE.

**PURPOSE:** To determine the repeatability of measurements of REE in individuals of various body weights and compositions, as well as to determine the reproducibility of REE using two pieces of equipment: 1) OxyCon® Mobile, a portable metabolic cart; 2) the portable handheld BodyGem®, an at-home use device.

**METHODS:** Pilot data were collected for 20 subjects; data from three subjects were excluded. Subjects were divided into Overweight/Obese ( $n=8$ ; BMI > 25 kg/m<sup>2</sup>) and Non-obese ( $n=9$ ; BMI < 25 kg/m<sup>2</sup>) groups. REE was collected for two trials for all subjects using the BodyGem® and for 10 subjects using the OxyCon®. One-way between subjects ANOVA's were calculated for demographic variables and REE. A two-way (Trial × Type of Equipment) repeated measures ANOVA was calculated for REE. Intraclass correlation coefficients (R) were used to determine reliability of REE for each type of equipment.

**RESULTS:** The Overweight/Obese group was significantly different from the Non-obese group for body weight, BMI, % body fat, hip circumference, and abdominal diameter. Group means for REE determined using the BodyGem® were not different. No significant differences were found between the REE determined by BodyGem® (Trials 1, 2: 1459 ± 276, 1469 ± 222 kcal/day;  $n=8$ ) and OxyCon® (Trials 1, 2: 1390 ± 307, 1386 ± 273 kcal/day;  $n=8$ ) [ $F(1,7) = .81, p = .398$ ]. There were no significant differences between Trials for either the BodyGem® [ $F(1,16) = 3.93, p = .06$ ] (Trials 1, 2: 1585 ± 292, 1535 ± 267 kcal/day;  $n=17$ ) or OxyCon® [ $F(1,7) = .005, p = .94$ ]. Comparison of the mean REE's for power, effect size, and R by Trial for BodyGem® and for OxyCon® were: 1- $b = 0.99, 0.95$ ;  $f = 0.48, 0.03$ ;  $R = 0.96, 0.92$ , respectively. Body weight, lean body weight, fat weight, and abdominal diameter were significantly correlated to REE from BodyGem® for each Trial ( $p < .05$ ).

**CONCLUSIONS:** REE was reproducible in individuals of varied BMI's. The "convenient to use" BodyGem® device produced comparable results to the OxyCon Mobile®.

(Supported by a Fahle Grant from the College of EDHD, BGSU)

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**1533 Board #135 May 27 9:30 AM - 11:00 AM**  
**Comparison Of Net Energy Expenditure And Steps Among Lean And Overweight Women During Walking And Jogging**

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(No relationships reported)

**PURPOSE:** To compare net energy expenditure (EE) and pedometer steps during walking and jogging in overweight and lean women.

**METHODS:** Twenty-three healthy women (20.7±1.6 y, 66.2±9.4 kg, 35.9±5.4 ml/kg/min, 24.4±3.3 kg/m<sup>2</sup>) participated in this study. Thirteen were normal weight (BMI < 25 kg/m<sup>2</sup>), ten were overweight (BMI ≥ 25 kg/m<sup>2</sup>), and all were non-smokers, not on medications affecting metabolism, and able to run 1 mile continuously at 5 mph. Each participant reported to the laboratory on 3 separate days, within a 1-week period, at the same time, under the same conditions, and with at least 1 day separating each visit. During the first visit, tests for resting metabolic rate (RMR) via indirect calorimetry, anthropometric measures, and VO<sub>2max</sub> via indirect calorimetry were determined. On the second visit, EE was assessed using indirect calorimetry during a 1-mile walk at 3 mph. On the third visit, EE was again assessed using indirect calorimetry during a 1-mile jog at 5 mph. Net EE was determined by subtracting RMR from the total EE during the 1-mile walk and 1-mile jog. During both the walk and the jog participants wore a pedometer to account for steps taken.

**RESULTS:** For the lean women, RMR was 1461±162 kcal/d and was significantly lower than the overweight women (1643±108 kcal/d). Net EE was 30% lower than total EE for the walk and 13% lower for the jog in lean women and 28% lower during the walk and 12% lower for the jog in overweight women. The net EE during the 1-mile walk was 47±5 kcal for the lean women and 59±7 kcal for the overweight women and during the 1-mile jog was 82±11 kcal for the lean women and 100±14 kcal for the overweight women. The overweight women burned more energy for both the walk and the jog compared to the lean women ( $P<0.05$ ). For both groups, pedometer steps were lower during the jog than the walk ( $P<0.05$ ); however, there were no differences in steps between groups for the walk or jog ( $P>0.05$ ).

**CONCLUSIONS:** These data indicate that there is a significant difference in EE during walking and jogging between lean and overweight women. These data may be used as a practical measure in teaching lean and overweight individuals the reality of EE during walking and jogging activities.

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**1534 Board #136 May 27 9:30 AM - 11:00 AM**  
**Energy Expenditure Of Mechanical Horse Riding And Its Measurement Reliability Among Young Adults**

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(No relationships reported)

Mechanical horse riding has been shown to improve insulin resistance in elder diabetic patients, and physical functions and body dimensions in healthy adults. Nevertheless, its energy demand appears to be relatively low and may not produce beneficial effects for cardiorespiratory fitness and weight control among younger adults.

**PURPOSE:** To study the energy expenditure (EE) and exercise intensity of mechanical horse riding and its measurement reliability.

**METHODS:** A Joba® mechanical horse (EU-6441, Panasonic, Japan), which provided forward tilt (FT), backward tilt (BT) and level (L) modes, was used at the highest operating speed (1.76 cycle·s<sup>-1</sup>). In experiment 1, first time riders exercised for 10 min either using FT (6 men and 6 women) or BT (4 men and 3 women) mode across 4 different days. Expired gas was collected every 2-min stage in Douglas bags and the last 3 stages were used to obtain intraclass reliability. In experiment 2, 15 men and 15 women ( $M \pm SD$ : age = 21.6 ± 3.8 and 21.9 ± 3.5 yr; height = 173.6 ± 8.1 and 160.1 ± 7.1 cm; weight = 69.0 ± 11.5 and 53.6 ± 5.0 kg, respectively) exercised for 10 min using all 3 modes, with 15-min rest in between and counter-balanced order. The last 6-min expired gas was collected to obtain EE. Heart rate was measured at the end of each minute. A practice session identical to the actual experiment was given to each subject at least 48 h prior to actual measurements. Maximum oxygen uptake was measured using



maximum progressive treadmill protocol. Repeated measures 2-way ANOVA was used to study gender and mode effects.

**RESULTS:** Intraclass coefficients ranged 0.82 - 0.95 with between-subject variance accounted for most of the total variance. EE of FT, BT and L were  $2.468 \pm 0.655$ ,  $2.136 \pm 0.471$ , and  $2.178 \pm 0.447$  kcal·h<sup>-1</sup>·kg<sup>-1</sup> (MET) for men; and  $2.004 \pm 0.419$ ,  $1.917 \pm 0.352$ , and  $1.863 \pm 0.375$  kcal·h<sup>-1</sup>·kg<sup>-1</sup> for women respectively. Among men, FT's EE was higher ( $P < 0.05$ ) than that of BT and L, and the later two modes had similar values. Among women, no EE differences were found among exercise modes. Gender difference occurred (men > women,  $P < 0.05$ ) in FT. Exercise intensities were 16 - 20% maximum oxygen uptake or heart rate reserve.

**CONCLUSIONS:** Energy expenditures or exercise intensities (1.9 - 2.5 MET) produced by the mechanical horse studied are in general lower than the recommended level ( $\geq 3$  MET) of physical activity.

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**1535 Board #137 May 27 9:30 AM - 11:00 AM**

**Energy Expenditure In Severe Obesity**

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*(No relationships reported)*

Obesity can be caused by an energy imbalance created by a high energy intake and/or low energy expenditure (EE). However, both resting EE (REE) and total daily EE (TDEE) have been shown to be higher in obesity. It is not clear to what extent the higher TDEE is due to resting and activity-related components, particularly in severe (Class II and III) obesity.

**PURPOSE:** The primary purpose of this study was to characterize TDEE, REE and active EE (AEE) in severe obesity. A second objective was to determine whether a wearable activity monitor (SenseWear Pro 3, BodyMedia, Pittsburgh, PA) can provide reasonably accurate estimates of EE compared to the criterion method of doubly labeled water (DLW) in severely obese.

**METHODS:** 62 Class II and Class III obese (BMI =  $42.7 \pm 5.2$  kg/m<sup>2</sup>, total body fat =  $58.5 \pm 10.4\%$ ), adult (45  $\pm$  7 yr) males (n=6) and females (n=57) completed assessments for body composition by dual x-ray absorptiometry or air-displacement plethysmography, REE by indirect calorimetry, TDEE by DLW (TDEE-D), and TDEE and AEE by activity monitor (TDEE-M and AEE-M, respectively).

**RESULTS:** TDEE-D was on average high ( $3235 \pm 520$  kcal/day) in accord with these subjects' high fat free mass, and was highly correlated ( $R^2 = 0.47$ ,  $P < 0.01$ ) with TDEE-M ( $3130 \pm 587$  kcal/day). In addition to the high REE ( $1823 \pm 315$  kcal/day), these severely obese subjects also had, on average, high AEE-M ( $813 \pm 586$  kcal/day).

**CONCLUSIONS:** Severe obesity is characterized by both high REE and, somewhat paradoxically, high AEE. In addition, innovative wearable activity monitors provided reasonably good estimates of TDEE and AEE compared to DLW methodology in this population. Further studies are needed to address the effects of structured physical activity and weight loss on energy expenditure in severe obesity.

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**1536 Board #138 May 27 9:30 AM - 11:00 AM**

**Energy Availability And Menstrual Regularity In African Black Female Runners**

Hattie Wright, Judy Prinsloo, Hans de Ridder, Szabolcs Peter. *North-West University, Potchefstroom, South Africa.* (Sponsor: South African Sugar Association, FACSM)

*(No relationships reported)*

**PURPOSE:** Endurance female athletes are at risk of having low energy availability which can have detrimental effects on their health and performance. It is also linked with exercise-induced menstrual dysfunction and disordered eating, collectively referred to as the female athlete Triad. Research regarding the prevalence of these components amongst black South African female athletes is limited. Method: Thirty two (n=32) recreational competitive black South African female distance runners, between the ages of 15 and 40 years (mean age:  $21.44 \pm 6.69$ ), were selected on the basis of availability. Two 24-hour dietary recalls were completed for each athlete to assess mean daily energy intakes, Actical® physical activity monitors measured daily and exercise energy expenditure, the Bod Pod® measured body composition, and menstrual irregularity was assessed with a questionnaire compiled from reviewed literature. Risk for disordered eating was assessed via the EAT-26 questionnaire.

**RESULTS:** Mean energy availability for the group was  $124.16 \pm 94.93$  kJ/kg LBM/day, even though 11 of the athletes were below the recommended daily energy availability to ensure menstrual health. Four of the thirty two athletes (12.5%) reported menstrual irregularities. 40.6% reported risk for disordered eating via the EAT-26 questionnaire. In the total group two athletes presented with low energy availability and irregular menstrual function while five presented with low energy availability and a high risk for disordered eating.

**CONCLUSION:** This group of black female athletes are at risk to develop the Triad since some already present with early stages of one or more components. .

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**1537 Board #139 May 27 9:30 AM - 11:00 AM**

**Balance: Bioengineering Approaches For Lifestyle Activity And Nutrition Continuous Engagement**

Deonna C. Hughes, Adrienne Andrew, Rohit Chaudhri, Tamara Denning, Carl Hartung, Philip Hurvitz, Jonathan Lester, Shirley Beresford, Gaetano Borriello, Barbara Bruemmer, Anne Vernez Moudon, Glen E. Duncan. *University of Washington, Seattle, WA.*

*(No relationships reported)*

New and innovative approaches are required to address the global obesity epidemic. Methods to accurately measure energy intake, expenditure, and balance to facilitate weight loss or maintenance goals represent important scientific needs.

**PURPOSE:** To create a practical, pervasive platform that provides users with a visualization of daily energy balance in "real-time".

**METHODS:** Using a list of design goals developed and refined over several months, we built a prototype food diary with energy balance visualization on a cell phone and integrated it with our multi-sensor board (MSB) via wireless connection. The MSB uses a decision stumps classifier and Hidden Markov Models to infer activities, and the ACSM prediction equation and user's body weight to estimate energy expenditure based on the classified activity.

**RESULTS:** The software is comprised of 3 major components: a food diary to enter amounts and types of foods and beverages consumed using the USDA database; an activity diary to manually enter intentional activity not classified by the MSB (e.g., water-based activities); and, the BALANCE visualization, which computes and displays the difference between energy intake from electronic food entry and expenditure from the MSB (accuracy for estimated energy expenditure is about 90%) and activity diary. Basal energy expenditure is "credited" to the user every hour using the Harris-Benedict formula.

**CONCLUSION:** We developed a cutting-edge tool to help people achieve weight-related goals that users will find both attractive and harmonious with their daily lives. In addition, using GIS we assembled an up-to-date dataset of the greater Seattle area to describe locations associated with physical activity and eating episodes. The data is being integrated with Google Maps to provide users with a visual display of food sources and their classification, and locations associated with physical activity, within the user's proximal environment. Thus, our tool will capture peoples' movement through space and time under free-living conditions and conveniently assist in the monitoring of food intake. This work could lead to numerous applications, for example, use as a personal assistive device to monitor energy balance and facilitate behavior changes favorable to weight loss.

*Supported by R21AG032232.*

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**1538 Board #140 May 27 9:30 AM - 11:00 AM**  
**Nutrition And Exercise Lifestyle Intervention Program (NELIP) Prevents Excessive Pregnancy Weight Gain In Overweight Women.**

Michelle F. Mottola, FACSM<sup>1</sup>, Maggie M. Sopper<sup>1</sup>, Margie H. Davenport<sup>1</sup>, Kristen Brandao<sup>1</sup>, Isabelle Giroux<sup>2</sup>. <sup>1</sup>University of Western Ontario, London, ON, Canada. <sup>2</sup>Brescia University College, London, ON, Canada.

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(No relationships reported)

Excessive pregnancy weight gain and weight retention in the postpartum period have been linked to obesity and chronic disease risk.

**PURPOSE:** To determine the effect of a Nutrition and Exercise Lifestyle Intervention Program (NELIP) for overweight and obese women on pregnancy weight gain, offspring birth weight and maternal weight retention at 2 months postpartum.

**METHODS:** Case-control matched design by pre-pregnant body mass index (BMI), age, and parity; 4 controls per case. Cases had a pre-pregnancy BMI of  $\geq 25.0$  kg/m<sup>2</sup> (N=65) and participated in a NELIP starting at 16-20 weeks of pregnancy, continuing until delivery. NELIP consisted of an individualized nutrition plan with total energy intake of approximately 2000 kcal/day (8360 kJ/day), and 40 - 55% of total energy intake from carbohydrate. Exercise consisted of a walking program (30% heart rate reserve), 3 - 4 times per week, using a pedometer to count steps. The Matched Cohort (MC; N=260) was from a large local perinatal database.

**RESULTS:** Weight gained by women on the NELIP was  $6.8 \pm 4.1$  kg ( $0.38 \pm 0.2$  kg/week), with a total pregnancy weight gain of  $12.0 \pm 5.7$  kg. Excessive weight gain occurred before NELIP began at 16 weeks gestation. Eighty percent of the women did not exceed recommended pregnancy weight gain on NELIP. Weight retention at 2 months postpartum was less compared to weight retention between pregnancies in the MC ( $2.2 \pm 5.6$  kg vs  $4.2 \pm 7.9$  kg; respectively,  $p < 0.05$ ). Mean birth weight was not different between groups ( $3.59 \pm 0.5$  kg vs  $3.56 \pm 0.6$  kg, respectively).

**CONCLUSIONS:** NELIP prevented excessive pregnancy weight gain with minimal weight retention at 2 months postpartum in overweight and obese women. This intervention may assist overweight and obese women in successful weight control after childbirth.

Funded by: CIHR-IAPH

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**1539 Board #141 May 27 9:30 AM - 11:00 AM**  
**The Association Between Soft Drink Consumption And Adiposity In Young Females**

Megan Costello, Kate A. Heelan, Deborah Mowry. *University of Nebraska - Kearney, Kearney, NE.*

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(No relationships reported)

Soft drink consumption (SDC) has increased since the 1960's surpassing all other kinds of beverage consumption. The increasing amount of SDC has been linked to the rising epidemic of obesity in children and postmenopausal women, however, it is unclear the quantity of SDC in college females and the impact it has on adiposity.

**PURPOSE:** The purpose of this study was to determine the quantity of SDC and the association between SDC and adiposity in young women, ages 16-24 years.

**METHODS:** Sixty-six female participants (age:  $19.86 \pm 2.13$  yrs, BMI:  $23.5 \pm 4.29$  kg·m<sup>-2</sup>) were asked to complete a 3-day food record and an assessment of body composition by dual-energy x-ray absorptiometry (DXA). Participants were compared based on SDC greater or less than 32 fl oz/day.

**RESULTS:** On average, participants consumed  $29.44 \pm 44.68$  fl oz/day of soft drinks and body fat (BF%) was  $33.2 \pm 8.53\%$ . Although modest, a significant association between SDC and adiposity ( $r=0.244$ ,  $p < 0.05$ ) was apparent. Comparisons between groups are seen in Table 1 (\*  $p < 0.05$ ).

**CONCLUSION:** It appears that SDC is associated with adiposity in college-aged females and high levels of SDC may significantly impact BF%. The increase in simple sugar consumption may be a significant contributor to the obesity epidemic due to its low satiety levels, and low caloric value. 38% of our population's soft drink consumption was > 32 fl oz per day suggesting moderation of SDC is a necessary public health promotion in this age group.

Table 1.			
Group	N	Soda Consumption (fl. oz.)	BF%
SDC <32 fl oz/d	41	$6.05 \pm 9.19$	$31.35 \pm 7.81$
SDC >32 fl oz/d	25	$67.8 \pm 52.91^*$	$36.24 \pm 8.94^*$

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**1540 Board #142 May 27 9:30 AM - 11:00 AM**  
**Relationship Between Sleep Time And Markers Of Obesity In Young Women**

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(No relationships reported)

Sleep may play an important role in human metabolism. Previous research has suggested an association between sleep time and obesity, with both sleep loss and sleep excess associated with increased risk of obesity.

**PURPOSE:** The purpose of this study was to examine the relationship between sleep time and markers of adiposity.

**METHODS:** Young (25-40 y) normal weight (BMI  $22.2 \pm 1.8$  kg/m<sup>2</sup>; n=28), overweight (BMI  $27.2 \pm 1.4$  kg/m<sup>2</sup>; n=22), and obese (BMI  $34.4 \pm 2.7$  kg/m<sup>2</sup>; n=27) women were recruited for the study. Height, weight, waist circumference, and body composition (dual energy x-ray absorptiometry) were determined for each participant. Participants kept a 7-day log reporting time to bed and time awake. Sleep (minutes/day) and awake (minutes/day) times were calculated for each day and a 7-day average was computed. One-way analysis of variance compared descriptive variables for each BMI category. Partial correlations (controlling for age) examined the relationship between sleep time (minutes/day) and markers of adiposity.

**RESULTS:** Markers of adiposity increased significantly in a stepwise fashion for each BMI category (waist circumference [cm]: normal weight  $77 \pm 7$ , overweight  $92 \pm 6$ , obese  $105 \pm 9$  [ $p < 0.01$ ]; body fat [%]: normal weight  $32 \pm 6$ , overweight  $41 \pm 6$ , obese  $48 \pm 4$  [ $p < 0.01$ ]; trunk fat [%]: normal weight  $31 \pm 7$ , overweight  $41 \pm 5$ , obese  $48 \pm 3$  [ $p < 0.01$ ]). The normal weight, overweight, and obese women reported sleeping for  $474 \pm 44$ ,  $498 \pm 52$ , and  $498 \pm 70$  minutes, respectively [ $p = 0.22$ ]. Using partial correlations (controlling for age), time (minutes/day) spent sleeping was positively associated with waist circumference ( $r = 0.21$ ;  $p = 0.04$ ) and trunk fat ( $r = 0.20$ ;  $p = 0.04$ ). No relationship was seen between sleep time and body weight, total body fat, or leg fat.

**CONCLUSIONS:** In this study, more time spent sleeping was associated with unfavorable markers of adiposity in young women.

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**1541 Board #143 May 27 9:30 AM - 11:00 AM**

## Effect Of Physical Exercise On Risk Factors For Chronic Diseases In Obese Women.

Silvia -V. S. Rocca, Sandra M. L. Ribeiro, Camila M. Melo, Julio Tiraepgui. *University of São Paulo, São Paulo, Brazil.*

(No relationships reported)

Obesity is associated with an increased risk for developing chronic diseases. The weight loss and body fat reduction, decrease the mortality and control these diseases. Exercise is one of the strategies used for the treatment of obesity by oxidize fat, increasing energy expenditure and mitigating the loss of lean body mass.

**PURPOSE:** Evaluate the effects of physical exercise on body weight reduction.

**METHODS:** For 12 weeks, 22 obese women (BMI>30 kg/m<sup>2</sup>) were submitted to a physical exercise program. At the beginning and at the end of the program were evaluated: BMI, waist (WC) and hip circumferences (HC), and waist-hip ratio (WHR); body composition by DEXA; total cholesterol, HDL-c, LDL-c, triacylglycerol and blood glucose; aerobic power.

**RESULTS:** At the end of the program, aerobic power values were significantly increased (VO<sub>2</sub>max. 19.8 ± 3.5 to 23.0 ± 4.3 ml/kg/min, p<0.05), confirming the physical training effects. Related to anthropometric values, only the visceral fat was reduced (WC 103.17 ± 9.89 to 99.38 ± 9.68cm and WHR 0.84±0.08 to 0.82 ± 0.07, p<0.05). Concerning to biochemical variables a meaningful increase in HDL-c (39.47 ± 9.56 to 43.40 ± 10.05 mg/dl, p<0.05) and significant decrease in blood glucose (100.15 ± 18.02 to 93.73 ± 14.54 mg/dl, p<0.05).

**CONCLUSIONS:** Exercise proves to be an important support in the body weight loss program, not necessarily promoting body weight loss, but lowering risk factors to develop chronic diseases.

Thanks FAPESP- Brazil- for the financial support.

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### 1542 Board #144 May 27 9:30 AM - 11:00 AM

#### Relationships Of Physical Activity Level With Obesity And Fitness In Children

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(No relationships reported)

It has long been indicated in Japan that improvements in physique of children are not associated with improvements in exercise abilities or fitness, and increases in obesity and metabolic syndrome in children have recently been reported. Physical changes in children are considered to be markedly affected by lifestyle, particularly diet and exercise.

**PURPOSE:** The effects of the physical activity level on obesity and exercise abilities were evaluated in elementary schoolchildren.

**METHODS:** The subjects were 334 3rd-5th graders (162 males and 172 females) at an elementary school that covers a wide district. In the survey, 1) the height, body weight, and BMI were determined; 2) the physical activity level was evaluated by measuring the daily number of walking steps, total energy expenditure, and energy expenditure by exercise using an accelerometer (Select2, Kenz) on 3 weekdays; 3) the state of exercising in extracurricular sports activities and time spent in going to and coming from school were investigated using a self-administered questionnaire; and 4) exercise abilities were evaluated using new sports tests by the Ministry of Education, Culture, Sports, Science and Technology.

**RESULTS:** 1) The BMI of the subjects was lower than the national average, and the percentage of obese children was low. 2) The number of walking steps was 16,000-20,000 in boys and 15,000-18,000 in girls, being considerably higher than the average in elementary schoolchildren in Kyoto City (about 14,000 in boys, about 11,000 in girls). 3) A significant correlation (r= about 0.6) was observed between the number of walking steps and time spent in going to and coming from school. 4) No significant correlation was noted between the activity level and exercise abilities. 5) Exercise abilities were significantly higher in those who participated in extracurricular sports activities than in those who did not, and the difference widened as the grade advanced.

**CONCLUSIONS:** The low percentage of obese children at this elementary school is considered to be related to the high number of walking steps. However, as fitness and exercise abilities were more closely related to sports activities than the number of walking steps, stimulation by sports is considered necessary for improving exercise abilities in elementary schoolchildren.

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### 1543 Board #145 May 27 9:30 AM - 11:00 AM

#### A Multidisciplinary School Intervention To Improve Nutritional Knowledge, Increase Physical Activity, And Reduce Body Mass

Wendy M. Miller, Silvia Veri, Peter A. McCullough, Barry A. Franklin, FACSM. *William Beaumont Hospital, Royal Oak, MI.*

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(No relationships reported)

Assessment of community interventions aimed at preventing and treating childhood obesity are greatly needed given the escalating prevalence of obesity. Successful interventions can, over time, be widely disseminated to halt or reverse current obesity trends.

**PURPOSE:** Evaluate the impact of a multidisciplinary 12-week school intervention that included two interactive educational sessions with a registered dietitian and bi-weekly physical activity sessions lead by creative movement dancers. Physical activity sessions included instruction and reinforcement of healthy lifestyle habits.

**METHODS:** Body mass index (BMI) was measured and questionnaires were administered at baseline to 77 intervention participants at a suburban public school. Follow-up surveys were completed after the 12-week intervention and follow-up BMI was measured 1 year after the baseline evaluation.

**RESULTS:** Mean age was 9.6 ± 1.0 years and 52% were male. Baseline BMI was 19.5 ± 4.3 kg/m<sup>2</sup>, with a BMI z-score of 0.8 ± 1.0 and a BMI percentile of 70.0 ± 26.3%. Over one-third of the children (38%) were either overweight or obese with a BMI percentile at or above 85%, and 19% were obese with a BMI percentile at or above 95%. There was significant improvement in post-program nutritional knowledge compared with baseline, with correct responses to food group questions of 100% vs. 78%, p<0.001, for the fruit group, 89% vs. 66%, p=0.006, for the vegetable group, and 94% vs. 75%, p=0.008, for the milk group, respectively. The majority of parents, 74%, reported an increase in their child's physical activity level during the program. There was a significant reduction in BMI at 1-year among overweight/obese children with a decrease in mean BMI z-score from 1.7 to 1.4, p=0.03, and a decrease in BMI percentile from 94.0% to 83.5%, p=0.02.

**CONCLUSIONS:** A 12-week multidisciplinary school intervention was associated with improved nutritional knowledge and reported physical activity levels, as well as a reduction in BMI among overweight children at 1 year follow-up. Further evaluation of this type of intervention, including a randomized-controlled trial and long-term studies, is warranted.

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### 1544 Board #146 May 27 9:30 AM - 11:00 AM

#### Effect Of Bmi On Acute Affective Responses During Treadmill Exercise Based On The Ventilatory Threshold

Hassan M. Elsangedy<sup>1</sup>, Cosme F. Buzzachera<sup>2</sup>, Kleverton Krinski<sup>1</sup>, Heriberto Colombo<sup>1</sup>, Bruno V. Santos<sup>1</sup>, Maressa P. Krause<sup>3</sup>, Luke Haile<sup>3</sup>, Wagner Campos<sup>1</sup>, Sergio G. DaSilva<sup>1</sup>, Fredric L. Goss, FACSM<sup>3</sup>. <sup>1</sup>Federal University of Parana, Curitiba, Brazil. <sup>2</sup>University of Rome, Rome, Italy. <sup>3</sup>University of Pittsburgh, Pittsburgh, PA.

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(No relationships reported)

Affect has been investigated as a determinant of attendance and adherence in exercise programs. Exercise at intensities below the ventilatory threshold (VT) is typically

associated with a more pleasurable experience than exercise above the VT. Previously, normal and overweight adults have been shown to have similar affective responses (AR) when exercising at intensities above the VT. However, this relation between affective responses and the VT has not been examined in obese subjects.

**PURPOSE:** To compare acute affective responses during treadmill exercise intensities based on the VT between normal-weight (BMI: 18.5 - 24.9 kg·m<sup>-2</sup>), overweight (BMI: 25.0 - 29.9 kg·m<sup>-2</sup>) and obese (BMI: ≥30.0 kg·m<sup>-2</sup>) women.

**METHODS:** Each BMI group had 22 subjects. Participants performed an incremental treadmill test until the point of volitional exhaustion to determine VO<sub>2max</sub>. Oxygen uptake (VO<sub>2</sub>) was measured continuously, and affective responses (Feeling Scale, Hardy & Rejeski, 1989) were recorded every minute. The VT was determined using the ventilatory equivalent method. Three intensities based on the VT were determined: 10% below (-)VO<sub>2VT</sub>, VO<sub>2VT</sub>, and 10% above (+)VO<sub>2VT</sub>. One-way ANOVA was used to compare AR obtained at each intensity ((-)VO<sub>2VT</sub>, VO<sub>2VT</sub>, (+)VO<sub>2VT</sub>) between BMI groups.

**RESULTS:** Relative (-)VO<sub>2VT</sub>, VO<sub>2VT</sub>, or (+)VO<sub>2VT</sub> did not differ between BMI groups. The obese group had a lower (p<0.05) AR associated with VO<sub>2VT</sub> and (+)VO<sub>2VT</sub> (0.5±0.85 and -1.95±2.36) than the normal-weight (2.50±1.79 and 1.18±2.50) and overweight groups (1.77±1.27 and 0.91±1.13). No other differences in AR were noted between BMI groups.

**CONCLUSION:** The relative exercise intensities (%VO<sub>2max</sub>) examined presently were similar between groups. However, the obese group had a lower AR, compared to the other two groups at VO<sub>2VT</sub> and (+)VO<sub>2VT</sub>. This corresponds to an unpleasurable experience during moderate to intense exercise. There may be underlying physiological and psychological mechanisms in obese, previously sedentary women that mediate this affective response.

**1545 Board #147 May 27 9:30 AM - 11:00 AM**  
**Bmi, Nutrition Habits And Physical Activity Levels In Freshmen And Senior Medical Students**

John Duperly<sup>1</sup>, Carolina Donado<sup>1</sup>, Vanessa Collazos<sup>1</sup>, Felipe Lobelo<sup>2</sup>, Deisy Herrera<sup>1</sup>, Carolina Segura<sup>3</sup>, Olga Lucia Sarmiento<sup>1</sup>, Erika Frank<sup>3</sup>.

<sup>1</sup>Universidad de los Andes - Fundación Santa Fe de Bogotá, BOGOTÁ, Colombia. <sup>2</sup>Division of Nutrition, Physical Activity and Obesity CDC-WHO Collaborating Center for Physical Activity and Health Promotion, Atlanta, GA. <sup>3</sup>University of British Columbia, Vancouver, BC, Canada. (Sponsor: Michael Pratt, FACSM)

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(No relationships reported)

**PURPOSE:** An increasing prevalence of overweight and obesity in young people has been widely reported in the literature. However, there is little information regarding obesity and its risk factors available for medical students, individuals whose habits and BMIs may affect the whole population through role modeling, and effects on counseling. The purpose of the study was to evaluate the prevalence of overweight and obesity, mean PA levels and related nutrition habits of freshman and senior Colombian medical students (MS)

**METHODS:** A cross-sectional survey of a representative sample of Colombian MS from 24 schools from first (n=1322) and fifth (n=844) year was conducted during 2007. The survey used an electronic, web-based, culturally-adapted Spanish version of the "Healthy doc=healthy patient" survey (response rate= 74.6%).

**RESULTS:** Obesity and overweight were significantly higher in fifth than in first year for men (4.3% vs 0.7%, p=0.01; and 25.1% vs 13.8%; p<0.01) and was significantly higher for obesity but not for overweight in women (2.0% vs 0.9%, p=0.1; and 9.1% vs 9.4%; p=0.9). Daily number of standardized servings of fast food (2.2 vs 2.0, p=0.2), carbohydrates (6.3 vs 5.8, p=0.06), soft drinks servings (0.8 vs 1.0, p=0.01) and fruit and vegetables (2.4 vs 2.4, p=0.8) was not meaningfully different between first and fifth year for men or women (1.7 vs 1.6, p=0.2; 4.1 vs 4.7, p<0.01; 0.5 vs 0.5, p=0.3; 2.7 vs 2.8, p=0.4). Number of portions was higher in men than in women, both in first (11.9 vs 9.1; p<0.01) and fifth year (11.4 vs 9.7; p<0.01). On the other hand, mean reported minutes of moderate or vigorous PA was significantly lower in fifth than in first year, both for men (183 vs 212, p<0.05; 108 vs 180, p<0.01) and women (144 vs 181, p=0.01; 59 vs 97, p<0.01).

**CONCLUSIONS:** The study shows a significant higher prevalence of obesity in fifth year compared to first year MS. Although estimation of caloric intake did not show important differences, we found a significantly lower prevalence of moderate and vigorous PA for fifth year. To what extent these PA findings contribute to the higher obesity prevalence in last year MS need to be further evaluated with longitudinal studies.

**1546 Board #148 May 27 9:30 AM - 11:00 AM**  
**Frequency Of Exercise For Body Fat Loss: A Controlled, Cohort Study**

F B. Willis<sup>1</sup>, Forest M. Smith<sup>2</sup>, Adele P. Willis<sup>3</sup>. <sup>1</sup>Texas State University and Dynasplint Systems, Austin, TX. <sup>2</sup>Smith Pediatrics, San Antonio, TX. <sup>3</sup>St David's Hospital, South Austin, Austin, TX.

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(No relationships reported)

The purpose of this study is to examine the changes in body fat mass of previously sedentary, de-conditioned subjects who began following the US Surgeon General's recommendation in frequency of exercise.

**METHODS:** Ninety subjects of both genders were recruited; ages ranged from 22 to 74, (mean = 37.5±13). Subjects were prescribed exercise of four times a week, 30 minutes of continuous exercise, for eight weeks. Eighty subjects completed the eight week study and were categorized based on voluntary compliance: Control (no exercise); Exercise < 2 times/week; Exercise 3-4 times/week; Exercise ≥ 4 times/week. Body Fat mass was the dependent variable in this study, as measured by air displacement plethysmography, and data analysis was accomplished with a repeated measures analysis of variance.

**RESULTS:** There was a significant change in body fat mass in this study, but the only significant difference between groups was for the group that exercised ≥ 4 times/week, (P = 0.004).

**CONCLUSION:** Voluntary compliance was used instead of randomization to reflect actual compliance in prescribed clinical exercise. Adherence to the US Surgeon General's Guidelines for frequency of exercising four times per week for 30 minutes was effective in reducing subjects' body fat mass in this study.

Results By Category of Compliance								
8 week tests	Initial	Final	Initial	Final	Initial	Final	Initial	Final
GROUP	Control (zero exercise)	Control (zero exercise)	Trains < 2 times/week	Trains < 2 times/week	Trains 2-3 times/week	Trains 2-3 times/week	Trains ≥ 4/wk	Trains ≥ 4/wk
Mean Pounds of FAT	64.4lbs	65.6lbs	49.4lbs	44.4lbs	59.3lbs	55.3lbs	58.4lbs	45.1lbs
SD	27.3	27.9	20.1	19.6	27.8	27.2	15.5	12.2
SEM	6.1	6.0	4.5	4.3	6.2	6.1	3.4	2.7
N	20	20	20	20	20	20	20	20
Change in FAT		+ 1.2lbs		- 4.7lbs		- 4.0lbs		- 13.3lbs



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## A-31 Free Communication/Poster - *Military Science*

MAY 27, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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### 1547 Board #149 May 27 11:00 AM - 12:30 PM The Effect Of Exercise Volume On The Performance Of Student Military Aviators

Martin R. Wright. *University of West Florida, Pensacola, FL* (Sponsor: Dr. Ludmila Cosio-Lima, FACSM)  
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(No relationships reported)

The future helicopter pilots of the Navy and Marine Corps undertake an extremely rigorous six months of advanced helicopter training prior to earning their wings and the designation of Naval Aviator. With varying personal exercise regimens among the students, it is unclear whether the volume of exercise influences the overall performance of a student military aviator (SMA).

**PURPOSE:** To determine whether exercise volume is related to academic and aviation performance during advanced flight school.

**METHODS:** 69 healthy SMAs (62 male, 7 female) from four different classes (1, 2, 3, and 4) voluntarily completed exercise questionnaires at the conclusion of their flight school syllabus. The data was matched with the SMAs' Naval Standard Score (NSS) which measures their performance against the peers within their class. The data was analyzed using SPSS.

**RESULTS:** 47.8 % of the SMAs reported working out 2-3 times/ wk, and 42 % of the SMAs reported working out 3-5 hrs/wk. 55.1 % of the SMAs did resistance training once or less per wk. The same percentage of SMAs also reported doing 2-3 cardio workouts per wk. A Pearson correlation coefficient was calculated for each class examining the relationship between NSS and actual hours of workout per wk. For class 1 and 3, a negative non significant correlation was found: class 1,  $r(18) = -.062$ ,  $p > .05$  and (class 3,  $r(12) = -.180$ ,  $p > .05$ ). For class 2, a non significant relationship was found ( $r(17) = .007$ ,  $p > .05$ ). Finally, a significant negative relationship was found for class 4 ( $r(14) = -.683$ ,  $p < .01$ ).

**CONCLUSION:** Exercise volume is not related to performance as measured by NSS of SMAs in advanced rotary flight school. A future study which examines a larger sample size and utilizes a measurement of performance that can be standardized over the entire population of flight school graduates is recommended (not NSS). Additionally, the daily recording of an SMA's workout time and study time throughout the syllabus is recommended instead of a questionnaire at the completion of training.

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### 1548 Board #150 May 27 11:00 AM - 12:30 PM Gender Differences In Preparatory Exercise Training Among Marine Recruits

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(No relationships reported)

Stress fractures are a problem in military and athletic populations, particularly among women. While poor aerobic fitness levels have been associated with increased stress fracture risk in military populations, recent research suggests that lower extremity weight training may be protective. Understanding physical preparations performed by incoming Marine Corps recruits may help explain the gender difference in stress fracture occurrence during basic training.

**PURPOSE:** The objectives of this study were to (1) assess the frequency of aerobic and weight training Marine Corps recruits participated in prior to entering basic training, and (2) identify differences in aerobic and weight regimens between male and female recruits.

**METHODS:** A total of 911 male and 693 female Marine Corps recruits from San Diego, CA, and Parris Island, SC, voluntarily participated. Participants completed the Physical Training Footwear & Musculoskeletal Injuries Trainee Survey, highlighting their aerobic and weight regimens in the year preceding basic training.

**RESULTS:** Significantly more female than male participants (49.9% and 18.6%, respectively;  $P < 0.001$ ) reported engaging in running or jogging training 4 or more months prior to basic training. However, there was no significant difference in frequency of running or jogging in the 2 months prior to basic training ( $P = 0.15$ ). Men reported weight training more often than women in the 2 months preceding basic training (women, 18.4%; men, 24.2%;  $P < 0.001$ ). Additionally, nearly half of the female subjects (46.5%) reported no history of weight training in the year preceding basic training compared with 31.4% of the male subjects ( $P < 0.001$ ).

**CONCLUSIONS:** Although female recruits reported performing cardiovascular training more months prior to the start of basic training than did the males, significantly more female than male recruits reported no history of weight training. The findings suggest that women and men prepare differently for basic training. Future studies should explore how this difference in training might affect the risk of injury in basic training.

*This work was Supported by the Naval Health Research Center, Work Unit No. 60626.*

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### 1549 Board #151 May 27 11:00 AM - 12:30 PM Lower Body Fat Improves Physical And Physiological Performance In Army Soldiers

Kim Crawford<sup>1</sup>, John Abt<sup>1</sup>, Timothy Sell<sup>1</sup>, Takashi Nagai<sup>1</sup>, Jennifer Deluzio<sup>1</sup>, Rusty Rowe<sup>2</sup>, Mark McGrail<sup>3</sup>, Scott Lephart, FACSM<sup>1</sup>. <sup>1</sup>University of Pittsburgh, Pittsburgh, PA. <sup>2</sup>Department of the Army, Stuttgart, Germany. <sup>3</sup>Department of the Army, Fort Campbell, KY.

(No relationships reported)

The Department of the Army's maximal allowable percent body fat varies depending on gender and age, ranging between 30-36% for females and 20-26% for males. However, the Army Weight Control Program policy stipulates all soldiers are encouraged to achieve the more stringent Department of Defense goal, which is 18% body fat for males and 26% for females.

**PURPOSE:** To determine if active duty soldiers who meet the Department of Defense percent body fat goals perform better on physiological and musculoskeletal tests and the Army Physical Fitness Test compared to soldiers who exceed the standards.

**METHODS:** A total of 99 male 101st Airborne Division (Air Assault) soldiers (age=28±7.0 years, height= 1.77±7.4 cm, mass= 82.9±12.4 kg) participated. Percent body fat (%BF) was assessed using air-displacement plethysmography. Based on the %BF, subjects were assigned to group 1 (body fat < 18%) or group 2 (body fat > 18%). Subjects completed a series of physical performance tests consisting of anaerobic power, anaerobic capacity, maximal oxygen consumption (VO2max), push-ups, sit-ups, two mile timed run test, shoulder internal and external rotation strength, and knee flexion and extension strength.

**RESULTS:** The mean %BF was  $13.3 \pm 3.7\%$  (group 1) and  $25.8 \pm 5.2\%$  (group 2). Subjects who met the Department of Defense body fat goals (group 1) performed significantly better on seven of the 10 tests including anaerobic capacity ( $8.3 \pm 0.6$  w/kg;  $7.2 \pm 1.0$  w/kg;  $p \leq 0.001$ ), VO<sub>2</sub>max ( $52.2 \pm 5.4$  ml/kg/min;  $44.1 \pm 6.8$  ml/kg/min;  $p \leq 0.001$ ), push-ups ( $78.2 \pm 18.5$  reps;  $65.7 \pm 13.9$  reps;  $p = 0.002$ ), shoulder internal rotation ( $66.1 \pm 16.2$  N/kg;  $50.4 \pm 14.5$  N/kg;  $p \leq 0.001$ ) and external rotation strength ( $45.4 \pm 7.7$  N/kg vs.  $36.6 \pm 7.4$  N/kg;  $p \leq 0.001$ ), and knee flexion ( $127.9 \pm 23.9$  N/kg;  $103.6 \pm 26.6$  N/kg;  $p \leq 0.001$ ) and extension strength ( $263.5 \pm 49.0$  N/kg;  $219.0 \pm 41.7$  N/kg;  $p \leq 0.001$ ).

**CONCLUSIONS:** Soldiers who met the Department of Defense %BF goals performed better on the physiological and musculoskeletal tests and Army Physical Fitness Test than soldiers who exceeded the standards. The higher performance on military physical readiness tests by soldiers with a lower percent body fat substantiates the need to continue to enforce stringent body fat standards for Army personnel in order to optimize military readiness.

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**1550 Board #152 May 27 11:00 AM - 12:30 PM**  
**Body Mass Bias And Allometric Scaling In The Army Physical Fitness Test Among Infantry Soldiers**

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(No relationships reported)

Previous research has reported that body mass is negatively correlated with performance in the APFT which includes push up (PU), sit-up (SU) and 2-mile run (RUN) events. Vanderburgh et al., (Med Sci Sports Exerc 40:1538, 2008) reports that these relationships result in a significant bias against larger individuals. By reducing the correlation between body mass and scaled scores, allometric scaling has been suggested as a means to reduce body mass bias in these tests.

**PURPOSE:** To determine the relationship between body mass and lean body mass and APFT performance, and to evaluate the effectiveness of allometric scaling in a sample of active duty soldiers.

**METHODS:** 187 Infantry soldiers ( $23 \pm 5$  yrs) were measured for body composition using dual energy x-ray absorptiometry. They performed the APFT consisting of completing the maximum number of PU in two minutes, maximum number of SU in two minutes and running two-miles as fast as possible. Allometric scaling was achieved by multiplying APFT raw scores for PU and SU by body mass<sup>1/3</sup> and multiplying RUN time by body mass<sup>-1/3</sup> (kg).

**RESULTS:** SU were not significantly correlated to total body mass ( $r = -0.11$ ) or lean body mass ( $r = -0.02$ ). There was a slight negative correlation between PU and body mass ( $r = -0.23$ ,  $p = 0.01$ ) but none between PU and lean body mass ( $r = -0.10$ ). There were significant correlations between RUN and total body mass ( $r = 0.37$ ,  $p < 0.01$ ) as well as lean body mass ( $r = 0.17$ ,  $p < 0.01$ ). Allometric scaling resulted in greater correlations between body mass and lean body mass with SU ( $r = 0.26$  and  $r = 0.31$ , respectively  $p < 0.01$ ) and RUN ( $r = 0.34$  and  $r = -0.48$ , respectively  $p < 0.01$ ), increasing body mass bias in these measures. After allometric scaling, PU was no longer correlated with body mass or lean body mass ( $r = 0.03$ ,  $r = 0.13$ ).

**CONCLUSION:** The Army does not correct for body size in scoring APFT events. In trained Infantrymen, allometric scaling did not reduce the correlation between body size measures and either SU or RUN. However, a body mass<sup>1/3</sup> correction for push-ups appears warranted since allometric scaling eliminated body mass bias from PU performance.

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**1551 Board #153 May 27 11:00 AM - 12:30 PM**  
**Temperature Effect On Military Endurance And Strength Performances**

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(No relationships reported)

**PURPOSE:** In the study, we determined the temperature effect on military physical fitness test for young soldiers.

**METHODS:** 31 male soldiers from military special force performed standardized 3000-meter running and chin-up strength test under 27 degree Celsius and 32 degree Celsius.

**RESULTS:** Increasing ambient temperature significantly impaired performance on 3000-meter running (from  $619 \pm 6.4$  seconds to  $724 \pm 5.4$  seconds,  $P < 0.001$ ), whereas slight enhanced chin-up strength (from  $18.1 \pm 0.5$  times to  $21.8 \pm 0.7$  times,  $P < 0.05$ ). Interestingly, the temperature effect on running performance was more affected on the individual had better performance at 27 degree Celsius ( $R = -0.55$ ,  $P < 0.001$ ).

**CONCLUSIONS:** Only 5 degree difference can cause a significant effect on endurance but not strength fitness. Bias-free endurance performance tests can be achieved by using temperature-adjusted scoring tables.

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**1552 Board #154 May 27 11:00 AM - 12:30 PM**  
**Relationship Between Aerobic Capacity And Sleep Quality In Military Men**

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(No relationships reported)

Previous research has shown that exercise influences sleep in a variety of populations. In addition, aerobic fitness has been shown to affect sleep quality in specific population samples, including older adults and young females. Little research has studied the effect of aerobic capacity on sleep quality in healthy military populations.

**PURPOSE:** The purpose of this study was to explore the relationship between aerobic capacity and sleep quality in healthy military men.

**METHODS:** A sample of 28 military men (mean age =  $31.4 \pm 7.4$  y) participated in this study. Subjects self-reported their most current Physical Readiness Test (PRT) run time (time to complete a 1.5-mile run) and completed a self-report sleep diary over 7 consecutive days. Sleep quality was assessed through sleep onset latency (SL), number of minutes of wake time after sleep onset (WASO), total sleep time (TST), and how refreshed the participant felt upon waking (REFRESH). Each sleep variable was averaged over the 7-day period. Correlational analyses were used to explore the relationship between aerobic capacity and SL, WASO, TST, and REFRESH.

**RESULTS:** WASO was positively correlated with PRT run time ( $r = .565$ ,  $p = .028$ ). SL, TST, and REFRESH did not significantly correlate with run time ( $r = .122$ ,  $p = .642$ ;  $r = -.356$ ,  $p = .161$ ;  $r = -.037$ ,  $p = .889$ , respectively).

**CONCLUSIONS:** Number of minutes of wake time after sleep onset appears to be influenced by aerobic capacity, such that lower aerobic capacity (measured as slower run times) was associated with more disturbed sleep (a greater amount of time spent awake after the onset of sleep). However, sleep onset latency, total sleep time, and how refreshed one felt upon waking do not appear to be influenced by aerobic capacity. Larger study samples are needed to confirm these findings. Additionally, future research should prospectively evaluate the effect of exercise training on aerobic fitness and sleep quality using gold-standard measures of fitness and sleep.

*This study was Supported by the Office of Naval Research Core Capabilities Research Program, Grant #N0001407WX20658.*

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**1553 Board #155 May 27 11:00 AM - 12:30 PM**  
**Relationship Between The Army Physical Fitness Test And Laboratory-based Physiological And Musculoskeletal**

## Assessments

John Abt<sup>1</sup>, Timothy Sell<sup>1</sup>, Takashi Nagai<sup>1</sup>, Jennifer Deluzio<sup>1</sup>, Karen Keenan<sup>1</sup>, Rusty Rowe<sup>2</sup>, Mark McGrail<sup>3</sup>, Sylvain Cardin<sup>4</sup>, Scott Lephart, FACSM<sup>1</sup>.

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(No relationships reported)

The Army Physical Fitness Test (APFT) is administered twice a year and is designed to evaluate cardiorespiratory fitness, strength, and endurance. The APFT is scored according to gender and age for the number of completed sit-ups and push-ups per two minutes and a two mile run. Despite the goal of the testing protocol, the APFT may not provide a complete picture of individual military readiness or potential for injury.

**PURPOSE:** To determine the relationship between the APFT and laboratory testing for physiological and musculoskeletal variables.

**METHODS:** A total of 90 male Army 101<sup>st</sup> Airborne (Air Assault) soldiers participated (Age:  $28.4 \pm 7.1$  years; Height:  $1.77 \pm 0.08$  m; Mass:  $83.1 \pm 12.2$  kg). Subjects performed the standard APFT and a battery of laboratory assessments consisting of VO<sub>2</sub> max, anaerobic power and capacity, torso rotation strength, shoulder internal and external rotation strength, quadriceps and hamstring strength, and body composition. The laboratory testing battery was based on variables that would most contribute to optimizing overall military readiness and those most likely related to injury in the Army. Subjects were ranked according to performance for each APFT and laboratory test, with a separate cumulative ranking score calculated for the APFT and laboratory tests. A Spearman Rho correlation was calculated to determine the relationship between the cumulative ranking scores for the APFT and laboratory tests. Secondary Spearman Rho correlations were run between the APFT cumulative ranking score and the individual laboratory tests.

**RESULTS:** A moderate relationship was identified between the cumulative APFT and laboratory testing ( $\rho = 0.653$ ,  $p < 0.001$ ). A moderate relationship was identified between the APFT and the VO<sub>2</sub> max ( $\rho = 0.709$ ,  $p < 0.001$ ), anaerobic capacity ( $\rho = 0.654$ ,  $p < 0.001$ ), and body composition ( $\rho = 0.632$ ,  $p < 0.001$ ).

**CONCLUSIONS:** The cumulative ranking relationship between the APFT and laboratory testing was mostly related to the VO<sub>2</sub> max, anaerobic capacity, and body composition test. The lack of relationship between the APFT and the other laboratory tests suggests that despite the potential to score high on the APFT, additional or modified training is necessary to optimize military readiness and prevent musculoskeletal injury.

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## A-32 Free Communication/Poster - Musculoskeletal Mechanics I

MAY 27, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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### 1554 Board #156 May 27 11:00 AM - 12:30 PM

#### A Gender Comparison of Lower Extremity Landing Biomechanics Utilizing Different Tasks

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(No relationships reported)

Jump landings are routinely used to study gender differences in landing. Standardizing the jump height to a fixed vertical distance may bias results as women are forced to land from heights that are a greater percentage of their own maximum vertical jump (MVJ).

**PURPOSE:** To compare lower extremity mechanics between genders from a fixed height and from a self initiated jump.

**METHODS:** Nine male ( $21.50 \pm 1.20$  years,  $173.25 \pm 2.82$  cm,  $75.58 \pm 7.92$  kg,  $60.97 \pm 5.81$  cm MVJ) and 8 female ( $20.56 \pm 1.24$  years,  $161.11 \pm 6.01$  cm,  $57.58 \pm 11.65$  kg,  $33.13 \pm 9.76$  cm MVJ) subjects participated in this study. Subjects were given standard footwear. Maximum vertical jump heights were obtained. Subjects performed 6 successful trials of a drop landing (DL) from a 61 cm height and a self initiated vertical jump landing (VJ) at their 80% MVJ height in random order. A 6-camera, EVa 3-D motion capture system (Motion Analysis, Santa Rosa, CA) captured (120 Hz) and analyzed (EVa version 5.11 and KinTrak 6.0 software) dominant lower extremity joint kinematics based on an 11 marker, 3 segment (thigh, shank, foot) model. Joint centers for the hip, knee and ankle were created according to Euler angle calculations. A synchronized force plate (AMTI, Watertown, MA) recorded time of initial contact and maximal vertical force. Dependent variables included: knee flexion angles at initial contact (KFIC), at maximal vertical ground reaction force (KFMZ) and maximum knee flexion angle (MaxKF). Data were exported into spreadsheet and means for all trials in both conditions were created and imported to SPSS 13.0. Two 1-way ANOVAs tested for differences ( $P = 0.05$ ) between groups in each condition.

**RESULTS:** No significant differences were found between males and females for KFIC or KFMZ in either the VJ or DL. No significant difference was found in MaxKF between males ( $75.55 \pm 8.46$ ) and females ( $67.52 \pm 6.31$ ) in the DL. However, males had greater MaxKF angles ( $83.38 \pm 18.90$ ) than females in the VJ ( $66.22 \pm 15.01$ ) ( $P = .001$ ).

**CONCLUSIONS:** Contrary to other published reports, our results showed no difference in knee flexion angles between genders in a DL task. Males exhibited greater absolute knee flexion in the VJ, which is not surprising given their MVJ heights. Future research investigating lower extremity motion during landing should incorporate appropriately comparable tasks.

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### 1555 Board #157 May 27 11:00 AM - 12:30 PM

#### Effect Of Pre-Load On Muscle Activation And Joint Mechanics During A Maximal Vertical Jump

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(No relationships reported)

Maximal vertical displacement during jumping is obtained by use of a pre-load of the lower limb musculature, where the muscle-tendon unit is rapidly stretched followed immediately by a concentric muscle action. A plyometric jump from a box involves such a pre-load. It has been established that maximum vertical jump height is greater with a plyometric jump, however the sites of enhanced energy generation have not been reported.

**PURPOSE:** To compare the push-off phase of plyometric (PJ) and static (no pre-load; SJ) maximum vertical jumps in terms of muscle activation and joint dynamics.

**METHODS:** Twelve experienced jumpers performed plyometric (off of a 60 cm box) and static (start from an initial squat position) maximum vertical jumps off of a force platform. Kinematic analysis of the lower limb was performed for the ankle, knee, and hip from sagittal plane video recordings. Electromyographic recordings of the gluteus maximus (GM), semitendinosus (S), rectus femoris (RF), vastus lateralis (V), and gastrocnemius (G) were also taken. Kinematic and force data were combined using inverse dynamic analysis to determine joint torque, power, and work. Condition comparisons were made using a two-way ANOVA with repeated measures.

**RESULTS:** Plyometric pre-load increased maximal vertical jumping by  $5.0 \pm 2.3$  cm. Average peak joint extensor torques at the ankle ( $4.3$  vs  $3.3$  Nm/kg,  $p = 0.06$ ), knee ( $5.1$  vs  $3.9$  Nm/kg,  $p = 0.07$ ) and hip ( $6.5$  vs  $5.0$  Nm/kg,  $p = 0.06$ ) tended to be greater for the PJ, due to the greater peak vertical force ( $28.3$  vs  $22.8$  N/kg,  $p = 0.03$ ). There were no significant differences in work and power output (Net Work:  $14.1$  vs  $12.2$  J/kg for PJ and SJ, respectively;  $p = 0.30$ ). Greater muscle activation was observed during the first half of the push-off for the PJ (GM:  $107$  vs  $34$  mV, RF:  $131$  vs  $54$  mV, V:  $240$  vs  $136$  mV, G:  $121$  vs  $46$  mV,  $p < 0.05$ ), while muscle activity was similar for the two conditions during the second half of the take-off.

**CONCLUSIONS:** Pre-loading had a small effect on vertical jump performance. Muscle activation was higher earlier during PJ due to the eccentric requirements of landing

prior to the jump, however this greater activation did not appear to translate into greater net work at any of the joints.

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**1556 Board #158 May 27 11:00 AM - 12:30 PM**  
**Reliability And Validity Of A Hand-held Myotonometer For Assessing Skeletal Muscle Stiffness**

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(No relationships reported)

Active stiffness of the muscles surrounding a joint has been shown to be an essential component for maintaining joint stability. To date, methods for measuring active muscle stiffness have utilized complicated computer algorithms and sophisticated laboratory hardware, making accurate assessment of muscle stiffness for the clinician nearly impossible.

**PURPOSE:** To examine the reliability and validity of a hand-held device for assessing skeletal muscle stiffness.

**METHODS:** Active muscle stiffness of the rectus femoris muscle was collected on 20 subjects ( $21.88 \pm 2.86$  yrs,  $169.96 \pm 9.29$  cm,  $71.17 \pm 11.82$  kg) over loads of 10, 20, 30, 40, and 50% of their maximum voluntary isometric contraction. Subjects were seated in an isokinetic dynamometer with their knee flexed to 60 degrees. Measurements were collected from the mid-bellies of the rectus femoris with a myotonometer that exerted a local impact on the tissue by means of a brief mechanical impulse. Five trials were measured in each condition. Intraclass correlations (ICC(2,1)) were performed across the five trials in each load condition to assess trial reliability.

**RESULTS:** Mean stiffness values for each of the load conditions (10% =  $314.52 \pm 69.11$ , 20% =  $344.74 \pm 85.96$ , 30% =  $362.26 \pm 99.28$ , 40% =  $371.76 \pm 99.11$ , 50% =  $386.79 \pm 120.40$  N/rad) were consistent with previous literature. Post-hoc analysis revealed that stiffness values at 10% load were significantly different than those at 30, 40, and 50% loads, and that 20% was significantly different than stiffness levels at 50% MVIC. Trial reliability was excellent for each load condition with ICCs ranging from 0.86-0.96 with SEMs ranging from 19.38-46.78 N/rad.

**CONCLUSION:** The results suggest that a hand-held myotonometer is a reliable tool for measuring muscle stiffness over a range of contraction levels. Stiffness levels increased with the proportional increase in force output, which agrees with previous literature showing an increase in active muscle stiffness values with an increase in contraction level. While we did not find a direct linear relationship between level of contraction and measured stiffness values, the data trend suggests the myotonometer measurements are also valid.

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**1557 Board #159 May 27 11:00 AM - 12:30 PM**  
**Strategies Used By Professional Movers To Reduce The Impact Of Carrying Loads And Ways To Assist Them**

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(No relationships reported)

Professional movers often carry loads against their backs rather than against their abdomen. When asked about this strategy, they believed it is easier on their backs. However, there is little research on hand-held load carriage.

**PURPOSE:** The purpose of this study was two-fold: (1) to assess the biomechanical differences between hand-held anterior load carriage (ALC) and posterior load carriage (PLC); and, (2) to determine if an assistive load carriage device (ALCD) could reduce muscle effort while carrying loads either anterior or posterior to the pelvis.

**METHODS:** The ALC and PLC were compared using an electromyographic (EMG) analysis while participants carried a load on a treadmill. Isometric maximum voluntary exertions (iMVE) were measured for right side of erector spinae (T9 and L3), trapezius, and anterior and posterior deltoid, rectus abdominis, external oblique and forearm flexors. Ten male subjects then conducted three trials of 10 strides for the ALC and PLC techniques while carrying 20% body weight in a specialized box. In a second study with an additional 10 male subjects, four conditions were used: ALC, PLC, anterior ALCD and posterior ALCD. Amplitude probability distribution functions (APDF) were used to compare EMG amplitudes at the 10<sup>th</sup>, 50<sup>th</sup>, and 90<sup>th</sup> percentiles.

**RESULTS:** Results indicated that PLC significantly reduced EMG activity of the erector spinae (>50%), trapezius, and anterior deltoid ( $p < 0.05$ ) as well as increasing EMG activity in the posterior deltoid ( $p < 0.05$ ). Results of the second study confirmed that PC significantly reduced erector spinae activity ( $p < 0.05$ ) and moved the shoulder load from the trapezius and anterior deltoid and focused it on the posterior deltoid. The assistive device reduced flexor digitorum activity (>40% reduction,  $p < 0.03$ ) and anterior deltoid activity (>75% reduction,  $p = 0.5$ ) in both ALC and PLC.

**CONCLUSIONS:** There were large reductions (>50%) in erector spinae muscle activity during PLC which explains why professional movers found it easier. When an assistive device was used, back muscle and forearm flexors (>40%) were the main beneficiaries. These results provide evidence that the ALCD used in this study can be an effective ergonomic tool to alleviate grip effort and shoulder activity in both ALC and PLC conditions.

Supported by Ontario WSIB Grant #05-07.

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**1558 Board #160 May 27 11:00 AM - 12:30 PM**  
**Effect Of Artificial Center Of Mass Height Changes On Landing Forces And Emg**

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(No relationships reported)

Anterior cruciate ligament (ACL) rupture is a topic of great interest because it is a particularly devastating injury, occurs mainly in non-contact, large deceleration situations and has a disproportionate incidence among women. Through various means, greater hamstrings involvement is thought to stabilize and protect the knee. Various gender-related factors have been suggested as contributors to ACL injury, but one that has not apparently been explored is weight distribution. Men typically have more upper body mass and thus a higher center of mass (CM). This may demand greater hamstring activation to control the forward trunk rotational inertia encountered in landing which could serve to protect the ACL. The potentially greater hip contribution to overall leg stiffness might also elicit different reaction force features.

**PURPOSE:** To explore whether manipulating the CM height elicited changes in reaction forces and EMG levels among men and women during landings.

**METHODS:** EMG and force platform records from 12 height-matched pairings of men ( $173 \pm 7$  cm,  $73 \pm 9$  kg) and women ( $173 \pm 8$  cm,  $64 \pm 10$  kg) performing bipedal landings from 60 cm were gathered. CM height was manipulated by adding 6.8 kg at the ankles, waist, or shoulders and directly measured using a reaction board. Ten landings in each condition were used for analysis. RMS EMG values for the initial 120 ms of contact were calculated for the vastus medialis, rectus femoris, biceps femoris and semitendinosus. Peak force (PF), loading rate (LR), leg stiffness (KL), and time to stability (TS) were derived from the force records. A 2 x 3 ANOVA was used to assess CM height and gender effects.

**RESULTS:** Among the force variables, no gender effects were identified. No differences were noted between the high and middle CM placements, but the low CM condition did result in greater PF (4%), greater KL (52%) and shorter TS (11%). For EMG activity there were no gender or CM height effects.

**CONCLUSION:** The added mass locations resulted in shifting the CM 2x lower than it was raised. The hastened TS may be attributable to the enhanced physical stability of the system. The KL response was unexpected since the mass was added below the hip and knee joints. The response is compatible with the TS outcome, however, and may suggest that riskier responses were provoked by this manipulation.

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**1559 Board #161 May 27 11:00 AM - 12:30 PM**  
**Lower Extremity Kinematics Of A Double Leg Jump Landing Task And Overhead Squat Are Correlated**



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(No relationships reported)

Movement screenings involving a squat task are used clinically to assess lower extremity movement patterns and identify individuals at risk for injury. However, there is little evidence supporting a link between movement patterns observed during movement screenings and dynamic tasks.

**PURPOSE:** To determine if lower extremity movement patterns during an overhead squat (OS) were correlated with those during a double leg jump landing (DLJL).

**METHODS:** Lower extremity kinematics were collected for 25 physically active subjects (8 Males, 17 Females) as they performed 3 trials of a DLJL, consisting of jumping from a 31 cm platform located a distance equal to 50% body height, landing on a force plate, and then immediately jumping for maximum vertical height. The OS consisted of a standard double leg squat with the arms raised above the head and the elbows extended. Three-dimensional knee and hip joint angles were analyzed for the descent phase of each task, defined as the start of the trial to peak knee flexion for the OS and from initial contact with the force plate to peak knee flexion for the DLJL. Pearson correlations were performed for each kinematic variable to assess the correlation within subject and between tasks.

**RESULTS:** Correlation coefficients are provided in Table 1. Frontal plane motion of the hip and knee, and transverse plane motion of the knee were significantly correlated between tasks ( $p < 0.05$ ).

**CONCLUSION:** The OS is an adequate predictor of the amount of frontal plane and transverse plane lower extremity motion an individual will exhibit during more dynamic tasks experienced in sport participation. This suggests that the OS may represent a clinical tool for identifying individuals who are at heightened risk for lower extremity injury.

Table 1. Correlation Coefficients for Lower Extremity Kinematics of DLJL and OS									
Hip Flexion	Hip Abduction	Hip Adduction	Hip External Rotation	Hip Internal Rotation	Knee Flexion	Knee Valgus	Knee Varus	Knee External Rotation	Knee Internal Rotation
$r = 0.028$ $p = 0.895$	$r = 0.633$ $p = 0.001$	$r = 0.742$ $p < 0.001$	$r = 0.053$ $p = 0.800$	$r = 0.000$ $p = 0.773$	$r = 0.145$ $p = 0.488$	$r = 0.892$ $p < 0.001$	$r = 0.944$ $p < 0.001$	$r = 0.822$ $p < 0.001$	$r = 0.860$ $p < 0.001$

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**1560 Board #162 May 27 11:00 AM - 12:30 PM**  
**Assessing The Reliability Of Asymmetrical Strength And Power Deficit Evaluation In Functionally-Limited Elders**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to assess the reliability of evaluating asymmetrical strength and power deficits in the lower-limbs of functionally-limited elders.

**METHODS:** A cross-sectional evaluation was performed on 57 older ( $74.2 \pm 0.9$ y, 26 male,  $SPPB \leq 9$ ) adults. Testing was performed twice, at the same time of day, separated by one week. Bilateral knee extensor strength and power was evaluated on Keiser pneumatic resistance training equipment. Asymmetrical strength deficit was defined as the 1 Repetition Maximum (1RM) difference between the right and left legs (Right Leg 1RM - Left Leg 1RM). Asymmetrical power deficit was defined as the difference in Peak Power (PP) between the right and left legs (Right Leg PP - Left Leg PP) at resistances equal to 40% and 70% of the 1RM. The results from the two individual testing days were evaluated for test-retest reliability. In addition, the relationship between asymmetrical strength and power and various measures of functional performance was explored.

**RESULTS:** Asymmetrical strength (Intra Class Correlation (ICC) = 0.799) and power @ 40 (ICC = 0.698) and 70% (ICC = 0.708) of 1RM all showed fair reliability between the two testing days. Correlations showed a moderate association between asymmetrical strength and power and chairstand time: strength ( $r = 0.497$ ,  $p < 0.003$ ) and power @ 40 ( $r = 0.315$ ,  $p < 0.042$ ) and 70% ( $r = 0.330$ ,  $p < 0.021$ ) of 1RM.

**CONCLUSIONS:** These findings support the reliability of evaluating asymmetrical strength and power deficits in the lower limbs of functionally-limited elders as well as the existence of a relationship between strength and power asymmetry and functional performance.

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**1561 Board #163 May 27 11:00 AM - 12:30 PM**  
**Decrease In Bowstring Lateral Deflection In Olympic Archery: A Case Report**

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Archery can be defined as a static sport requiring strength and endurance of the upper body, in particular the forearm and shoulder girdle. A predominant forearm and pull finger muscle contraction strategy in archery is defined as the response to the audible impetus or "snap" of a so called "clicker" by active contraction of the m. extensor digitorum (MED) and gradual relaxation of the m. flexor digitorum superficialis (MFDS) at all performance levels. However, one particular archer with a long history at elite performance level showed a different strategy, which is thought to have considerable positive effects on her performance.

**PURPOSE:** To carry out a detailed analysis of the contraction strategy performed by this particular top-level archer and to consider the advantages of her strategy on bowstring release.

**METHODS:** Electromyographic (EMG) activity of the MFDS and MED of elite archer were recorded together with a pulse synchronized with the clicker snap. Raw EMG records as 1 s before and after the clicker pulse were rectified, integrated, and normalized. The data was then averaged for successive shots. Mean scores were calculated for the subject's 12 shots and averaged. Paired samples t-tests were used for assessing differences between scores of MED and MFDS during each time interval. A probability of  $p < 0.05$  was selected to indicate statistical significance.

**RESULTS:** The current archer presented a sharp relaxation of MFDS about 100 ms later than the fall of the clicker. Besides, she showed a gradual relaxation of MED after the fall of the clicker. On the other words, there was no active contraction of MED. However, an active contraction of MFDS was observed at about 200 msec after the snap of the clicker and just after the sharp relaxation. During the whole shot, the normalized value of the MED and MFDS was significantly ( $p < 0.05$ ) different at the time intervals of -1000, -900, 100, 200 ms.

**CONCLUSION:** She responds to the fall of the clicker by relaxing MFDS and without active involvement of MED. The contraction-relaxation strategy that she performs is different than the earlier findings. In her strategy, release of the bowstring is accomplished by only relaxing the MFDS. So, the force of the string on the fingers is sufficient to produce the extension of the three-finger hook, which may decrease the lateral deflection of bowstring.

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**1562 Board #164 May 27 11:00 AM - 12:30 PM**  
**Influence Of Time Forecast On Electromechanical Delay In Older Women**

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(No relationships reported)

The presence of a time forecast has influences on muscle reaction times.

**PURPOSE:** The purpose of this study is, by measuring electromechanical delay(EMD) and muscle reaction times in the condition that the sense of seeing is intercepted and the forecast of time is interrupted for older women, to investigate how the restricted condition affects the electromechanical delay(EMD) and various reaction time.

**METHODS:** 25 healthy older women subjects gave informed consent for participating in this experiment. Their age, height, and weight are 74.1±5.3 years, 149.8±5.3 cm, 48.3± 7.4kg(mean±SD), respectively. The measurement is performed for extension movement of knee joint. And we investigated the trial both in normal condition(NOR-C) and the restricted condition(RES-C).

**RESULTS:** The main results are as follows: EMD of RES-C(CON: 96.7±12.3ms, ECC: 98.0±8.7ms) is significantly longer( $p<0.001$ ) than NOR-C(CON: 89.6±10.3ms, ECC: 88.4±7.0ms). Similarly, in total reaction time and pre-motor reaction time, there are significant difference( $p<0.001$ ) between NOR-C and RES-C. Moreover, in movement time to the peak torque, there is no significant difference between NOR-C and RES-C.

**CONCLUSION:** These results suggested that the EMD has an effect on time forecast; this older is considered to cause falls during a walk and occurrence of injuries.

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**1563 Board #165 May 27 11:00 AM - 12:30 PM**

**Latent Effect Of Passive Static Stretching On Driver Clubhead Speed, Distance, Accuracy, And Solid Contact In Male Competitive Golfers.**

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(No relationships reported)

**PURPOSE:** This investigation was conducted to determine the effect of two different warm-up treatments over time on driver clubhead speed, distance, accuracy, and consistent ball contact in male competitive golfers.

**METHODS:** Two supervised warm-up treatments, an active dynamic warm-up with golf clubs (AD) and a 20 minute total body passive static stretching routine plus an identical AD warm-up (PSS), were applied prior to each performance testing session using a counterbalanced design on non-consecutive days. Immediately following the AD treatment, subjects were instructed to hit three full swing golf shots with their driver with one minute rest in between swing trials. Immediately following the PSS treatment, subjects were instructed to hit three full swing golf shots and thereafter at 15, 30, 45, and 60 minutes post PSS with their driver with one minute rest between swing trials.

**RESULTS:** Significant decreases ( $p < 0.05$ ) in clubhead speed, distance, accuracy, and solid contact were observed between AD and PSS. At 15, 30, 45, and 60 minutes post PSS, significant performance decrements continued but with less magnitude. Theoretical explanations for this acute decrease in performance is a more compliant muscle tendon unit, decrease neuromuscular reflex sensitivity, and neural inhibition due to the PSS treatment. Of interest, however, the clubhead speed measurements highly correlated with skeletal muscle force production recovered at faster rates than measures dependent upon neuromuscular coordination.

**CONCLUSIONS:** The results of this inquiry confirm previous findings from this laboratory strongly suggesting that passive static stretching should be avoided prior to practice or competition in favor of a gradual active dynamic warm-up with golf clubs. From this applied sport data, it appears that the muscle tendon unit recovers from passive static stretching at faster rates than coordinating / neurological mechanisms contained in the muscle spindle.

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**1564 Board #166 May 27 11:00 AM - 12:30 PM**

**Landing Patterns In Subjects With Recurrent Lateral Ankle Sprains**

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(No relationships reported)

The most common symptoms after ankle sprains were chronic ankle instability, proprioception defect and probable neuromuscular adaptation.

**PURPOSE:** The purpose of this study was to identify the normal landing pattern using detailed biomechanical analysis including analysis of the kinematics and ground reaction force, and to compare the landing pattern in the subjects with recurrent ankle sprain and normal subjects.

**METHODS:** Ten male adults were recruited in this study (5 subjects with recurrent lateral ankle sprains group, 5 subjects with normal control group). All subjects would be asked to perform maximal standing jumps and drop landing from 3 platforms with different heights (0.37 m, 0.67 m, & 0.97 m, respectively). Those movements were collected by VICON 512 (Oxford Metrics, UK) motion analysis system and the kinematics was analyzed using self making software with MATLAB. The ground reaction force of both lower limbs was recorded by two AMTI force platforms, and the kinetic data were calculated with inverse dynamics.

**RESULTS:** In the different landing height, the main differences of kinematics were the maximum flexion angles of hip and knee joints in normal landing patterns and the flexion angles increased with the landing height, as well as the flexion of pelvis, hip abduction, and knee external rotation in the subjects with recurrent ankle sprains. When compare those two groups, the landing pattern in the subjects with recurrent ankle sprain was significant smaller than normal subjects in knee flexion ( $65.71^\circ \pm 6.43^\circ$  vs.  $70.19^\circ \pm 13.76^\circ$ ) and hip flexion ( $34.15^\circ \pm 5.42^\circ$  vs.  $42.54^\circ \pm 10.07^\circ$ ). The time to maximum angles in ankle dorsiflexion and foot pronation were also quite different between these two groups. The maximum vertical ground reaction force in sprain group was significant smaller than normal group.

**CONCLUSIONS:** In this study, we have revealed the adaptation of performing drop landing in the individuals with recurrent ankle sprains. It could be considered as a recommendation of the rehabilitation.

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**1565 Board #167 May 27 11:00 AM - 12:30 PM**

**Single Leg Cycling; An Evaluation Of Pedal Powers**

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(No relationships reported)

Single and double-leg cycling have been used in therapeutic and training settings. The benefits of single-leg training may be compromised because single and double-leg cycling are biomechanically different. Specifically, during normal double-leg cycling the gravitational forces acting on each leg are essentially balanced by the contralateral limb and thus do not require active leg flexion. Conversely, single-leg cycling requires active leg flexion to lift the leg. Recently, we devised a counterweighted cycling crank that may facilitate single-leg cycling with similar biomechanics to normal double leg cycling.

**PURPOSE:** The purpose of this study was to determine the optimal counterweight to facilitate single-leg cycling with biomechanics similar to normal bilateral cycling.

**METHODS:** Following warm up (5 min), three trained cyclists (age: 33 +/- 4 years) performed 105 second trials (single leg and double leg) on a cycle ergometer equipped with a force and position sensing pedal. Single-leg protocol was repeated four times (with counterweights of 10, 20, 25 and 30 lbs). Trials were performed at 60rpm with increased power every 15 seconds (50, 100, 150, 200, 250, and 300 watts for double-leg and half of those powers for single-leg). Pedal forces were recorded for each power condition and averaged every 6 degrees of crank rotation. Differences between single and double-leg cycling for each 6 degree interval were determined. Sum of squared differences for each condition were used to evaluate optimal counterweight.

**RESULTS:** Sum of squared difference varied among the counterweights evaluated and reached a minimum at 20 lbs. For our current sample population, 20lb counterweight produced the closest approximation to double leg cycling.

**CONCLUSIONS:** Single-leg cycling may be a beneficial training and rehabilitation modality and determining the optimal counterweight is an important first step towards that end.

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**1566 Board #168 May 27 11:00 AM - 12:30 PM**  
**Effect Of Variable Numbers Of Repetitions On Peak Torque In Isokinetic Testing Of The Knee Extensors**

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(No relationships reported)

Isokinetic testing devices have allowed for the evaluation of strength across a wide spectrum of populations and muscle groups; however a specific protocol for isokinetic testing of the knee extensors with an emphasis on the specificity of repetitions has not been established.

**PURPOSE:** The purpose of the study was to examine the effect(s) of variable repetitions of maximal isokinetic knee extensions on peak torque production in males. Secondly, the purpose was to assess if differences existed between athletes and non-athletes. **METHOD:** Thirty, healthy college aged males (15 athletes and 15 non-athletes) with no history of knee injury were recruited from the University of Puget Sound to attend two familiarization and four test sessions to perform maximal knee extensions on a Cybex NORM at 60, 120, 180, 240, and 300°·sec<sup>-1</sup>. Rest periods were held constant at 60 seconds and knee flexions were held constant at 300°·sec<sup>-1</sup>. Four, six, eight and ten repetitions were randomly assigned at each test session. Peak torque was recorded for each trial. Data were analyzed using a 2 x 4 x 5 repeated measures ANOVA design with group, repetitions, and velocity as the independent variables, and peak torque as the dependent variable, alpha <0.05.

**RESULTS:** There were no significant differences in peak torque for variable repetitions. Male varsity athletes produced significantly greater peak torque than non-athletes at all velocity sets (F= 25.385, p<0.05). Finally, there was a significant difference in peak torque by velocity (F=757.503, p<0.05).

**CONCLUSION:** Peak torque production in males was not affected by the number of repetitions. Athletes were able to generate more peak torque at all velocities than their non-athletic peers. Research was funded by a summer grant from the University of Puget Sound.

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**1567 Board #169 May 27 11:00 AM - 12:30 PM**  
**Acute Effects Of Static Stretching On Peak Torque And The Rate Of Velocity Development**

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(No relationships reported)

**PURPOSE:** To examine the acute effects of hamstring and calf static stretching on peak torque (PT) and the rate of velocity development (RVD) during leg flexion muscle actions at 60, 180, and 300°·s<sup>-1</sup> in men and women.

**METHODS:** Thirteen women (mean ± SD age = 20.8 ± 1.8 yrs; body mass = 64.0 ± 8.3 kg; height = 163.1 ± 5.7 cm) and fifteen men (22.0 ± 4.4 yrs; 82.7 ± 16.1 kg; 173.1 ± 6.8 cm) performed three maximal voluntary isokinetic leg flexion muscle actions at three randomly-ordered velocities (60, 180, and 300°·s<sup>-1</sup>) before and after a bout of hamstring and calf static stretching. The stretching consisted of 1 unassisted and 3 assisted static stretching exercises designed for the posterior muscles of the thigh and leg. Four repetitions of each stretch were held for 30 s with 20-s rest between repetitions. Torque, position, and velocity signals were sampled from the dynamometer at 1 KHz. PT (Nm) was the highest 20-point average value during each repetition, while RVD was the latency time (s) from the initiation of lever arm movement to attainment of the pre-set velocity.

**RESULTS:** PT decreased ( $p \leq 0.05$ ; collapsed across velocity) as a result of the stretching, but only for the women. There were no other stretching-related changes for PT or RVD ( $p > 0.05$ ). PT and RVD decreased from 60 to 300°·s<sup>-1</sup> ( $p \leq 0.05$ ; collapsed across time and gender).

**CONCLUSION:** The stretching caused a 7.5% decrease in leg flexion PT for the women, but there were no changes for the men. RVD was unaltered from pre- to post-stretching for both genders. These findings suggested that the stretching-induced torque deficits experienced by the women were unrelated to the mechanisms that influence the RVD.

Table 1. Mean (± SE) values of Peak Torque and Rate of Velocity Development during leg flexions at 60, 180, and 300-s-1 for the pre- and post-stretching isokinetic assessments.						
	Pre-stretching			Post-stretching		
Women	60-s-1	180-s-1	300-s-1	60-s-1	180-s-1	300-s-1
PT (N·m)	47.430 ± 3.865	32.325 ± 3.248	25.102 ± 3.375	42.967 ± 3.124*	31.195 ± 3.216*	22.853 ± 3.207*
RVD (s)	0.043 ± 0.003	0.111 ± 0.009	0.185 ± 0.018	0.048 ± 0.003	0.112 ± 0.009	0.178 ± 0.017
Men	60-s-1	180-s-1	300-s-1	60-s-1	180-s-1	300-s-1
PT (N·m)	78.389 ± 3.274	64.352 ± 3.543	56.705 ± 2.578	79.266 ± 4.215	63.979 ± 4.116	55.277 ± 3.205
RVD (s)	0.035 ± 0.003	0.081 ± 0.005	0.114 ± 0.005	0.036 ± 0.004	0.077 ± 0.005	0.115 ± 0.007
PT = Peak Torque; RVD = Rate of Velocity Development						
* Indicates significant decrease from pre- to post-stretching						

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**1568 Board #170 May 27 11:00 AM - 12:30 PM**  
**The Effect Of Reproductive Hormones On Muscle Properties Across The Menstrual Cycle**

David R. Bell, Jonathan T. Blackburn, Marc F. Norcross, Kristin S. Ondrak, Anthony C. Hackney, FACSM, Darin A. Padua. *University of North Carolina at Chapel Hill, Chapel Hill, NC.* (Sponsor: Kevin Guskiewicz, FACSM)

(No relationships reported)

Reproductive hormones influence mechanical properties of ligamentous tissues such as the anterior cruciate ligament (ACL), potentially increasing their susceptibility to injury. However, little research has focused on the influence of reproductive hormones on muscle properties. As the hamstrings are capable of limiting ACL loading, changes in their mechanical properties may influence ACL injury risk.

**PURPOSE:** To determine if hamstring properties including stiffness (K), electromechanical delay (EMD), rate of force production (RFP), and time to 50% peak force (TT50) change across the menstrual cycle and differ across sex.

**METHODS:** Muscle properties were assessed at two time points in each subject: 7 days apart in males (n=15) and at points in the menstrual cycle corresponding with low (3-5 days post menses) and high (2-4 days post ovulation) estrogen concentrations in females (n=15). K was assessed by quantifying the damping effect imposed by the hamstrings on oscillatory knee flexion/extension induced by perturbation. EMD, TT50, and RFP were assessed during maximal isometric knee flexion. EMD was defined as the time interval between the onsets of EMG and force. TT50 was calculated as the time between the onset of force and the instant at which 50% peak force was attained. This force was expressed relative to body mass (N/kg), and RFP was calculated as the ratio of this normalized force to TT50. Blood hormone levels (estrogen [E], progesterone [P], and free testosterone [FT]) were assessed with radioimmunoassay procedures. 2 (sex) x 2 (time) repeated measures ANOVAs were used for analysis.

**RESULTS:** Females had greater [E] ( $68.0 \pm 23.2$  vs  $99.0 \pm 28.5$  pg/mL,  $p < 0.01$ ) and [P] ( $0.79 \pm 0.5$  vs  $6.6 \pm 6.7$  ng/mL,  $p < 0.01$ ) at ovulation than menses and equal [FT] ( $1.5 \pm 0.6$  vs  $2.1 \pm 0.6$  ng/mL,  $p = 0.63$ ). No interaction effects were observed for K ( $p = 0.43$ ), EMD ( $p = 0.65$ ), or TT50 ( $p = 0.62$ ), or RFP ( $p = 0.93$ ). Males had greater K ( $13.9 \pm 2.6$  vs  $11.5 \pm 1.7$  N/cm,  $p < 0.01$ ), RFP ( $1042 \pm 619$  vs  $501 \pm 223$  N/kg·sec<sup>-1</sup>,  $p < 0.01$ ), and faster TT50 ( $103 \pm 46$  vs  $129 \pm 32$  ms,  $p < 0.05$ ).

**CONCLUSION:** Muscle properties did not change during low and high estrogen periods of the menstrual cycle but sex differences were present. Results may be driven primarily by muscle mass than hormonal fluctuations. Future research needs to test at more time points during the menstrual cycle.

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1569 Board #171 May 27 11:00 AM - 12:30 PM

### The Effects Of Fatigue And Decision Making On Lower Limb Kinematics After Neuromuscular Training Program.

Tyler N. Brown, Riann Palmieri-Smith, Scott McLean. *University of Michigan, Ann Arbor, MI.*

(No relationships reported)

Despite the efficacy of neuromuscular training programs in countering risk factors associated with ACL injury, injury rates have not diminished. Fatigue and decision-making, factors synonymous with sports participation and known to promote high-risk mechanics, are not currently accounted for within the prevention modality. By failing to do so, we propose prevention efforts may remain substantially compromised.

**PURPOSE:** To determine whether the kinematic adaptations achieved through neuromuscular training are maintained over time in an unanticipated fatigued movement scenario.

**METHODS:** Thirty four (22 trained, 12 control) females had initial contact (IC) and peak stance (PS) lower limb kinematics initially quantified during non-fatigued anticipated (NAN) and then during fatigued unanticipated (FUN) single-leg land-and-cut tasks. Fatigue was induced cumulatively with subjects performing sets of 8 repetitive squats between unanticipated trials until squats could no longer be performed. All subjects were tested before (Base), immediately after (Post0) and six weeks (Post6) following a six week neuromuscular training program. Subject-based mean NAN IC and PS knee and hip flexion angles and corresponding angles from the final FUN trial were subsequently quantified and submitted to repeated measures three-way ANOVAs to test for the main and interaction effects of movement condition, time and group.

**RESULTS:** While a trend of a more extended landing posture was evident for FUN compared to NAN landings, statistically significant differences were not observed between these two conditions for IC or PS hip and knee flexion postures. Further, training did not counter this trend, with a consistently more extended posture evident for FUN tasks in both the control and training groups, both immediately and six weeks post.

**CONCLUSION:** Sports relevant movement tasks, incorporating fatigue and decision making, induce a more extended lower limb landing posture, which may increase the potential for ACL injury. Exposure to a standard, lab-based neuromuscular training protocol, however, does not reverse this trend, suggesting trained adaptations in the control strategy may not hold up under the rigors of realistic sports participation. Consideration of this fact within ongoing prevention efforts is warranted.

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## A-33 Free Communication/Poster - Sleep Deprivation and Diurnal Variation

MAY 27, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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1570 Board #172 May 27 9:30 AM - 11:00 AM

### 53 Hrs Of Sleep Deprivation On Thermoregulation During Multiple Stages Of Acute Cold Exposure

Katherine E. Pierce<sup>1</sup>, Tiffany A. Collinsworth<sup>2</sup>, Edward J. Ryan<sup>3</sup>, Chul-Ho Kim<sup>3</sup>, Keisuke Ida<sup>3</sup>, Jacob E. Barkley<sup>3</sup>, Gary H. Kamimori, FACSM<sup>4</sup>, Ellen L. Glickman, FACSM<sup>3</sup>. <sup>1</sup>Mount Union College, Alliance, OH. <sup>2</sup>Kennesaw State University, Kennesaw, GA. <sup>3</sup>Kent State University, Kent, OH. <sup>4</sup>Walter Reed Army Institute of Research, Silver Springs, MD.

(No relationships reported)

**BACKGROUND:** While the effects of sleep deprivation have proven to be psychologically detrimental, the physiological responses remain unclear. Sleep deprivation may alter a number of physiological processes; thereby suggesting that in combination with cold exposure, the ability of the body to maintain thermoregulatory homeostasis may be impaired. The relationship between sleep deprivation and thermoregulation has not been extensively evaluated.

**PURPOSE:** To evaluate the effect of 53-hrs of sleep deprivation on the thermoregulatory responses of young adult Caucasian males during multiple bouts of acute cold exposure.

**METHODS:** Eight males ( $22.8 \pm 1.7$  y) underwent two conditions [control (CON) or sleep deprivation (SDEP)] during which they were exposed to cold air (10°C) for 120-min, once per day, for 3 consecutive days (i.e., stage 1, 2, 3) beginning at 6:00am. Rectal temperature ( $T_{re}$ ), mean skin temperature ( $T_{sk}$ ) and oxygen consumption ( $\dot{V}O_2$ ) was collected at baseline (BASE) and 5-min, 15-min and every 15-min thereafter for the duration of the trial. Additionally, physical activity (PA) was continuously monitored with the use of an accelerometer.

**RESULTS:** Condition (SDEP, CON) by time (BASE, 5, 15min and every 15min until 120min), repeated measures ANOVAs revealed a significant interaction for  $T_{re}$  ( $p = 0.02$ ) during stage 2. The interaction was due to a significantly greater  $T_{re}$  ( $p < 0.05$ ) in the SDEP vs. the CON condition during BASE and minute 5 and 15 of ACE and no difference thereafter during Stage 2 of ACE. As expected, during SDEP volunteers expended  $400 \pm SD$  more kcal than CON as a result of increased ( $p = 0.001$ ) PA (SEDP  $679,470.00 \pm 135,598.89$  counts, CON  $389,024.13 \pm 114,933.04$  counts). Multilevel model regression analyses then demonstrated that daily PA across both conditions was positively associated ( $p \leq 0.01$ ) with BASE  $T_{re}$  across the final 2 stages.

**CONCLUSION:** SDEP appears to affect an individual's thermoregulatory response in a cold environment as the sleep deprived volunteers exhibited a greater  $T_{re}$  in SDEP than CON.



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**1571 Board #173 May 27 9:30 AM - 11:00 AM**

**The Effects Of 53 Hours Of Sleep Deprivation On Thermal Sensation During Acute Cold Exposure.**

Ellen L. Glickman, FACSM<sup>1</sup>, Katie Pierce<sup>1</sup>, Tiffany Collinsworth<sup>1</sup>, Jacob E. Barkley<sup>1</sup>, Gary Kamimori, FACSM<sup>2</sup>, Keisuke Ida<sup>1</sup>, Chul-Ho Kim<sup>1</sup>. <sup>1</sup>Kent State University, Kent, OH. <sup>2</sup>Walter Reed Army Institute of Research, Silver Spring, MD.

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(No relationships reported)

The relation between cold perception (i.e., an individual's ability to sense and scale thermal discomfort) and acute cold exposure (ACE) is an area that has considerable practical application to those individuals who may work in environmental extremes. Furthermore, it is well known that sleep deprivation (SDEP) decreases cognitive function which may influence individuals' perception of cold or thermal sensation (TS).

**PURPOSE:** To determine the effects of 53-h of SDEP on thermal sensation using the Gagge scale [TS: Gagge Scale (1967)] and Modified Gagge Scale [(TSM: Glickman-Weiss et al. 1994)] in apparently healthy Caucasian males during 3 separate stages of ACE.

**METHODS:** Eight males (22.8 ± 1.7 y) underwent 2 conditions [control (CON) or SDEP] during which they were exposed to cold air (10°C) for 120 min, once per day, for 3 consecutive days (or 3 stages). TS, TSM and rectal temperature ( $T_{re}$ ) was collected at baseline and 5 min, 15 min and every 15 min thereafter for the duration of the trial.

**RESULTS:** Two-way, repeated measures ANOVAs revealed significant condition by time interactions for  $T_{re}$  ( $p = 0.02$ ), TS ( $p = 0.05$ ) and TSM ( $p = 0.03$ ).  $T_{re}$  was greater ( $p < 0.05$ ) in the SDEP vs. the CON condition during min 0, 5, 15 then not different thereafter during Stage 2 of ACE. TS and TSM were greater (individuals sensed and scaled that they were colder) in the SDEP vs. the CON condition at 75 and 90 min for TS and 45 and 75 min for TSM (then not different thereafter) during Stage 2 of ACE.

**CONCLUSION:** From these data it appears that SDEP alters the perception of one's environment as participants, when sleep deprived, exhibited a greater  $T_{re}$  but sensed and scaled that they were colder.

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**1572 Board #174 May 27 9:30 AM - 11:00 AM**

**Effects Of Sleep Deprivation On The Thermoregulatory Responses During Recovery From Acute Cold Exposure**

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(No relationships reported)

While the physiological responses to acute cold exposure (ACE) have been examined, little research has been conducted examining the recovery (ACE-REC) aspect of ACE specifically during the presence of additional physiological stressors such as sleep deprivation (SDEP). Therefore, further examination of ACE-REC during SDEP warrants investigation to examine the afterdrop associated with cold exposure as this is the critical period when core temperature typically decreases and hypothermia may ensue.

**PURPOSE:** To examine the effects of 53 hours of SDEP on the thermoregulatory responses of males during recovery (ACE-REC) from three consecutive bouts of acute cold exposure (ACE).

**METHODS:** Eight healthy, Caucasian males (22.8 ± 1.7 y) completed a control (CON) trial during a normal night's sleep and an experimental trial during 53 hours of SDEP in which they were exposed to cold air (10°C) for 120-min, once per day beginning at 6:00am, for 3 consecutive days (ACE REC stage 1, 2, 3) followed by 120-min of ACE-REC beginning at 8:00am in 25°C. During ACE-REC, rectal temperature ( $T_{re}$ ) and mean skin temperature ( $T_{sk}$ ) were examined at baseline (BASE), 5-min, 15-min and every 15-min thereafter for the duration of the ACE-REC. Aerobic metabolic rate ( $\dot{V}O_2$ ) was measured at BASE, 15-min, 25-min and every 30-min thereafter for the duration of the ACE-REC.

**RESULTS:** Condition by time repeated measures ANOVAs demonstrated a main effect for time ( $p \leq 0.001$ ) for  $T_{re}$  for all stages of ACE-REC whereby  $T_{re}$  decreased across time. ACE-REC Stage 3 demonstrated a condition by time interaction ( $p \leq 0.001$ ) whereby  $T_{re}$  was greater for SDEP relative to CON. Condition by time ANOVAs for all three ACE-REC stages also demonstrated a main effect for time ( $p \leq 0.001$ ) for  $T_{sk}$  and  $\dot{V}O_2$ . as  $T_{sk}$  and  $\dot{V}O_2$  decreased across time.

**CONCLUSION:** Based on these data, during ACE-REC,  $T_{re}$  was increased during SDEP conditions as compared to CON conditions after 53-hours of sleep deprivation. Alterations of the sleep-wake cycle through SDEP may have altered core temperature.

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**1573 Board #175 May 27 9:30 AM - 11:00 AM**

**The Effect Of Jet Lag On Parameters Of Sleep In Elite Divers Quantified By Actigraphy.**

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(No relationships reported)

It is well documented that circadian desynchronization caused by long haul travel can have a negative effect on athletic performance. However, the majority of available research using elite athletes has simply focused on subjective parameters of sleep.

**PURPOSE:** To quantify the effect of circadian desynchronization on objective parameters of sleep following long haul travel crossing 8 time zones.

**METHODS:** 6 male (mean age 23.3 ± 5.8 yrs) and 9 female (mean age 22.1 ± 3.8 yrs) GB Olympic Squad divers were monitored using wristwatch actigraphy over 16 nights which included 10 nights in their home environment in Great Britain (baseline) and 6 nights post travel from Great Britain to China (nights 1-6). Key measures included: time in bed (TIB), actual sleep time (AST), sleep latency (SL), mean wake bout time (MWBT) and sleep efficiency (SE).

**RESULTS:** The largest disruption in sleep parameters occurred on nights 1 and 4. Athletes had more TIB (09:54 ± 01:09 vs. 08:42 ± 00:35 hrs,  $p < 0.05$ ) and experienced higher AST (08:12 ± 01:07 vs. 06:59 ± 00:34 hrs,  $p < 0.01$ ) on night 1 post travel compared to baseline. During nights 2 and 3, parameters of sleep closely resembled baseline. During night 4 post travel, athletes experienced lower AST (05:56 ± 01:20 vs. 06:59 ± 00:34 hrs,  $p < 0.05$ ) and higher MWBT (02:58 ± 02:16 vs. 02:07 ± 00:24 mins,  $p < 0.05$ ) compared to baseline. SL was longer on night 4 than night 1 (00:33 ± 00:51 vs. 00:20 ± 00:15 hrs,  $p < 0.05$ ). SL and MWBT were negatively correlated with SE ( $r = -0.57$ ,  $p < 0.01$  and  $r = -0.62$ ,  $p < 0.01$ , respectively).

**CONCLUSION:** The apparent reduction in parameters of sleep on night 4 are likely due to a combination of 1) delayed effect of extra sleep acquired relative to baseline on night 1, and 2) negative effect of circadian desynchronization, in particular on SL and MWBT. Objectively monitoring the effects of circadian desynchronization by wristwatch actigraphy proved an indispensable tool for planning future travel strategies in this group of athletes.

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**1574 Board #176 May 27 9:30 AM - 11:00 AM**

**The Race Across America: A Cycle Race Or A Sleep Deprivation Challenge?**

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The Race Across America (RAAM) is a continuous cycle race in which having adequate sleep and recovery represents an important aspect of performance.

**PURPOSE:** To investigate sleep quantity and quality among riders in a 4-man team participating in the RAAM.

**METHODS:** Riders followed a daily work-rest strategy consisting of two episodes of 3 hours riding and 3 hours recovery, and one episode of 6 hours riding and 6 hours recovery. The sleep pattern measurements of 3 endurance-trained cyclists were obtained from an actigraph activity monitor secured to the right ankle of each cyclist. The monitors recorded activity counts per minute for 3 days pre-race and throughout the 3,014 mile race duration. Derived measures include sleep duration, wake time after sleep onset, and sleep efficiency ((sleep duration – wake time)/sleep duration) × 100).

**RESULTS:** Baseline measures showed the participants to be highly efficient sleepers (sleep efficiency mean + SD: 83.8 + 3.4 %). Cyclists mean sleep efficiency decreased to 17.9 + 10.6 % during the RAAM. The mean sleep duration per episode of sleep of cyclist 1, 2, and 3 was 51 + 46.3, 40.6 + 43, and 51.6 + 36.3, respectively. After the onset of sleep, the three cyclists mean wake time per sleep episode was 54.7 + 57.3, 47.7 + 62.5, and 47.9 + 57.6, respectively. The cyclists mean sleep efficiency per episode of sleep was 18.4 + 15.3, 14.4 + 12.8, and 20.7 + 12.6, respectively. Although the amount of sleep recorded declined significantly as the event progressed, there was considerable intra-individual variation. In the first six sleep attempts cyclists 1, 2 and 3 slept for total durations of 385, 347, and 352 min, respectively. However, in the last 6 sleep attempts one cyclist recorded just 9 min sleep in contrast to 129 and 173 min for the other two cyclists, a finding that is illustrative of large intra-individual variation.

**CONCLUSIONS:** Riding in the RAAM was associated with significant disruption to measures of sleep quantity and quality. Although the sleep patterns exhibited were related to a successful 3<sup>rd</sup> place finish, improved sleep may have resulted in enhanced performance. Due to the wide variation between the cyclists in the amount of sleep disruption experienced, interventions to improve sleep quantity and quality during multi-day ultra-endurance events such as the RAAM should be individually based.

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**1575 Board #177 May 27 9:30 AM - 11:00 AM**  
**Effect Of Sleep Deprivation On Running Time To Exhaustion In Untrained Males**

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(No relationships reported)

Sleep deprivation (SD) has consistently been shown to negatively impact thought processes and mood. Elite and amateur athletes, as well as military personnel, regularly experience SD, yet the impact on exercise performance has yet to be fully elucidated.

**PURPOSE:** To compare the running time to exhaustion (RTE) of untrained males under normal sleep (NS) and SD conditions. Rate of perceived exertion (RPE), heart rate (HR), oxygen consumption (VO<sub>2</sub>), respiratory exchange ratio (RER), and lactate (LCT) were also considered.

**METHODS:** Two endurance runs to volitional exhaustion at 75% VO<sub>2peak</sub>, one after NS and one after SD (22.3 ± 0.68 hr), were completed by 6 untrained males (29 ± 6.5 yrs, 35 ± 3.7 ml/kg/min) following an 8 hr fast. VO<sub>2</sub>, VCO<sub>2</sub>, and RER were measured by a PhysioDyne Max II Metabolic Cart, HR was measured by a Polar HR Monitor, LCT was analyzed with an AccuTrend lactate analyzer, RPE was self reported from the Borg Scale, and RTE was recorded with a Timex Stopwatch. Repeated measures t-tests were computed for RTE, VO<sub>2</sub>, and RPE. Repeated measures ANOVAs were computed to compared differences in RER, LCT, and HR.

**RESULTS:** No significant interactions (p > 0.05) existed between sleep and time for RER, LCT, and HR. No significant differences (p > 0.05) existed for RTE, VO<sub>2</sub>, and RPE. A significant main effect (p < 0.05) for time existed for LCT and HR. Mean LCT (mmol/l) increased during NS and SD exercise (1.87 ± 0.06 at baseline, 4.44 ± 0.60 at the completion of exercise, and 2.85 ± 0.36 at 10 min post exercise, p < 0.05). Mean HR (bpm) increased during NS and SD exercise (63.25 ± 2.48 at baseline, 175 ± 6.43 at the completion of exercise, and 96.00 ± 4.35 at 10 min post exercise, p < 0.05). A significant main effect (p < 0.05) for condition existed for HR. HR during the NS trial was significantly higher than mean HR during the SD trial (112.8 ± 3.36 v. 109.9 ± 2.87, p < 0.05).

**CONCLUSION:** Sleep deprivation appears to impact HR, and SD may influence exercise performance.

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**A-34 Free Communication/Poster - Space Physiology and Microgravity**

MAY 27, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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**1576 Board #178 May 27 9:30 AM - 11:00 AM**  
**Near-infrared Spectroscopic Measurements Of Calf Muscle During Walking At Simulated Reduced Gravity- Preliminary Results**

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Lunar and planetary exploration space suit design can be enhanced by considering the physiologic responses of individual muscles during locomotion in reduced gravity. Near-infrared spectroscopy (NIRS) provides a non-invasive method to study metabolic responses of individual muscles in ambulatory subjects during reduced gravity simulations.

**PURPOSE:** To investigate calf muscle oxygen saturation (SmO<sub>2</sub>) and pH during reduced gravity walking at varying treadmill inclines and added mass conditions using NIRS.

**METHODS:** Four male subjects aged 42.3 ± 1.7 years (mean ± SE) and weighing 77.9 ± 2.4 kg walked at a moderate speed (3.2 ± 0.2 km•h<sup>-1</sup>) on a treadmill at inclines of 0, 10, 20, and 30%. Unsuit subjects were attached to a partial gravity simulator which unloaded the subject to simulate body weight plus the additional weight of a space suit (121 kg) in lunar gravity (0.17G). Masses of 0, 11, 23, and 34 kg were added to the subject and then unloaded to maintain constant weight. Spectra were collected from the lateral gastrocnemius (LG), and SmO<sub>2</sub> and pH were calculated using previously published methods (Yang et al. 2007 Optics Express ; Soller et al. 2008 J Appl Physiol). The effects of incline and added mass on SmO<sub>2</sub> and pH were analyzed through repeated measures ANOVA.

**RESULTS:** SmO<sub>2</sub> and pH were both unchanged by added mass (p > 0.05), so data from trials at the same incline were averaged. LG SmO<sub>2</sub> decreased significantly with increasing incline (p = 0.003) from 61.1 ± 2.0% at 0% incline to 48.7 ± 2.6% at 30% incline, while pH was unchanged by incline (p = 0.12).

**CONCLUSIONS:** Increasing the incline (and thus work performed) during walking causes the LG to extract more oxygen from the blood supply, presumably to support the increased metabolic cost of uphill walking. The lack of an effect of incline on pH may indicate that, while the intensity of exercise has increased, the LG has not reached a level of work above the anaerobic threshold. In these preliminary studies, 30% incline walking at reduced gravity may not require anaerobic LG activity due to the low exercise intensity (42.8 ± 1.6% of VO<sub>2max</sub>). It is also possible that at reduced gravity additional work required for increased inclines may be performed by other muscles.

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**1577 Board #179 May 27 9:30 AM - 11:00 AM**  
**Low Load Resistance Training With Blood Flow Restriction As A Countermeasure To Disuse Atrophy**

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(No relationships reported)

Decreases in strength and neuromuscular function are observed following prolonged disuse. Exercise countermeasures to prevent muscle dysfunction during disuse typically involve high intensity resistance training.

**PURPOSE:** To evaluate the effectiveness of low-load resistance training with a blood flow restriction to mitigate muscle loss and dysfunction during 30 days of unilateral lower limb suspension (ULLS).

**METHODS:** Sixteen subjects (9M, 7F; 18-49 yr) underwent 30 days of ULLS. Measurements of voluntary and evoked forces and muscle cross-sectional area (CSA) of the knee extensors were collected before and after ULLS. During ULLS, 8 subjects (5M, 3F) participated in a low-load (20% of an isometric maximum voluntary contraction (MVC)) resistance training program with a blood flow restriction (1.3 times systolic blood pressure) on the knee extensors three times per week.

**RESULTS:** After 30 days of ULLS, the subjects who performed the blood flow restricted resistance training experienced a 1.3% loss of quadriceps femoris CSA and a 1.5% decrease in one repetition maximum (1-RM) strength while the subjects who did not exercise lost 8% CSA and 21% strength. The loss of CSA and 1-RM strength was significantly different between the groups ( $p=0.04$  and  $p=0.02$ , respectively). The number of repetitions completed during a dynamic knee extension muscular endurance task at a workload of 40% MVC improved 31% in the subjects who performed blood flow restricted exercise, but decreased 24% in those who did not exercise ( $p=0.01$ ). No changes during ULLS, or between the groups were found for twitch and doublet force, central activation, rates of force development and rates of relaxation ( $p>0.05$ ).

**CONCLUSIONS:** Low-load blood flow restricted resistance training of the knee extensors can maintain muscle strength and size during 30 days of ULLS and results in improved muscular endurance.

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**1578 Board #180 May 27 9:30 AM - 11:00 AM**  
**Baroreflex Sensitivity Decreases During 90-day Bed Rest**

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**PURPOSE:** Baroreflex sensitivity (BRS) decreases during spaceflight and simulated spaceflight (head down bed rest [BR]). However, previous studies have only examined BRS in response to a limited blood pressure (BP) range or to a single sudden change in BP. The purpose of this study was to examine BRS during 90 days of 6° head-down tilt BR over a broad range of BP perturbations.

**METHODS:** Nineteen normal volunteers (12M, 7F) were tested one day before BR, and then near BR days 30, 60 and 90. BP was pharmacologically altered by continuous infusions of phenylephrine (PE) and sodium nitroprusside (SNP). Electrocardiogram and continuous BP were collected during 10 min of normal saline (NS), followed by increasing concentrations of PE (10 min each of 0.4, 0.8 and 1.6 µg/kg/min). After a 20 min break, NS was infused again for 10 min, followed by increasing concentrations of SNP (10 min each of 0.4, 0.8, 1.2 µg/kg/min). Baroreceptor sensitivity was measured as the slope of a sequence of 3 or more beats in which the systolic BP and following R-R interval (RR) both increased or decreased. Spectral heart rate variability (HRV) and mean RR were analyzed using data from only the NS infusions. Two-way repeated-measures analysis of variance was performed to examine the effects of BR and gender.

**RESULTS:** RR decreased ( $p<0.001$ ) from pre-BR across BR days. High frequency in normalized units, a measure of parasympathetic activity, decreased with BR ( $p=0.027$ ) and was lower ( $p=0.046$ ) in men ( $0.39\pm0.02$ , mean  $\pm$ SEM) than women ( $0.48\pm0.02$ ). The spontaneous baroreflex slope, our measure of BRS, increased with PE and decreased with SNP across BR ( $p<0.001$ ). The percentage decrease in BRS from pre- to post-BR appeared to be larger in women ( $43.6\pm7.0\%$ ) than in men ( $31.3\pm3.9\%$ ,  $p=0.06$ ).

**CONCLUSIONS:** Parasympathetic activity and baroreflex sensitivity decrease during 90 days of BR, and BRS tends to diminish more in women than in men.

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**1579 Board #181 May 27 9:30 AM - 11:00 AM**  
**Graded Compression Stockings Prevent Post-spaceflight Orthostatic Hypotension**

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**PURPOSE:** Post-spaceflight orthostatic intolerance is observed in 20-30% of astronauts. Previous data from our laboratory suggests that this is largely a result of decreased venous return. Currently, NASA astronauts wear an anti-gravity suit (AGS) which consists of inflatable air bladders over the calves, thighs and abdomen, which are typically pressurized from 0.5 to 1.5 PSI (~27 to 78 mmHg). ISS crew members sometimes wear Russian Kentavrs which consist of laced compression shorts and gaiters, providing ~30 mmHg nominally. While these garments are effective during reentry, there are a number of drawbacks that make them impractical for postflight use. We studied the ability of commercially available, custom fit, graded compression stockings (Jobst, 55 mmHg at ankle to 6 mmHg at top of thigh, 25 mmHg mean compression) to prevent postflight orthostatic intolerance, hypothesizing that these garments would prevent orthostatic intolerance following short duration space flight.

**METHODS:** Five crew members from a single Space Shuttle flight were tilted to 80° for 10 min while wearing the stockings upon arrival at the clinic (~2 hrs after landing). Hemodynamic data were compared to data from all crewmembers tested (without countermeasures) since return to flight ( $n=9$ ).

**RESULTS:** Two-way, repeated measures ANOVA, using the entire tilt time curve (0-10 min) show that systolic blood pressure (SBP,  $p=0.008$ ), stroke volume (SV,  $p=0.003$ ), and cardiac output (CO,  $p=0.004$ ) were higher in crewmembers who wore the Jobst stockings. A one-way ANOVA comparing the last minute standing also showed that SV ( $p=0.001$ ) and CO ( $p<0.001$ ) were higher and SBP tended to be higher ( $p=0.06$ ) in Jobst subjects compared to controls. Control subjects had a higher rate of presyncope than Jobst subjects (3/9 vs 0/5) during the tilt on landing day.

**CONCLUSIONS:** Orthostatic hypotension continues to present following spaceflight, despite fluid loading and other countermeasures. This preliminary study shows that compression stockings may ameliorate this problem. These stockings are readily available, inexpensive, and can be worn for days following landing. We have observed similar protection against orthostatic intolerance in ground-based studies of hypovolemic test subjects. Further refinements to the design of these stockings are in progress.

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**A-35 Free Communication/Poster - Sports Equipment**

MAY 27, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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**1580 Board #182 May 27 9:30 AM - 11:00 AM**  
**Effect Of Ankle Bracing On Vertical Jump: Performance And Muscle Activation Patterns In Lower Limb.**

Eric Snyder, Julie Duling, Casey Luttfing, Lucinda Bouillon. *University of Findlay, Findlay, OH.*  
(No relationships reported)

A powerful vertical jump is an important aspect of being a successful volleyball player. Often times, athletes may use ankle bracing to reduce injuries. Currently, it is unclear whether bracing may alter muscle activation patterns in the lower limb secondary to increased stabilization.

**PURPOSE:** To determine if ankle bracing has an effect on muscle activation patterns and performance during vertical jump (VJ) in braced (B) and unbraced (NB) conditions.

**METHODS:** Eight healthy volleyball collegiate females (18.7 + 1.03yr; 172.9+ 6.52cm; 76.0+ 20.99kg) were recruited. Bi-polar surface electromyography (SEMG), sampling at 1000Hz, was utilized to record muscle activity of 8 muscles on the dominant limb, the rectus femoris (RF), vastus medialis oblique (VMO), biceps femoris (BF), gluteus maximus (GMax), gluteus medius (GMed), tibialis anterior (TA), peroneus longus (PL), and lateral gastrocnemius (LG), during the VJ after random assignment to either B or NB conditions. Muscle activity was analyzed for 3 seconds, and SEMG amplitude values (root mean square) were rectified and normalized to each respective maximal voluntary isometric muscle contraction (MVC). The rectified and normalized SEMG amplitude values were then averaged for all subjects across the three trials of the VJ and expressed as %MVC. The Vertec was used to measure VJ height starting with both feet planted on the ground and then jumping to reach the highest point on the Vertec. Three trials were performed and the mean value of VJ and SEMG for each muscle were recorded for each subject and compared between conditions (B and NB) using paired t-tests ( $\alpha=0.05$ ).

**RESULTS:** The intrareliability ICCs ranged from 0.90-0.99, with the CVs ranging .58% to 2.1%. Paired t-tests found that jump height for B group (258.8+ 9.32 cm) and NB group (259.6+ 8.16 cm) were not significantly different. Differences in muscle activity with the LG demonstrated higher mean activity when braced, (B: 73.5+ 22.23%; NB:66.2+ 25.74%,  $p=0.05$ ) and the PL exhibited lower mean activity when braced, (B: 53.1+ 29.57%; NB: 67.22+ 21.49%,  $p<0.05$ ).

**CONCLUSION:** Ankle bracing does not have an effect on an individual's performance with vertical jump, but there is greater activation of the lateral gastrocnemius and decreased activity of the peroneus longus with the ankle brace during a vertical jump.

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**1581 Board #183 May 27 9:30 AM - 11:00 AM**  
**Test-retest Reliability And Validity Of Ultrasonic 3d-motion Analysis System**

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(No relationships reported)

There are many motion capture systems which can measure three-dimensional human motion. However, most of motion capture system required large space and not cost friendly. Zebris 3D-motion analysis system adopted ultrasound as the measurement tool instead of using video resource. The strength of ultrasonic 3D-motion analysis is easy to maneuver, less space requirement and cost friendly. So far, there were few studies using ultrasonic 3D-motion analysis system as the research tool since the system was relative new on the market. Therefore, the reliability and validity of ultrasound motion analysis system has not been really examined.

**PURPOSE:** To exam reliability and validity of ultrasonic 3D-motion analysis system when compared to Biodex system.

**METHODS:** The Zebris ultrasonic 3D-motion analysis system CMS-HS v10 (Medical GmbH, Tübingen, Germany) was used to measure validity of rigid body angular motions when compared to Biodex system (Biodex medical system, Shirley, NY). Two sets of ultrasound cluster (each has three markers) were separately placed on the Biodex rotational axis and its attachment arm. The calibration of Biodex was defined when Biodex attachment arm placed parallel to the floor and set it as 0°. Positive angle direction was defined when the attachment arm went upward. Ultrasonic 3D kinematic data were measured every 10° of Biodex attachment arm motion from -70° and end at 110° at 50 Hz sampling rate. Repeated experiments were performed again next week to exam intra-session test-retest reliability of ultrasonic 3D-motion analysis system.

**RESULTS:** The validity test between ultrasonic 3D-motion analysis system and Biodex system showed strong correlation ( $r=1.0$ ). The test-retest reliability coefficient of ultrasonic 3D-motion analysis system in flexion-extension direction was approached to 1(0.998-1); in valgus-vargus direction was about 0.855(0.529-0.93); in rotational direction was 0.997(0.983-0.997).

**CONCLUSIONS:** Ultrasonic 3D-motion analysis system demonstrated high validity when compared to Biodex system. It also demonstrated good consistency and repeatability in test-retest reliability examinations. The findings presented in this study suggest that ultrasonic 3D-motion analysis system is a trustable and equally efficient tool to measure 3D kinematics data.

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**1582 Board #184 May 27 9:30 AM - 11:00 AM**  
**Knee Wraps Change The Angle Of Peak Torque During Leg Extension Among Collegiate Powerlifters**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to determine the effect of knee wraps on the angle of peak torque during continuous passive movement isokinetic leg extension in collegiate powerlifters.

**METHODS:** Nine (6 male, 3 female) healthy, competitive collegiate powerlifters, ranging in age from 19-23, were utilized in this study. A CSMI Humac Norm isokinetic extremity testing system was used to evaluate the angle of peak torque during continuous passive movement isokinetic leg extension with knees (a) unwrapped and (b) wrapped. Paired samples t-tests were used to determine if there were statistically significant differences in the angle of peak torque during the two testing conditions. Alpha levels were set a priori at 0.05 to determine statistical significance.

**RESULTS:** (reported by mean change + SD): The change in the angle of peak torque during continuous passive movement isokinetic leg extension (67.00 + 40.46 degrees) was significant ( $p<0.001$ ).

**CONCLUSIONS:** The data from this study indicate that the use of knee wraps significantly changes the angle of peak torque during continuous passive movement isokinetic leg extension in collegiate powerlifters.

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**1583 Board #185 May 27 9:30 AM - 11:00 AM**  
**Validity Of New Chronopic V.3 Open Hardware To Measure Time On Jump Related Tests**

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(No relationships reported)

Chronojump project involves the creation of an electronic short time tracking device focused on measuring the time of jumps. Chronojump uses a measurement PIC device called Chronopic. Early versions of Chronopic were adapted from a microcontroller used in robotics area. The new Chronopic v.3 has been developed from scratch, with only



the components needed for sports time evaluation (eg. Bosco tests). It's licensed as open hardware in order to be accessible, to allow derivative development and to be fully peer-reviewable.

**PURPOSE:** validate Chronopic v.3 for jump time tests.

**METHODS:** Square waves generators Hameg HM 8035 and HM 8030-4 (for lower frequencies unavailable on 8035) create waves with 50% of duty cycle which are detected by an Agilent 54621A Oscilloscope. Agilent and Chronopic v.3 recorded waves from 9 to 1.5 Hz at intervals of 0.5 Hz and the data was compared.

**RESULTS:** On full studied spectrum; at low signal (corresponding to TC -Contact Time on a jump) AVG error is 0.04% and 0.18 SD, while at high signal (TF -Flight Time) AVG error is 0.05% and 0.19 SD. Sampling normal jump data (200-700 ms): at low signal AVG error is 0.04% and 0.16 SD, while at high signal AVG error is 0.13% and 0.21 SD. These results were satisfactory. On the other hand, the intentional limitation of Chronopic v.3 on filtering signals corresponding to a TC or TF lower than 50 ms in order to prevent electronic rebounds doesn't work in all situations: two ranges of instability were found: 9.390-9.950 Hz (53.248-50.251 ms of TC or TF) and 20-20.200 Hz (25-24.752 ms of TC or TF). This filtering problem is not significant in jump tests because the instability occurs at intervals below the lowest contact times of a drop jump: 150 ms approx. Also the conflictive full range time is shorter than 4 ms.

**CONCLUSIONS:** Chronopic v.3 measurements are optimal for jump tests time tracking. Two little signal ranges can produce rebound problems at really low times. This withdrawal is far related to the Chronopic v.3 intended range of frequencies (jump time tests) but it will be studied further and fixed in firmware if necessary.

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**1584 Board #186 May 27 9:30 AM - 11:00 AM**  
**Effects Of Football Equipment On Average Momentum: Implications For High School Players.**

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(No relationships reported)

The concept of momentum is continuously demonstrated through collisions on the football field. A player's momentum is an essential component of routine responsibilities, such as tackling or blocking an opposing player during a game. Momentum is related to a player's mass and velocity. A traditional measure of assessing a player's velocity is done through administering the 40-yd dash without protective equipment. Previous research has shown the addition of protective equipment will cause an increase in a player's mass and a decrease in the player's velocity; however, this variable trade-off's effect on momentum has yet to be determined.

**PURPOSE:** : To determine effects of football equipment on players' average momentum in the 40-yd dash.

**METHODS:** Sixty-six high school football players (weight  $78.28 \pm 15.45$  kg) were timed in the 40-yd dash, wearing either standard football equipment (EP) or nylon shorts and a T-shirt (NEP), on a natural grass field. An automatic timing system with high speed video camera (30 frames/sec), starter pistol, receiver, and timing software was utilized to collect 40-yd dash times. Participants performed two trials under each condition and the faster of the two trials for each condition were used for analysis. A calibrated balance scale was used to record participant weight, both with and without pads. A dependent samples T-test was utilized to assess significance between momentum with and without equipment at an alpha level of 0.05.

**RESULTS:** A significant difference was found between NEP ( $499.51 \pm 79.97$  kg-m/s) and EP ( $512.43 \pm 77.81$  kg-m/s) conditions ( $p < 0.05$ ).

**CONCLUSIONS:** Momentum of high school football players increased significantly with the addition of standard football equipment. Though there is a decrease in velocity with the added weight of equipment, the product of the reduced velocity and the increased weight is greater than the product of the increased velocity and reduced weight. . Examining differences in momentum (with and without equipment) can aid in the identification of players that fall below the norm. The players that carry extra weight inefficiently may require specific training to accommodate the increase in mass caused by protective equipment.

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**1585 Board #187 May 27 9:30 AM - 11:00 AM**  
**Physical And Mechanical Properties Of Commercialized Mouthguard Materials Across A Range Of Temperatures**

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(No relationships reported)

Mouthguards (MG) should be tested and function well at their theoretical end-use intra-oral temperature (approx 37°C). However, the influences of breathing and ambient environment make it unlikely that MGs could maintain this constant temperature. Therefore, a MG materials need to perform consistently over a wide range of possible temperatures (-20 to 40°C).

**PURPOSE:** To characterize commercialized MG materials' properties and investigate the effect of temperature on these properties.

**METHODS:** Five commercial thermoplastic MG materials (ER, EF, PR, PL, PS) were tested. The durometer hardness, water absorption, tear strength, and impact attenuation of the MG materials were measured according to ASTM D2240-05, D570-98 (2005), D624-00, and ASTM D6110-06f (modified) guidelines. Tests were conducted on 5 separate specimens at both room 23  $\pm$  2°C and intra-oral 37  $\pm$  2°C temperatures. Data was entered into the Statistical Package for Social Sciences (SPSS v. 15.0, SPSS Inc., Chicago, Ill.). Independent t-tests (Type I error = 0.05) were implemented to test for differences between room and intra-oral temperatures.

**RESULTS:** Material hardness between room and intra-oral temperatures was significantly different for the ER ( $t(8) = 20.87, p < .05$ ), EF ( $t(8) = 19.61, p < .05$ ), PR ( $t(8) = 15.18, p < .05$ ), PL ( $t(8) = 16.44, p < .05$ ), and PS ( $t(8) = 17.71, p < .05$ ) materials. Water absorption between room and intra-oral temperatures was significantly different for the ER ( $t(4) = -7.23, p < .05$ ), EF ( $t(4) = -25.325, p < .05$ ), PR ( $t(4) = -3.11, p < .05$ ), PL ( $t(4) = -5.95, p < .05$ ), and PS ( $t(4) = -88.22, p < .05$ ) materials. Tear strength between room and intra-oral temperatures was significantly different for the ER ( $t(6) = 14.14, p < .05$ ), EF ( $t(6) = 18.91, p < .05$ ), PR ( $t(6) = 5.34, p < .05$ ), PL ( $t(6) = 6.15, p < .05$ ), and PS ( $t(6) = 14.26, p < .05$ ) materials. Impact attenuation between room and intra-oral temperatures was significantly different for the EF ( $t(4) = 7.92, p < .05$ ), PL ( $t(4) = 3.62, p < .05$ ), and PS ( $t(4) = -11.15, p < .05$ ). However, there was no difference between temperatures for the ER ( $p = .058$ ) or PR ( $p = .275$ ) materials.

**CONCLUSIONS:** Temperature negatively affects the physical and mechanical properties of MG materials. It is particularly noteworthy that none of the commercialized products met current ANSI and SAI standards for impact attenuation.

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**1586 Board #188 May 27 9:30 AM - 11:00 AM**  
**An Electromyographic Investigation Of The Biceps Brachii Using Adjustable Variable Resistance**

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( D.G. Drury, STRIVE Enterprises, Inc, Consulting Fee.)

Although variable resistance has been used extensively in the production of strength training equipment for many years, the physiological and biomechanical data analyzing this type of training remains scant. Furthermore, very few investigations have quantified how the use of different cams can alter muscle fiber recruitment.

**PURPOSE:** To investigate differences in the electromyographic (EMG) muscle fiber recruitment of the Biceps Brachii (BB) at various joint angles during the Concentric (Con) and Eccentric (Ecc) phases of exercise on an Adjustable Variable Resistance (AVR) machine.

**METHODS:** Eighteen healthy college aged ( $20.61 \pm 1.42$ ) males performed 2 sets of BB flexion and extension exercise using divergent cam settings (A & B) of a STRIVE AVR machine. EMG and Electrogoniometer (EG) measurements were taken simultaneously to determine the electrical activity of the BB at joint angles corresponding to 40°,

85° and 120° during both the Con and Ecc phases of the movement. The pace of the exercise was controlled using a metronome and the resistance was a weight corresponding to 50% of a predetermined 6 repetition maximum. The Root Mean Square (RMS) EMG scores were rectified and normalized by dividing each score into a maximal isometric reference contraction performed prior to testing. The order in which the cam positions were introduced was randomized and sets were separated by 3:00 minutes of rest. EMG scores were analyzed using a standard T-test with an a-priori value of significance set at  $p < 0.05$ .

**RESULTS:** RMS EMG scores are reported below for cam positions A & B.

Cam	40° Con	85° Con	120° Con	40° Ecc	85° Ecc	120° Ecc
A	32.63±12.10	40.67±14.01	62.33±23.16	18.70±9.88	18.77±8.95	24.15±13.20
B	26.86±11.17	37.36±10.32	63.54±22.18	13.73±7.34	17.58±8.83	25.22±11.07
P-value	0.0005**	0.2131	0.6164	0.0002**	0.3146	0.6875

**CONCLUSIONS:** Based upon the limitations of this study, we conclude that muscle activation can indeed be altered within a given range of motion by altering the orientation of the Cam.

**1587 Board #189 May 27 9:30 AM - 11:00 AM**  
**Makiwara Punching Board Performance Evaluation**

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**PURPOSE:** Makiwara, punching board, training is an integral part of the development of proper karate punching technique. Karate practitioners use a board design and wood type based on their skill level and physical characteristics. This study compared the force-deflection, or stiffness of two makiwara board designs (tapered and stacked) made with four species of wood commonly used for punching boards (oak, cherry, ash, and fir).

**METHODS:** Five replications each of Northern White Ash, Pennsylvania Cherry, Red Oak, and Douglas Fir makiwara boards of the tapered board and stacked board designs were constructed for testing in a base/loading mechanism specifically designed for this purpose (N = 20). Boards were tested by static loading each with weights and recording deflection values at 111.2 N (25 lbs) increments of weight ranging from 111.2 N to 1000.8 N (25-225 lbs) in counterbalanced order. Force-deflection data were plotted for each board specie and design. ANOVA (2 x 4) with repeated measures as used to determine if differences exist among the designs and species.

**RESULTS:** Mean deflections were significantly different for all conditions ( $p < 0.05$ ) of board type and load for stacked and tapered makiwara board types. Tapered boards showed less flexure upon loading than did stacked boards ( $p < 0.05$ ). For both tapered and stacked board types, oak had the least average deflection followed by fir, cherry, and ash ( $p < 0.05$ ). Load/deflection curves show approximate linearity of all board types over all wood species. Stiffnesses calculated from the best fit load/deflection lines show the same trends as with average deflections with oak being the stiffest wood and ash being the most compliant. Stacked boards were more prone to breakage. Specifically, four of the stacked fir boards broke (80%), all five of the stacked ash boards broke (100%), and two of the stacked cherry boards broke (40%). None of the oak boards broke.

**CONCLUSION:** The results of this study suggest compliance with recommendations of progressive overload in sports training. The lower stiffness (by a factor of two) of stacked boards implies a greater suitability for novice practitioner as these will offer less resistance to the punch. For truly progressive training one could start with the most compliant wood type (ash) and move up towards the stiffest (oak).

**1588 Board #190 May 27 9:30 AM - 11:00 AM**  
**Comparison Of Forefoot And Heel Pressures Across Fast Walking And Four Elliptical Trainer Conditions**

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 (No relationships reported)

Elliptical training is growing in popularity in many medically-based fitness facilities and rehabilitation centers as a method of building cardiovascular fitness. However, some exercisers with underlying medical conditions may be at risk for stress-related foot injuries.

**PURPOSE:** To enhance understanding of how plantar pressures (heel, forefoot) vary across elliptical trainers and in comparison to walking in order to guide clinical decision-making related to elliptical training exercise prescriptions.

**METHODS:** 20 healthy adults participated (10 male, 10 female; age 46±23yrs). After a familiarization session, each subject performed comfortable and fast walking (FW) trials followed by a randomized order of elliptical training on the following devices: LifeFitness (L), Octane (O), SportsArt (S) and True (T). To simulate FW, subjects were instructed to use the longest stride length available on each device while maintaining an elliptical training speed that matched their comfortable walking speed. Pressure data were recorded during fast walking and the final 30 seconds of the third minute of each elliptical trial. For each subject, Peak Pressure (PP, in KPa) and Pressure-Time Integral Dosage (DOS, defined as the cumulative pressure during one minute of activity) values were calculated using data recorded from 10 cycles for each activity. Separate 5x1 ANOVAs with repeated measures identified significant differences for the heel and forefoot.

**RESULTS:** Forefoot: PP (Mean±SD): FW>L,O,T (272+80>166+48, 165+57, 154+53;  $p < .001$ ). DOS: T,L,O,S>FW (7621+2152, 7541+1773, 7270+2022, 7216+2132>5764+1055;  $p < .002$ ). Heel: PP: FW>S,O,L,T (256+62>137+39, 118+35, 115+39, 109+32;  $p < .001$ ). DOS: FW>T,L (5731+2735>3319+1972, 3302+1878;  $p < .001$ ) & S>T (4810+2600>3319+1972;  $p < .001$ ).

**CONCLUSION:** While forefoot peak pressures were consistently lower during elliptical training, the finding that cumulative pressures (DOS) were higher suggests care should be used during extended periods of exercise at longer stride lengths if forefoot protection is warranted (e.g., diabetes). Pressure patterns under the heel indicate that elliptical training may provide a protective benefit compared to FW when injury to the heel is of concern (e.g., heel spurs).

Supported by Dept of Ed, NIDRR grant #H133G070209.

**A-36 Free Communication/Poster - Vascular Function**

MAY 27, 2009 7:30 AM - 12:30 PM  
 ROOM: Hall 4F

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1589 Board #191 May 27 11:00 AM - 12:30 PM

**Cardiovascular Reactivity To Psychological Stress And Carotid Intima-media Thickness In Children**

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(No relationships reported)

The antecedents of atherosclerosis and CVD occur during childhood. Reactivity to psychological stress may be pathogenic for CVD in that it is associated with the precursors of essential hypertension and left ventricular mass in children. Carotid artery intima-media thickness (IMT) is a valid index of diffuse subclinical atherosclerosis. The relationship between cardiovascular stress reactivity and carotid artery IMT has been established in adults, but not yet studied in children.

**PURPOSE:** To determine whether a child's cardiovascular reactivity to an interpersonal stressor is associated with greater carotid artery IMT.

**METHODS:** Cardiovascular reactivity to an interpersonal stress (ad lib speech) was measured in 20 boys and 20 girls age 11.0 + 1.4 years. Each child was tested on three days; a stress day, non-stress control day, and an IMT measurement day. The order of the stress and non-stress days was counterbalanced across subjects. Measures included heart rate (HR), systolic (SBP) and diastolic (DBP) blood pressure reactivity by an automated monitor, and mean common carotid artery IMT measured by ultrasound imaging.

**RESULTS:** Univariate correlation showed that SBP reactivity was correlated ( $r=0.40$ ,  $p<0.05$ ) with carotid artery IMT. DBP and HR reactivity were not significantly ( $p>0.22$ ) correlated with carotid artery IMT. Sequential regression analyses were used to establish the incremental increase in  $R^2$  ( $R^2_{inc}$ ) for the prediction of IMT due to cardiovascular reactivity independent of age, SES, race, percentage body fat, and baseline BP or HR. SBP reactivity ( $\beta=0.002$ ,  $R^2_{inc}=0.10$ ,  $p<0.05$ ) independently predicted carotid artery IMT. DBP reactivity ( $p>0.12$ ) and HR reactivity ( $p>0.82$ ) were not predictive of carotid artery IMT.

**CONCLUSIONS:** Youth's cardiovascular reactivity to laboratory-based psychological stressors predicts BP responses to daily stress and is stable over time. Thus, youth who have the greatest BP reactivity to laboratory stressors may be most at risk for developing CVD later in life. SBP reactivity to psychological stress is associated with IMT and perhaps the early pathogenesis of CVD in childhood.

Supported by grant RO1 HD42766 to Dr. Roemmich.

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1590 Board #192 May 27 11:00 AM - 12:30 PM

**Combined Influence Of Fatness And Physical Activity On Resting Blood Pressure In Children**

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(No relationships reported)

Although the independent associations between fatness and physical activity on blood pressure (BP) have been observed in children, it is also known that fatness mediates the relationship between physical activity and cardiovascular disease risk factors in youth.

**PURPOSE:** The purpose of this study was to determine the combined influence of fatness and moderate-to-vigorous physical activity (MVPA) on resting BP in children.

**METHODS:** Participants were 157 (78 males, 79 females) children ages 5 to 9 yrs who participated in the UNKids Study. Minutes of MVPA were assessed using accelerometry. Body fatness was determined by dual energy absorptiometry and resting BP was measured according to standard procedures. Four categories were formed by cross tabulation of high/low levels of MVPA and high/normal levels of fatness. Group differences were determined by ANCOVA, controlling for age, sex, and height.

**RESULTS:** Overall, the high fat group as a whole had significantly higher BP than the normal fat group ( $p<0.05$ ). While the high MVPA group as a whole had lower systolic BP (SBP), diastolic BP (DBP), and mean arterial pressure (MAP) than the low MVPA group, significance was not reached. There were significant differences in SBP and MAP across the four groups ( $p<0.05$ ). Overall, the normal fat/high MVPA had the lowest BPs (e.g., SBP = 101.3+0.9 mmHg) and the high fat/low MVPA group had the highest BPs (e.g., SBP = 106.0+1.3 mmHg). When comparing the fat/MVPA groups, SBP was significantly lower in the normal fat/high MVPA group (101.3+0.9 mmHg) compared to both low and high MVPA groups within the high fat group (105.3+1.6 mmHg in high MVPA group and 106.0+1.3 mmHg in low MVPA group). MAP was also significantly different between the normal fat/high MVPA (79.7+0.7 mmHg) and the high fat/low MVPA group (83.4+1.0 mmHg) and between the normal fat/low MVPA group (80.8+0.8 mmHg) and the high fat/low MVPA group (83.4+1.0 mmHg). Although BP was slightly lower between the high and low MVPA groups within a fat group, this did not reach statistical significance.

**CONCLUSIONS:** The results indicate a clear pattern across fat/MVPA groups. Regardless of participating in a level of MVPA that meets the current guidelines ( $>60$  minutes/d), overfat children had higher resting SBP than normal fat children.

Supported by American Heart Association grant # 0665500Z

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1591 Board #193 May 27 11:00 AM - 12:30 PM

**Influence Of Measures Of Body Composition On Vascular Function In Children.**

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(No relationships reported)

Brachial artery flow mediated dilation (FMD) has become a commonly applied technique for the assessment of vascular health in humans. Although shear stress and artery size are acknowledged determinants of the FMD response, recent studies suggest that FMD is also governed by other factors.

**PURPOSE:** To investigate the relationships between vascular function and body composition variables in children.

**METHODS:** FMD (FMD%) was recorded and then normalised for the stimulus shear rate (FMD/SR<sub>AUC</sub>) in 129 healthy children (75 female; 10.3±0.3 yrs; 54 male; 10.4±0.3 yrs). Body composition variables (mass, lean mass and fat mass in the whole body, arm and forearm) were assessed by DEXA. Bivariate correlations explored the association between FMD%, FMD/SR<sub>AUC</sub> and body composition variables. A stepwise multiple linear regression investigated the relative contribution of baseline diameter, SR<sub>AUC</sub> and body composition variables to FMD%.

**RESULTS:** FMD% significantly ( $p<0.05$ ) correlated with arm fat mass ( $r=-0.18$ ) and forearm fat mass ( $r=-0.201$ ). FMD/SR<sub>AUC</sub> significantly correlated with whole body mass ( $r=-0.26$ ), whole body fat mass ( $r=-0.24$ ), arm mass ( $r=-0.25$ ), arm fat mass ( $r=-0.28$ ), forearm mass ( $r=0.194$ ) and forearm fat mass ( $r=0.211$ ). Baseline artery diameter accounted for 13.5 % of the variation in FMD%, while shear rate stimulus and body composition variables did not significantly contribute to FMD% prediction. Significant correlations were observed between baseline artery diameter and whole body mass ( $r=0.21$ ), whole body lean mass ( $r=0.28$ ), arm mass ( $r=0.23$ ), arm lean mass ( $r=0.32$ ), forearm mass ( $r=0.24$ ) and forearm lean mass ( $r=0.31$ ).

**CONCLUSIONS:** Significant correlations were observed between FMD%, FMD/SR<sub>AUC</sub> and measures of total and fat mass suggestive that fat mass has a negative association with vascular health. Although whole body and segmental body composition variables exert a relatively weak influence with regard to the determination of vascular function in children, further research might focus on the utility of ratio and allometric scaling procedures to explain the magnitude of the FMD response.

1592 Board #194 May 27 11:00 AM - 12:30 PM

**Superior Skin Microvascular Vasodilator Function in Trained Versus Untrained Male Adolescents**

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(No relationships reported)

In youth, remedial benefits of exercise training on conduit vessel endothelium-dependent vasodilator function have recently been documented, however it remains to be established whether exercise training also impacts on endothelium-dependent vasodilator function at the microvascular level in youth who are free from chronic disease.

**PURPOSE:** To determine whether a group of trained youth have superior skin microvascular endothelium-dependent vasodilator function compared to untrained healthy controls.

**METHODS:** Forearm skin blood flow (SkBF) was assessed in 17 trained ( $14.6 \pm 0.2$  yrs,  $VO_{2peak}$ :  $54.9 \pm 1.5$  mL.kg<sup>-1</sup>.min<sup>-1</sup>, Self-assessed Tanner stage 2 - 4) and 9 untrained ( $15.6 \pm 0.2$  yrs,  $VO_{2peak}$ :  $43.1 \pm 1.7$  mL.kg<sup>-1</sup>.min<sup>-1</sup>, Tanner stage 2 - 4) male adolescents using laser Doppler flowmetry at baseline (basal SkBF) and following physiological provocation. Endothelium-dependent vasodilator function of the skin microcirculation was assessed physiologically through local heating to 44°C for 30 minutes (maximal SkBF) and post-occlusive reactive hyperaemia (PORH), which involved SkBF assessment following 3 minutes of arterial occlusion. Cutaneous vascular conductance (CVC) (SkBF/MAP) was calculated at baseline and at maximal thermal flux.

**RESULTS:** Maximal SkBF was significantly higher in trained versus untrained youth (Trained:  $281.7 \pm 29.2$  vs Untrained:  $204.2 \pm 22.6$  PU,  $p=0.04$ ). Maximal flux during PORH was also significantly higher in trained compared to untrained youth (Trained:  $50.4 \pm 5.2$  vs Untrained:  $35.2 \pm 5.0$  PU,  $p=0.04$ ). Trained youth also demonstrated significantly greater basal SkBF and basal CVC (basal SkBF Trained:  $11.2 \pm 0.9$  vs Untrained:  $8.6 \pm 1.0$  PU,  $p=0.03$ ; basal CVC Trained:  $0.12 \pm 0.01$  vs Untrained  $0.08 \pm 0.01$  PU/mmHg,  $p=0.04$ ) and possessed superior maximal CVC (Trained:  $3.00 \pm 0.34$  vs  $2.02 \pm 0.23$  PU/mmHg,  $p=0.03$ ) compared to their untrained counterparts.

**CONCLUSION:** Skin microvascular endothelium-dependent vasodilator function is significantly enhanced in healthy, trained male adolescents. This may have implications for the prevention of endothelial dysfunction with aging and chronic diseases such as diabetes.

1593 Board #195 May 27 11:00 AM - 12:30 PM

**The Impact of Exercise Training Upon Endothelial Function In Postmenopausal Women With Type 2 Diabetes.**

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(No relationships reported)

A decline in endothelial function as measured by flow mediated dilatation (FMD) is an early independent predictor of cardiovascular disease (CVD) and has been seen in diabetes and following the menopause in women. The influence of exercise training upon FMD in postmenopausal women with type 2 diabetes is however, unclear.

**PURPOSE:** to determine the effect of a 6 month exercise training regime at 75%  $VO_{2peak}$  upon FMD and CVD risk factors in postmenopausal women with type 2 diabetes.

**METHODS:** Peak oxygen uptake ( $VO_{2peak}$ ) was assessed via a Bruce treadmill test in 15 women. Eight participants then trained under supervision twice per week (+one home session) at 55, rising to 75%  $VO_{2peak}$  for six months. Seven participants acted as controls. CVD risk factors were assessed pre and post intervention. Body composition was assessed via skinfold analysis and measurement of waist and hip circumferences, BMI and body mass. A fasting venous blood sample was analyzed for total cholesterol, high (HDL-C) and low density lipoproteins, triglycerides, glucose, insulin, glycosylated haemoglobin (HbA1c) and high sensitivity C-reactive protein (hsCRP). Flow mediated dilatation (FMD) during reactive hyperaemia was recorded as an index of endothelial function. The impact of the intervention upon FMD and any confounding effect of key risk factors were analyzed using two way ANCOVA.

**RESULTS:** Exercise training significantly improved  $VO_{2peak}$  (trained baseline:  $22.12 \pm 5.8$ ; post:  $24.50 \pm 6.7$ , control baseline:  $19.11 \pm 4.2$ ; post:  $19.22 \pm 2.5$  mL.kg.min<sup>-1</sup>), waist circumference (trained baseline:  $99.5 \pm 15$ ; post:  $93.5 \pm 13.2$ , control baseline:  $102.5 \pm 11.5$ ; post  $102 \pm 11.9$  cm) and FMD (trained baseline  $4.2 \pm 2.7$ ; post  $7.1 \pm 2.8$ , control baseline  $4.5 \pm 2.8$ , post:  $2.9 \pm 1.4$  %) compared to controls ( $P < 0.05$ ). There was no significant impact of training upon any of the remaining CVD risk factors ( $P > 0.05$ ). The 69% improvement in FMD was not influenced by adding covariates to the analysis.

**CONCLUSION:** Aerobic exercise training can significantly improve endothelial function in postmenopausal women with type 2 diabetes and importantly, this improvement is independent of changes in any other key CVD risk factor.

Supported by a Heart Research UK grant 2508/06/08

1594 Board #196 May 27 11:00 AM - 12:30 PM

**Change In Plasma Nitrite Following An Acute Bout Of Exercise In Older Women**

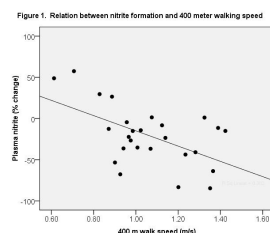
Devon A. Dobrosielski, Anthony P. Marsh, Tennille D. Presley, Andreas S. Perlegas, Daniel B. Kim-Shapiro, Walter J. Rejeski. Wake Forest University, Winston-Salem, NC. (Sponsor: Peter H. Brubaker, FACSM)

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(No relationships reported)

Nitric oxide (NO) has many anti-atherogenic properties and is a key mediator of arterial vasodilation. Thus, it may play a critical role in facilitating the delivery of blood to active skeletal muscle in older adults, ultimately impacting functional health. Plasma nitrite may be an effective marker of vascular NO bioavailability.

**PURPOSE:** To determine whether a change in plasma nitrite following an acute bout of physical activity differs in older adults with different physical function.



**METHODS:** Physical function was evaluated using the Short Physical Performance Battery (SPPB, range 0-12). On a separate visit, venous blood was drawn before and 10 minutes following the completion of a 400 m walk test. Blood samples were added to heparin and frozen for subsequent analysis using chemiluminescence.

**RESULTS:** Twenty six women ( $79 \pm 4$  years, SPPB range: 3-12) participated in the study. Plasma nitrite levels decreased approximately 22% following the 400 meter walk (Baseline:  $129 \pm 82$  nM vs. Post:  $100 \pm 62$  nM,  $p=0.005$ ), although no change or an increase in nitrite levels was observed in some subjects. Percent change in plasma nitrite



was related to walking speed ( $r=-.550$ ,  $p=0.004$ ) (Figure 1). Walking speed was significantly related to SPPB ( $r=.723$ ,  $p=0.001$ ), but there was no association between SPPB score and change in plasma nitrite.

**CONCLUSIONS:** These findings suggest a role for plasma nitrite in the adaptation to physical exertion in older adults. Interestingly, the magnitude and direction of change in plasma nitrite levels appears to be influenced by walking speed. Whether this response is involved in blood flow regulation is not known and warrants further study.

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**1595 Board #197 May 27 11:00 AM - 12:30 PM**

**Increased Fitness Attenuates Endothelial Dysfunction Following A High Fat Meal In Postmenopausal Women**

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Endothelial dysfunction is a known predictor of coronary artery disease (CAD) and may be worsened in the postprandial state, particularly after ingestion of a high-fat meal. Post-menopausal status also confers a greater risk for the development of endothelial dysfunction and CAD, whereas cardiorespiratory fitness is positively associated with endothelial function.

**PURPOSE:** To examine if increased fitness ( $VO_{2max}$ ) attenuates postprandial endothelial dysfunction that follows the ingestion of a high-fat meal challenge in sedentary post-menopausal women.

**METHODS:** Fifteen sedentary post-menopausal women (Age=56.6 ± 4.2 yr; BMI=27.0 ± 4.9 kg/m<sup>2</sup>; % body fat=40.9 ± 7.1%;  $VO_{2max}$ =22.6 ± 4.3 ml.kg<sup>-1</sup>.min<sup>-1</sup>; range =16.4-31.5) were admitted to the General Clinical Research Center on two occasions for  $VO_{2max}$  and brachial artery flow mediated dilation testing. Subjects underwent an incremental  $VO_{2max}$  protocol and on a separate day underwent serial brachial artery flow mediated dilation measurements at baseline (after an overnight fast) and 2 and 4-hours after ingestion of a high-fat breakfast meal challenge (57% fat, 25% protein, and 18% carbohydrate). Percent flow-mediated dilation (% FMD) was quantified by comparing B-mode ultrasound images of the brachial artery at rest and during reactive hyperemia following 5-min of forearm occlusion with a blood pressure cuff at 50mmHg above systolic blood pressure. Measurements of brachial artery diameter were made by using computerized edge detection software.

**RESULTS:** A significant relationship was observed between  $VO_{2max}$  and %FMD at 2 hours ( $r=-.52$ ,  $p=0.047$ ) and 4 hours ( $r=0.63$ ,  $p=0.012$ ) postprandially.

**CONCLUSION:** Fitness is associated with increased %FMD in post-menopausal women following a high fat meal challenge, with elevated fitness associated with an improved endothelial response in the postprandial period. This may be yet another mechanism by which increased cardio-respiratory fitness lowers cardiovascular risk.

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**1596 Board #198 May 27 11:00 AM - 12:30 PM**

**Aging Slows Muscle Oxygenation Responses During Reactive Hyperemia In Women**

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Aging is associated with impaired arterial compliance and endothelial function, furthermore, menopause may accentuate endothelial dysfunction. These alterations might also affect not only vasodilatation of large arteries but also microvasculature function. Near infrared spectroscopy (NIRS) can allow to determine the relative changes of oxygenated hemoglobin (HbO<sub>2</sub>) in the microvasculature with high temporal resolution. However, little is known about microvasculature function of aged women.

**PURPOSE:** To determine the influence of aging on microvascular reactivity in women.

**METHODS:** Ten younger (22±0.4yrs, mean± S.E.M.) and ten older healthy women (62±0.6yrs) were studied. Resting cardiovascular measurements and post occlusive reactive hyperemia were performed in supine position. NIRS signals were measured during 5 min of arterial cuff occlusion (cuff pressure > 50mmHg above systolic blood pressure), and during 3 min of post occlusive reactive hyperemia at their forearm muscle. Skinfold thickness was measured by B-mode ultrasound. Beta-stiffness was also calculated from pulse wave velocity as an index of arterial compliance. The recovery time of HbO<sub>2</sub> is half the time required for the HbO<sub>2</sub> to reach maximal value in response to cuff release from the time of cuff occlusion. The recovery rate of HbO<sub>2</sub> was assessed by determining the slope of HbO<sub>2</sub> and time relationship during first 20 sec.

**RESULTS:** Although there were no significant differences in body mass index (21.3±0.8 vs 22.5±0.6 kg/m<sup>2</sup>, young vs old), skinfold thickness (3.9±0.3 vs 4.1±0.3 mm, young vs old), and mean blood pressure (88±1.4 vs 90±1.3 mmHg, young vs old) in two groups, beta-stiffness in old (8.14±0.24) was significantly impaired compared to the young subjects (5.55±0.25,  $p<0.05$ ). Recovery time of HbO<sub>2</sub> in old (12.0±0.7sec) was significantly slower than that in young subjects (8.4±0.4 sec,  $p<0.05$ ). Slope of HbO<sub>2</sub> in young (1.53±0.09  $\mu\text{mol/l}\cdot\text{sec}^{-1}$ ) was significantly steeper than that in old subjects (1.17±0.13,  $\mu\text{mol/l}\cdot\text{sec}^{-1}$ ,  $p<0.05$ ).

**CONCLUSIONS:** These results indicate that post menopausal women exhibit a delayed HbO<sub>2</sub> response during reactive hyperemia. We suggest that these alterations in HbO<sub>2</sub> kinetics are indicative of microvasculature dysfunction in these subjects.

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**1597 Board #199 May 27 11:00 AM - 12:30 PM**

**Changes In Vascular And Physical Function With Exercise Training In The Aged**

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Previous work from our laboratory indicates the ability of the vasculature to respond favorably to a regional-specific exercise stimulus, even in individuals in their 9<sup>th</sup> and 10<sup>th</sup> decade of life. Interestingly, few studies have examined whether changes in vascular function can be induced through whole-body training and contribute to preserving functional ability in the aged.

**PURPOSE:** This study aimed to determine the effects of eight weeks of structured exercise, followed by a 4 week retention period, on measures of vascular and physical function in individuals in their 8<sup>th</sup>-10<sup>th</sup> decade of life.

**METHODS:** Twenty-one participants (age: 83±5.yrs) engaged in both resistance and aerobic training, performed for 60-minutes, two times per week. Brachial artery dimensions and reactivity were measured before and after training, using ultra-high resolution ultrasonography. A previously validated physical functional performance test (CSFP10) was used to assess basic and instrumental activities of daily living.

**RESULTS:** Training volume, defined as amount of weight lifted and aerobic work performed, increased significantly from the first to the last week of training (Weight Lifted: 3181±1481 to 5819±1877lbs,  $p=0.001$ ; Aerobic Load: 1.91±1.85 to 2.54±2.45AU,  $p=0.005$ ). Baseline brachial artery cross-sectional area (CSA) increased significantly after training (Pre: 12.42±6.42 to Post: 13.28±6.80 mm<sup>2</sup>,  $p=0.001$ ), whereas brachial artery reactivity remained unchanged (Pre: 4.92±2.29 to Post: 4.19±1.65%,  $p=0.31$ ). Physical function improved in all individual domains, except for upper body flexibility, collectively contributing to a 15% increase in the total CS-PFP10 score (Pre: 50.55±14.76 to Post: 57.94±14.43U,  $p=0.001$ ). The change in CSA was related to the change in the total amount of weight lifted over the course of the training ( $r^2=0.19$ ). No vascular or functional changes were noted in age-matched controls. Individuals who maintained a training volume of at least 70% of their 8<sup>th</sup>-week workload showed no reversal of the training-induced changes in vascular or physical function.

**CONCLUSIONS:** This study suggests exercise training induces conduit artery expansion and enhanced physical function in individuals, in their 8<sup>th</sup> through 10<sup>th</sup> decade of life. Removal of the training stimulus reverses these changes.

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1598 Board #200 May 27 11:00 AM - 12:30 PM

**Effects Of 6-week Kaatsu Walking Training On Limb Venous Compliance In Elderly Subjects**

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(No relationships reported)

Venous compliance declines with age and improves with chronic endurance exercise. KAATSU-walking is a unique training method for promoting muscle hypertrophy and strength gains under the conditions with restricted venous blood flow, and inducing venous pooling of blood, which may affect limb venous compliance. However, the effects of KAATSU training on venous properties have not been investigated.

**PURPOSE:** This study investigated the influence of a 6-week-walk training combined with KAATSU on venous properties in older men and women.

**METHODS:** Twenty-two elderly men and women, aged 60-78 years, were randomized into either a KAATSU-walk training group (n=11, KAATSU-walk) or a non-exercising control group (n=11, Control). The KAATSU-walk group performed 20 min treadmill walking (67 m/min), five days/wk for 6 wk. A non-exercising group was advised to perform daily slow walk for 20 min five days/wk during the study. Before (pre) and after (post) 6 wk, strain gauge venous occlusion pletysmography was used to assess limb venous vascular properties. Venous volume variation (VVV) was defined as the maximal relative volume increase in the limb at a certain cuff pressure, and VVV at different occlusion pressures represents the pressure-volume curve. Compliance was derived from the slope of the pressure-volume curve. Venous emptying rate was calculated as the slope of the tangent at the curve 0.5 s after cuff release. The time 0.5 s after cuff deflation was chosen to avoid any cuff artifact, and the effective pressure of the cuff on the venous system at 0.5 s was calculated by using the pressure-volume curve.

**RESULTS:** Leg venous compliance was significantly increased in KAATSU-walk group (pre  $0.066 \pm 0.004$  ml·100ml<sup>-1</sup>·mmHg<sup>-1</sup>, post  $0.078 \pm 0.007$ ,  $P < 0.05$ ), compared with control group (pre  $0.069 \pm 0.008$ ; post  $0.068 \pm 0.04$ ). Leg venous flow resistance decreased (pre  $1.31 \pm 0.1$  mmHg·ml<sup>-1</sup>·100 ml·min; post  $1.08 \pm 0.08$ ) in KAATSU-walk group, compared with control group (pre  $1.23 \pm 0.12$ ; post  $1.38 \pm 0.07$ ). In contrast, arm compliance did not change significantly in KAATSU-walk and control group.

**CONCLUSIONS:** The present study provides the first evidence that daily KAATSU-walk may be a unique and novel training for improving limb venous compliance in untrained older subjects.

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1599 Board #201 May 27 11:00 AM - 12:30 PM

**Effects Of 12 Weeks Of Group Training On Arterial Stiffness In Elderly Hypertensives**

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(No relationships reported)

The decline in arterial function with aging is considered to be part of a physiological process reflected in elevated blood pressure. For elderly men, regular physical exercise is recommended for the prevention and treatment of cardiovascular diseases. However, few attempts have so far been made to identify the role of exercise training in arterial function in elderly hypertensives.

**PURPOSE:** The aim of this study was to evaluate the effects of group training on arterial stiffness and blood pressure in elderly hypertensives and to compare these effects to those on healthy elderly.

**METHODS:** 36 elderly women with systolic blood pressure (SBP) 140 to 159 mmHg or diastolic blood pressure (DBP) 90 to 99 were assigned to the hypertensive group (HTT), and 34 elderly women with normal blood pressure were assigned to the normal blood pressure group (NP). All subjects participated in 90-min group training twice a week for 12 weeks. Before and after training, SBP, DBP and brachial to ankle pulse wave velocity (baPWV) were obtained in the supine position using an automatic pulse wave form analyzer.

**RESULTS:** After training duration, baPWV reduced  $-3.8 \pm 9.5\%$  in HTT ( $1960.4 \pm 275.6$  to  $1884.8 \pm 280.4$  cm/sec) and  $-7.5 \pm 7.2\%$  in NT ( $1598.5 \pm 205.3$  to  $1490.1 \pm 221.2$  cm/sec), respectively. Compared with HTT, a greater reduction in delta baPWV was observed in NP ( $p < 0.05$ ). However, no significant differences were found in SBP ( $-3.1 \pm 9.2\%$  in HTT vs.  $-3.6 \pm 9.9\%$  in NP) and DBP ( $-3.1 \pm 9.8\%$  in HTT vs.  $-3.8 \pm 8.2\%$  in NP).

**CONCLUSIONS:** Even though elderly hypertensives show a reduction of baPWV, larger reduction was found in NP compared with HTT. These results indicate that short term group training produces less improvement of arterial stiffness in elderly hypertensives than in healthy elderly.

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1600 Board #202 May 27 11:00 AM - 12:30 PM

**Effects Of "Life-long" Exercise Training On Arterial Stiffness In The Elderly**

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**BACKGROUND:** It is well known that human arteries become stiffer with sedentary aging. Conversely, studies by us and others have revealed that Masters athletes (Age > 65) who have been training 6-7 sessions/wk throughout their adult lives maintain youthful aortic compliance. Although previous findings support the beneficial effects of exercise training on arterial compliance in the elderly, it is still unknown how lower doses of "life-long" exercise training ameliorate arterial compliance.

**METHODS:** We recruited senior adults (Age > 65) with different life-long exercise doses from the Aerobic Center Longitudinal Study, in which patterns of physical activity have been measured for > 25 yrs; 1) sedentary seniors (Q1: no regular exercise, N=7), 2) mild-active seniors (Q2: Exercise; 2-3 times/wk, N=3), 3) moderate-active seniors (Q3: Exercise; 4-5 times/wk, N=7), and 4) Masters athletes (Q4: Exercise; 6-7 times/wk, N=13). Central aortic and peripheral arterial compliance were estimated by central (carotid-femoral) and peripheral (carotid-radial) pulse wave velocity (PWV), respectively. Common carotid arterial compliance was estimated by cross-sectional area changes of systolic and diastolic phases (Sono-CT), and corresponding systolic and diastolic blood pressures with beta-stiffness index.

**RESULTS:** Central PWV was significantly slower in seniors who trained 2-3, 4-5 or 6-7 times per week (Q2, Q3, and Q4) than in sedentary seniors (Q1), indicating that even 2-3 times per week exercise training has beneficial effects on aortic compliance. Interestingly, central PWV was not significantly different among Q2, Q3 and Q4, suggesting that this beneficial effect could plateau at small doses of exercise training. Similarly, the beta stiffness index of the common carotid artery was lower (more compliant) in Q2, Q3, and Q4 than in Q1, and was not different among Q2, Q3 and Q4. Peripheral PWV was not significantly different among all groups, suggesting limited effects of exercise training on upper limb peripheral arterial compliance.

**CONCLUSIONS:** It appears that 2-3 times per week of "life-long" regular exercise training provides similar beneficial effects on arterial compliance as more vigorous exercise regimens.

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1601 Board #203 May 27 11:00 AM - 12:30 PM

## Relationship Between Vasoreactivity And Structure In An Elderly Cohort Of The Louisiana Healthy Aging Study

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Brachial flow mediated dilation (BAFMD), and carotid intima media thickness (CIMT), physiologic and structural measures of subclinical atherosclerosis are typically not related in population-based studies. This results in the interpretation that the controlling mechanisms for these measures are distinct and independent.

**PURPOSE:** (1) To examine the association between BAFMD and carotid artery dimensions and (2) to determine the link between measures of physical activity, vasoreactivity and structure, and physical function, in the elderly.

**METHODS:** Participants (n=69; Age: 83±12, Range: 61 to 98yrs) from the LHAS were used for these analyses. Brachial (Diameter and BAFMD) and carotid artery dimensions (Diameter, CIMT, and arterial mass (CMASS)) were determined using high-resolution ultrasonography. Physical activity status (Total Daily Energy Expenditure (TDEE) and amount of daily physical activity (PAL=TDEE/RMR) were assessed using doubly-labeled water. Physical function (CSPFP-10) was determined from a previously validated instrument used to assess basic and instrumental activities of daily living.

**RESULTS:** The association between CIMT and BAFMD was not quite significant ( $r=-0.28$ ,  $p=0.06$ ). However, linear regression for BAFMD and CMASS was highly significant ( $\text{CMASS} = -0.314 * (\text{BAFMD}) + 14.14$ ,  $r=-0.48$ ,  $p=0.01$ ). In addition, PAL ( $r=0.45$ ,  $p=0.001$ ) was significantly related to BAFMD, and TDEE ( $r=-0.33$ ,  $p=0.03$ ) and PAL ( $r=-0.41$ ,  $p=0.006$ ) were significantly related to CMASS. Both BAFMD ( $r=0.37$ ,  $p=0.002$ ) and CMASS ( $r=-0.38$ ,  $p=0.01$ ) were significantly associated with the CSPFP-10 total score. Interestingly, a MANCOVA for nonagenarians (n=28, Age: 92±2yrs) revealed those in the higher functional tertiles had greater BAFMD ( $p=0.05$ ), compared to those in the lowest tertile, yet similar CMASS.

**CONCLUSION:** These data indicate a significant inverse relationship between BAFMD and CMASS, in an elderly cohort of the LHAS. Moreover, it appears these measures (BAFMD and CMASS) are sensitive to a person's daily energy expenditure, which may subsequently contribute to one's physical functionality. However, the finding that nonagenarians with higher function have greater BAFMD yet similar CMASS, suggests the underlying mechanisms for these measures can still change in a distinct and independent manner.

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1602 Board #204 May 27 11:00 AM - 12:30 PM

### Attenuated Age-related Increase In Carotid Intima-media Thickness In Cardiorespiratory Fit Men And Women

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**PURPOSE:** Age-related increase in carotid intima-media thickness (IMT) has been identified as an independent risk factor of cardiovascular disease (CVD). Cardiorespiratory fitness is generally associated with a lower incidence of CVD. Although the mechanisms underlying this protective effect are not fully understood, it is possible that fitness attenuates the age-related increase in carotid IMT. Accordingly, the present investigation was performed to determine the possible influence of fitness on the age-related increase in carotid IMT using a cross-sectional study design.

**METHODS:** A total of 926 healthy men and women (age 18-76 yr) participated in this study. All subjects underwent fitness assessment (maximal oxygen uptake) by a graded incremental cycle exercise test and were divided into either the fit or unfit group. Carotid IMT was measured from the images obtained using an ultrasound machine equipped with a high-resolution linear array transducer.

**RESULTS:** In both groups, carotid IMT increased progressively with age ( $P<0.001$ ). In middle-aged and older men and women, the carotid IMT in the fit group ( $0.68\pm0.11$  mm) was significantly thinner than that in the unfit group ( $0.70\pm0.11$ ,  $P<0.01$ ). The carotid systolic blood pressure (SBP) in the fit group ( $121\pm22$  mmHg) was also lower than that in the unfit group ( $127\pm25$ ,  $P<0.001$ ). There were no significant differences in carotid IMT or SBP in young men and women ( $P<0.001$ ). When ANCOVA was performed with carotid SBP as a covariate, differences in carotid IMT between fit and unfit groups were abolished.

**CONCLUSIONS:** In conclusion, the results of this study support the hypothesis that maintenance of cardiorespiratory fitness exerts a protective effect against CVD in part by attenuating the age-related increase in carotid IMT. This modulatory effect on carotid IMT may be due to the high fitness to prevent or reduce the age-associated elevation of carotid distending pressure.

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1603 Board #205 May 27 11:00 AM - 12:30 PM

### Mechanisms Of Enhanced Endothelium-dependent Vasodilation In Skeletal Muscle Resistance Vasculature Following Acute Exercise

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Skeletal muscle blood flow remains elevated following acute exercise. Enhanced endothelium-dependent vasodilation of the skeletal muscle resistance vasculature may contribute to the enhanced blood flow following acute exercise. However, the mechanism mediating this enhanced vascular responsiveness following acute exercise is not known.

**PURPOSE:** To determine the mechanism responsible for the enhanced endothelium-dependent vasodilation observed in skeletal muscle arterioles and feed arteries following an acute bout of exercise.

**METHODS:** Male Sprague-Dawley rats were divided into exercise (EX) and sedentary control groups (SED). The EX group ran on a treadmill at 30 m/min (15° incline) for 45 minutes. First-order (1A) arterioles and feed arteries (FA) were isolated from the soleus muscle, cannulated, and pressurized. Luminal diameter changes were determined in response to the endothelium-dependent vasodilator acetylcholine (ACh,  $10^{-9}$  -  $10^{-4}$  M), alone and in the presence of the nitric oxide synthase (NOS) inhibitor L-NAME ( $10^{-5}$  M) or the combination of L-NAME and the cyclooxygenase (COX) inhibitor indomethacin ( $10^{-5}$  M). Luminal diameter changes were also determined in response to the nitric oxide donor, sodium nitroprusside (SNP,  $10^{-10}$  -  $10^{-4}$  M).

**RESULTS:** Responsiveness to ACh was enhanced in soleus muscle FA and 1A arterioles from EX rats compared to SED rats. NOS inhibition reduced vasodilation in and eliminated differences between SED and EX 1A arterioles. In contrast, NOS inhibition significantly reduced vasodilation to ACh in both SED and EX FA, but did not eliminate differences between them. NOS + COX inhibition abolished the enhanced vasodilation to ACh in both soleus FA and 1A arterioles and eliminated the differences between SED and EX in both soleus muscle 1A arterioles and FA. Responsiveness to SNP was not different between either 1A arterioles or FA from soleus muscle.

**CONCLUSIONS:** These data demonstrate that the enhanced endothelium-dependent vasodilation in soleus muscle 1A arterioles following acute exercise is mediated through the NO signaling pathway, whereas the enhanced endothelium-dependent vasodilation in soleus muscle FA following acute exercise is mediated through the COX signaling pathway.

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1604 Board #206 May 27 11:00 AM - 12:30 PM

### Initial Orthostatic Hypotension Upon Rising From Squat Is Explained By Rapid Vasodilation In Leg Muscles

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Standing up is a frequent (3-10 %) trigger of loss of consciousness both in young and old subjects. This is due to an exaggerated transient BP (blood pressure) fall within 15 s upon standing, referred to as initial orthostatic hypotension (IOH). It is unclear what causes the marked increase in systemic vascular conductance that leads to IOH. Two possibilities have been proposed: 1) rapid vasodilation in the contracting leg muscles, and 2) systemic sympathetic withdrawal evoked by a sudden increase in right atrial pressure.

**PURPOSE:** This study tested the hypothesis that IOH is due to rapid vasodilation in contracting leg muscles with the effort of standing.

**METHODS:** 17 young healthy University undergraduates performed three different experimental conditions; standing up after a 10 s squat, a 1 min squat, or a 5 min squat. Beat by beat mean arterial blood pressure (MAP), cardiac output (CO), heart rate (HR) and stroke volume (finger photoplethysmography, Finometer) and right femoral artery blood flow (FABF; Doppler and Echo ultrasound) were recorded.

**RESULTS:** data mean  $\pm$ SE. Quiet standing represented baseline for all hemodynamic responses. Within 10 s of standing from squat, MAP (mmHg) fell to a nadir significantly below baseline in all conditions (baseline vs. standing from squat: 10 s squat  $89.1 \pm 3.8$  vs.  $72.0 \pm 3.9$ , 1 min squat  $91.2 \pm 3.6$  vs.  $69.2 \pm 3.1$ , 5 min squat  $91.1 \pm 3.1$  vs.  $62.8 \pm 4.4$ , all  $P < 0.001$ ). This occurred despite elevations in CO (L/min) (baseline vs. standing from squat: 10 s squat  $4.2 \pm 0.3$  vs.  $6.7 \pm 0.5$ , 1 min squat  $4.3 \pm 0.3$  vs.  $7.0 \pm 0.5$ , 5 min squat  $4.1 \pm 0.3$  vs.  $7.6 \pm 0.5$ , all  $P < 0.01$ ) and was explained by large increases in total vascular conductance (TVC; ml/min/100mmHg). The increase in TVC could be attributed primarily too increased 2-legged vascular conductance (LVC; ml/min/100mmHg) (TVC vs. LVC increase from standing baseline: 10 s squat  $43.0 \pm 5.3$  vs.  $36.7 \pm 6.3$ , 1 min squat  $47.8 \pm 4.5$  vs.  $44.6 \pm 6.8$ , 5 min squat  $54.9 \pm 4.2$  vs.  $55.7 \pm 12.2$ ) which co-occurred with the MAP nadir.

**CONCLUSIONS:** Rapid vasodilation in leg muscles with the effort of standing outstrips compensatory CO responses and is the cause of IOH.

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**1605 Board #207 May 27 11:00 AM - 12:30 PM**

**Arterial Structure And Function In Women And Men Following Long Duration Bed Rest**

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Orthostatic intolerance is a well-recognized consequence of space flight and bed rest (BR), with a greater incidence reported in women.

**PURPOSE:** We hypothesized that leg, but not arm, arterial structure and function would be altered following prolonged BR, as a model of space flight, and that women would be more susceptible to BR-induced deconditioning than men.

**METHODS:** Ten volunteers (5 males, 5 females) completed 90 d of 6° head-down BR. Subjects participated in tests of brachial (BA) and anterior tibial (AT) artery endothelium-dependent (flow mediated dilation [FMD] following 5-7 min of arterial occlusion) and endothelium-independent (0.4 mg sublingual nitroglycerin [SN]) vasodilation before BR (PRE) and on days 7 (BR7), 21 (BR21), and 90 (BR90) of BR. Vessel diameter and intimal medial thickness (IMT) were measured by ultrasound. IMT, baseline diameter, and percent change in diameter from baseline during FMD and SN tests were compared across BR and between genders using repeated measures two-way ANOVA with Bonferroni *post-hoc* tests in which PRE and women were control conditions.

**RESULTS:** Baseline vessel diameter was lower in women than in men in both the BA ( $p=0.005$ ) and AT ( $p=0.01$ ) across all days. Baseline AT diameter decreased during BR ( $p=0.01$ ) and tended to be more profound in women (interaction,  $p=0.06$ ). AT diameter was reduced in women at BR21 and BR90 ( $p<0.01$ ) but not in men. In contrast, there was no BR effect on baseline BA diameter. IMT also decreased in the AT ( $p<0.001$ ) but not in the BA during BR; AT IMT was reduced by BR21 ( $p<0.05$ ). As a group, there was no effect of BR on AT FMD, BA FMD, and AT SN-dilation, although BA SN-dilation was significantly reduced on BR21 ( $p=0.01$ ). Across all BR days, women exhibited higher AT FMD ( $p=0.03$ ), BA FMD ( $p=0.02$ ), and BA SN-dilation ( $p=0.01$ ) and tended to demonstrate greater AT SN-dilation ( $p=0.11$ ).

**CONCLUSIONS:** These preliminary results suggest that arterial remodeling occurs during BR in the leg (decreased diameter and IMT), but not in the arm, and that women appear to be more responsive to BR than men. These changes in the leg, coupled with larger responses to direct and indirect stimulation of the arterial smooth muscle, may be related to the greater incidence of orthostatic intolerance in women after BR and space flight.

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**1606 Board #208 May 27 11:00 AM - 12:30 PM**

**Eccentric Muscle Damage And Macrovascular Function: Stiff Muscles And Stiff Arteries?**

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(No relationships reported)

In animal models, muscle damage caused by eccentric contractions instigates an inflammatory response, and reduces local microcirculatory blood flow and vasodilator function. Local alterations in the microcirculation may translate to unfavorable changes in the larger, central blood vessels. Currently, it is unknown if local muscle damage is potent enough to alter macrovascular function in humans.

**PURPOSE:** To determine whether muscle damage caused by eccentric contractions reduce macrovascular function.

**METHODS:** Recreationally-active males ( $n=16$ , age  $24 \pm 6$  years) participated in a randomized crossover experiment consisting of 2 trials, separated by at least 14 days. Prior to the start of each trial, subjects were familiarized with isometric force and vascular measurements. In each trial, muscle damage was induced using 2x20 unilateral eccentric contractions of the elbow flexors and randomized between dominant and non-dominant arm. Measurements were taken at baseline, and at 1, 24, 48, and 72 hours following the eccentric exercise.

**RESULTS:** Isometric muscle force was lower ( $p<0.01$ ), and muscle soreness ratings were higher ( $p<0.01$ ) than baseline for all time points in both trials. In addition, serum creatine kinase was elevated at 24h and 72h post ( $p<0.05$ ). Aortic pulse wave velocity, a measure of central arterial stiffness, and aortic augmentation index, a measure of arterial wave reflection, did not change throughout the experimental period despite significant muscle damage to the elbow flexors. In addition, there was no difference in pulse wave velocity or augmentation index between the dominant and non-dominant trials at any time point.

**CONCLUSION:** Muscle damage to the elbow flexors does not translate to unfavorable changes in central macrovascular function.

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**1607 Board #209 May 27 11:00 AM - 12:30 PM**

**Peripheral Arterial Compliance Is Compromised In Young Multiple Sclerosis Patients**

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A reduction of arterial elasticity in patients with autoimmune and inflammatory diseases such as rheumatoid arthritis and systemic lupus erythematosus has been previously reported and believed to be secondary to systemic inflammation. Similar involvement of peripheral arteries is not expected in a disease that affects exclusively the central nervous system, such as Multiple Sclerosis (MS).

**PURPOSE:** The primary purpose of this study was to examine large arterial compliance and small arterial compliance (C1 and C2 respectively) in patients with MS and



compare them to healthy age-matched controls. Our hypothesis is that healthy controls will have more compliant arteries compared to individuals with MS.

**METHODS:** Men and women between the ages of 20 to 39 years, 9 with Relapsing Remitting MS ( $\mu = 34.4 \pm 6.3$  yrs), and 9 healthy, age matched controls ( $\mu = 30.2 \pm 4.4$  yrs) volunteered for this study. Arterial compliance was measured by using Pulse Contour Analysis (PCA), which records and analyzes the blood pressure waveform data from the Arterial PulseWave Sensors.

**RESULTS:** There were no significant differences between the two groups for age, height or weight ( $p > 0.05$ ); however, there were significant differences in C1 and C2 between the groups ( $p < 0.05$ ). The MS group had less arterial compliance of both large (C1) ( $14.8$  vs  $19.9$  ml/mmHg), and small (C2) ( $6.1$  vs  $10.5$  ml/mmHg) arteries compared to healthy controls. Absolute C2 recordings for the young MS group corresponded to values seen in people in the sixth decade of life.

**CONCLUSION:** Arterial compliance is significantly compromised in young individuals with MS, compared to age matched controls, suggesting a systemic effect of an inflammatory process that is believed to be confined to the CNS.

**1608 Board #210 May 27 11:00 AM - 12:30 PM**  
**Wasted Left Ventricular Pressure Energy is Increased In Patients With Refractory Angina**

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Increased myocardial oxygen demand contributes to refractory angina. Afterload plays a key role on myocardial stress and it is directly related to the Tension Time Index (TTI), a marker of myocardial oxygen consumption. TTI depends on cardiac output and reflected pressure waves from the vascular tree. Conduit arterial stiffness, length and diameter, and muscular arterial vasodilation are major factors that determine pressure wave reflection. Left ventricular (LV) wasted pressure energy (Ew) is the portion of TTI curve attributed to amplitude (RWA) and duration (RWD) of wave reflection, and can be interpreted as the excess of energy expended by the LV.

**PURPOSE:** The aim of this study was to determine differences in central hemodynamics, wave reflection characteristics, and Ew between patients with chronic stable angina resistant to anti-anginal therapy and patients with controlled hypertension.

**METHODS:** High-fidelity radial artery pressure waveforms were recorded non-invasively by applanation tonometry and ascending aortic pressure waveforms generated using a mathematical transfer function in 36 patients (age  $65 \pm 9$  yrs) with refractory angina taking two or more anti-anginal drugs (RAP) and 36 treated hypertensive patients (CON) matched for age, sex, height, weight, blood pressure and heart rate. Pulse wave analysis was used to determine arterial properties and wave reflection characteristics and calculation of  $Ew = [(p/4) * (RWA \times RWD) * 1.333]$ .

**RESULTS:** Augmentation index ( $AI_a$ ) ( $27 \pm 9$  vs.  $19 \pm 7\%$ ,  $P < 0.001$ ), reflected wave amplitude ( $15 \pm 8$  vs.  $8 \pm 4$  mmHg,  $P < 0.001$ ) and duration ( $189 \pm 29$  vs.  $165 \pm 22$  ms,  $P < 0.001$ ) were higher in RAP compared to CON. Aortic systolic ( $123 \pm 19$  vs.  $115 \pm 10$  mmHg,  $P < 0.03$ ) and pulse ( $51 \pm 15$  vs.  $40 \pm 10$  mmHg,  $P < 0.01$ ) pressures, and Ew ( $3053 \pm 1878$  vs.  $1457 \pm 896$  dyne\*cm<sup>-2</sup>\*s,  $P < 0.001$ ) were also higher in RAP than CON.

**CONCLUSIONS:** Patients with refractory angina have increased  $AI_a$ , and wave reflection amplitude and duration compared to treated hypertensive patients. This phenomenon causes the LV to expend wasted energy in late systole resulting in an imbalance between myocardial oxygen supply and demand, despite anti-anginal therapy. These results suggest that improved peripheral arterial function could decrease myocardial oxygen demand and refractory angina.

**1609 Board #211 May 27 11:00 AM - 12:30 PM**  
**Validation Of A Novel Wristband Micromanometer Used For Applanation Tonometry**

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(No relationships reported)

**PURPOSE:** To validate the clinical use of a newly designed wristband micromanometer. Augmentation Index ( $AI_x$ ),  $AI_x$  normalized at 75bpm ( $AI_x@75$ ), and round trip travel time of the reflective waveform ( $Dtp$ ) were compared to measurements produced using the traditional pencil-type micromanometer (Millar Instruments, Houston, Texas).

**METHODS:** Resting pulse wave analysis was measured non-invasively in triplicate using radial artery applanation tonometry in 32 apparently healthy subjects (males  $n = 21$ ; females  $n = 11$ ). Each subject was randomized to testing first with either the novel wristband micromanometer or pencil-type micromanometer.  $AI_x$ ,  $AI_x@75$ , and  $Dtp$  were calculated from aortic pressure waveforms which were synthesized using a generalized transfer function from high fidelity radial pressure waveforms calibrated from standard brachial artery sphygmomanometry. Paired t-tests and Wilcoxon's signed rank test, for non-normally distributed variables, was performed between means and coefficients of variation; at  $\alpha = 0.05$ . Bland-Altman analyses were performed to test for agreement between micromanometers.

Table 1. Means, Coefficients of Variations, and Standard Deviations for all Variables Measured

	Wristband		Pencil Type	
	M±SD	CV±SD	M±SD	CV±SD
APH (AU)	121.55 ±21.55		124.75 ±18.88	
PHV (AU)	2.3 ±0.76		2.4 ±0.61	
DV (AU)	2.01 ±0.46*		2.37 ±0.72*	
QI (%)	97.74 ±2.51*		97.22 ±1.91	
ASP (mmHg)	100.02 ±11.68*		100.45 ±11.59*	
ADP (mmHg)	73.57 ±9.67		73.57 ±9.69	
MAP (mmHg)	85.56 ±10.75		85.81 ±10.66	
APP (mmHg)	26.45 ±5.39*		26.88 ±5.12*	
HR (bpm)	61.49 ±10.64		61.18 ±10.83	
ED (ms)	328.84 ±24.31		332.37 ±19.86	
ΔTp (ms)	114.73 ±17.07*		118.31 ±17.50*	
TPP (ms)	219.75 ±24.24**		224.99 ±23.20**	
ΔTs (ms)	158.55 ±19.09		162.66 ±19.28	
P1 (mmHg)	24.16 ±4.58		24.38 ±4.77	
BUCK (AU)	179.44 ±42.85		176.71 ±35.93	
AIx2 (%)	108.37 ±13.70		109.03 ±13.74	
AIx1 (%)	6.52 ±10.95		6.98 ±11.18	
AIx@75 (%)	0.04 ±11.44		0.3 ±11.68	
AG (mmHg)	1.85 ±3.47		1.97 ±3.33	

APH = Aortic Pulsewave Height; PHV = Pulsewave Height Variation; DV = Diastolic Variation; QI = Quality Index; ASP = Aortic Systolic Pressure; ADP = Aortic Diastolic Pressure; MAP = Mean Arterial Pressure; APP = Aortic Pulse Pressure; HR = Heart Rate; ED = Ejection Duration; ΔTp = Round Trip Travel Time of the Reflected Wave; TPP = Time to Peak Pressure; ΔTs = Systolic Duration of the Reflected Wave; P1 = Pressure at 1<sup>st</sup> peak/shoulder; BUCK = Buckberg Sub-Endocardial Viability Ratio; AIx2 = Augmentation Index 2; ESP = End Systolic Pressure; AIx1 = Augmentation Index 1; AIx@75 = Augmentation Index normalized to 75 beats per minute; AG = Augmented Pressure; NDA = No Data Available.

Note: \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , paired t-test, † =  $p < 0.01$  Wilcoxon's signed rank test

**RESULTS:** The Bland-Altman analyses show full agreement between micromanometers. The observed minor but statistically significant differences, for only 5 variables, in coefficients of variation and means will have no impact in a clinical or research interpretation model.

**CONCLUSIONS:** Our results show that the novel wristband micromanometer is highly correlated with the traditionally accepted pencil-type micromanometer used to determine  $AI_x$ ,  $AI_x@75$ , and  $Dtp$  in males and females. These data suggest that the wristband micromanometer is a valid and reliable alternative to the pencil type

**1610 Board #212 May 27 11:00 AM - 12:30 PM**  
**The Acute Effects Of Smokeless Tobacco On Central Hemodynamics**

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(No relationships reported)

It has been shown that one time use of smokeless tobacco (ST) in habitual and recreational users increases heart rate, peripheral blood pressures, and circulating plasma levels of epinephrine. These changes suggest there may also be alteration in central hemodynamics and cardiovascular workload.

**PURPOSE:** This study sought to examine the acute effect of a single bout of ST on central hemodynamics.

**METHODS:** Eight apparently healthy male subjects (age =  $31.5 \pm 6.4$  yrs), who were recreational and/or habitual ST users were given a 2.5-gram oral dose of ST after baseline measurements were recorded. ST was held in the lower lip for 30 min while measurements were taken at 10 min intervals. After removal of the ST, measurements continued at 10 min intervals for an additional 30 min. All measurements were obtained in triplicate, non-invasively using radial artery applanation tonometry. Aortic pressure waveforms were synthesized using a generalized transfer function from high fidelity radial pressure waveforms calibrated from standard brachial artery sphygmomanometry.

**RESULTS:**

Values reported as Mean (SE); \* significant difference from baseline ( $p < 0.05$ ); †  $p = 0.071$

	BL	10	20	30	Post-10	Post-20	Post-30
HR	67.8 (6.4)	80.2 (7.3)*	76.3 (7.1)*	77.3 (7.0)*	74.7 (7.4)*	73.2 (7.0)*	71 (7.1)
B SP	128.4 (4.7)	130.0 (20.5)	146.4 (7.7)*	144.9 (7.4)*	140.5 (6.4)*	141.8 (5.9)*	137.8 (6.0)*
B DP	79.3 (4.4)	86.7 (7.2)	89.7 (4.9)*	90.6 (4.1)*	89.1 (3.9)*	89.1 (4.0)*	83.6 (4.6)
B MP	95.5 (4.7)	106.6 (8.2)	108.8 (6.5)*	107.6 (5.6)*	105.9 (5.0)*	105.8 (5.0)*	100.9 (5.2)
B PP	49.3 (3.2)	61.9 (6.0)	57.6 (4.4)*	52.6 (4.8)	51.9 (3.8)	50.9 (3.4)	52.6 (4.1)
A SP	112.8 (4.6)	126.2 (8.3)	127.0 (7.3)*	124.1 (6.2)*	122.3 (5.5)*	122.0 (5.1)*	118.3 (5.7)
A DP	80.7 (4.5)	88.9 (7.6)	92.0 (5.5)*	92.6 (4.6)*	91.1 (4.2)*	91.0 (4.5)*	85.3 (4.8)
A MP	95.4 (4.6)	106.6 (8.2)	108.9 (6.4)*	107.6 (5.6)*	105.9 (5.0)*	105.8 (5.0)*	100.9 (5.2)
A PP	32.0 (2.1)	37.2 (3.3)	35.0 (3.0)	31.5 (2.1)	31.2 (1.8)	31.1 (1.9)	33.0 (3.6)
Tr	159 (5.9)	147.8 (3.3)*	149 (3.2)*	147.5 (2.7)*	149.8 (3.3)*	147.2 (2.0)*	149.1 (2.2)*
Aix@75	3.5 (4.2)	7.6 (3.2)*	6.5 (3.1)	6.8 (2.7)	5.9 (2.2)	5.4 (2.6)	6.7 (3.5)
Buckberg	188.7 (15.3)	154.3 (12.4)*	161.9 (12.9)*	168.8 (14.8)*	173.4 (15.9)*	176.8 (13.9)*	181.8 (16.8)
ESP	105.0 (4.4)	115.9 (7.7)	117.9 (6.6)*	115.6 (5.3)*	114.1 (5.0)*	114.5 (4.8)*	110.4 (5.1)
WLVE	17.6 (9.3)	30.4 (12.5)*	32.2 (14.0)†	26.0 (11.1)	25.2 (10.3)	26.3 (9.9)*	29.9 (13.3)

B=Brachial, A=Aortic, SP=Systolic Pressure (mmHg), DP=Diastolic Pressure (mmHg), MP=Mean Pressure (mmHg), PP=Pulse Pressure (mmHg), HR=Heart Rate (beats/min), Tr=Travel time of reflected pressure wave (msec), Aix@75=Augmentation Index normalized to 75 beats/min (%), Buckberg=Sub Endocardial Viability Ratio (%), ESP=End Systolic Pressure (mmHg), WLVE=Wasted Left Ventricular Energy (Dynes/cm<sup>2</sup>·min x 10<sup>3</sup>)

**CONCLUSIONS:** One time use of ST results in a transient significant increase in central pressures, HR, Aix@75, and WLVE. Travel time of reflected pressure waves is significantly decreased following ST administration which contributes to elevated central pressures and is reflected by the significant elevations in augmentation index, ESP, and WLVE. The changes in central hemodynamics associated with one time ST use in recreational and habitual users appears to contribute to an increase in cardiac stress.

**1611 Board #213 May 27 11:00 AM - 12:30 PM**  
**Correlates Of Endothelial Function And The Peak Systolic Blood Pressure Response To A Graded Maximal Exercise Test**

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(No relationships reported)

**PURPOSE:** An elevated systolic blood pressure (SBP) response during maximal exercise may be a predictor of endothelial dysfunction and future hypertension. We examined associations among the peak SBP response to a graded exercise stress test (GEST) and correlates of endothelial function among men ( $n=48$ ,  $43.7 \pm 1.4$  yr) with high BP ( $145.6 \pm 1.5/85.9 \pm 1.1$  mmHg).

**METHODS:** For 20 min prior to the GEST, BP was measured every 2 min in the seated position via auscultation and averaged as baseline BP. Volunteers completed a maximal cardiopulmonary GEST to determine peak oxygen consumption ( $\text{VO}_{2\text{peak}}$ ). Brachial artery reactivity (BAR) was measured 3 and 5 min post-occlusion and expressed as a % change from baseline. Nitric Oxide (NO) was measured via chemiluminescence assay. Plasma glucose concentrations were determined in duplicate by an automated glucose oxidase method. Endothelial nitric oxide synthase genotype (ENOS -786 T>C; rs2070744) (ENOS TT,  $n=24$ ; ENOS TC/CC,  $n=24$ ) was determined by polymerase chain reaction and restriction enzyme digestion. Simple linear and multiple variable regression analyses examined relationships among the change in peak SBP achieved on the GEST and correlates of endothelial function.

**RESULTS:** Linear regression analyses revealed the peak SBP change was positively correlated to blood glucose ( $r^2=0.063$ ,  $p=0.015$ ), age ( $r^2=0.016$ ,  $p=0.024$ ),  $\text{VO}_{2\text{peak}}$  ( $r^2=0.014$ ,  $p=0.037$ ), ENOS -786 T>C ( $r^2=0.051$ ,  $p=0.026$ ), baseline SBP ( $r^2=0.005$ ,  $p=0.084$ ), and baseline NO ( $r^2=0.013$ ,  $p=0.053$ ); and negatively correlated to % BAR change at 3 min post-occlusion ( $r^2=0.104$ ,  $p=0.029$ ). Multiple variable regression analyses indicated that this model explained 26.7% of the peak SBP response to a GEST. Lastly, among carriers of the ENOS C<sup>786</sup> risk allele, the peak SBP change was  $11.1 \pm 5.0$  mmHg higher ENOS TT homozygotes, 92.4 versus 81.3 mmHg, respectively ( $p=0.03$ ).

**CONCLUSIONS:** Surrogate measures of endothelial function appear to explain a clinically significant portion of the peak SBP response to a GEST. Further work is needed to investigate how interactions among clinical and genetic correlates of endothelial function explain the variability in the peak SBP response to a GEST.

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**1612 Board #214 May 27 11:00 AM - 12:30 PM**  
**Effects Of A Novel Whey-derived Peptide On Vascular Responses In Healthy Individuals**

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**PURPOSE:** Whey protein is a potential source of bioactive peptides. Based on findings from *in vitro* experiments showing a whey derived peptide increased endothelial nitric oxide synthesis, we tested the *in vivo* bioactivity of the peptide on vascular function in healthy humans.

**METHODS:** A randomized, double blind, placebo-controlled, crossover study design was used. Twenty healthy men and women (age  $25 \pm 5$  yr, body mass  $69.8 \pm 9.1$  kg, BMI  $24.3 \pm 2.3$  kg/m<sup>2</sup>) participated in two vascular testing days each preceded by 2 wk of supplementation with 5 g/day of a novel whey-derived peptide (WP) or placebo. There was a 1-2 wk washout period between trials. After two weeks of supplementation, vascular function and circulating biomarkers were assessed in response to a single dose of either WP or

placebo. Macrovascular and microvascular function were assessed using brachial artery flow mediated dilation (FMD) via high-resolution ultrasound and venous occlusion strain gauge plethysmography, respectively.

**RESULTS:** Baseline peak FMD was not different for placebo (7.7%) and WP (7.8%). Placebo intake had no effect on FMD at 30, 60, and 90 min post-ingestion (7.5%, 7.2%, and 7.6%, respectively) whereas WP resulted in a significant increase compared to baseline (8.9%, 9.9%, and 9.0%, respectively) ( $P = 0.000$  for time x trial interaction). Baseline reactive hyperemia forearm blood flow was not different for Placebo ( $27.2 \pm 7.2$  %/min) and WP ( $27.3 \pm 7.6$  %/min). Placebo intake had no effect on reactive hyperemia forearm blood flow measured 120 min post-ingestion ( $27.2 \pm 7.8$  %/min) whereas WP resulted in a significant increase compared to baseline ( $29.9 \pm 7.8$  %/min) ( $P = 0.008$  for time x trial interaction). The insulin response was significantly higher during WP than placebo at 15, 30, and 45 min, but there were no significant differences in glucose, myeloperoxidase, total nitrites/nitrates, and inflammatory responses.

**CONCLUSIONS:** Consistent with cellular work showing components of whey protein have nitric oxide enhancing effects, these findings indicate that supplementation with a novel whey derived peptide in healthy individuals improves vascular function, perhaps by increasing basal NO bioavailability.

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**1613 Board #215 May 27 11:00 AM - 12:30 PM**  
**Regular Swimming Exercise And Central Artery Compliance**

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Swimming is an exercise modality that is highly suitable for health promotion and disease prevention, and is one of the most popular, most practiced, and most recommended forms of physical activity. Yet little information is available concerning the influence of regular swimming on coronary heart disease (CHD).

**PURPOSE:** To determine whether central artery compliance in middle-aged and older swimmers is higher than sedentary controls, but lower than runners.

**METHODS:** Eighty apparently healthy adults (57 men and 23 women) aged 35 to 80 yrs were studied: 20 swimmers (age  $57 \pm 11$  yr), 20 runners ( $58 \pm 10$  yr), and 40 sedentary controls ( $57 \pm 8$  yrs).

**RESULTS:** Groups were not different in age, height, plasma cholesterol, LDL cholesterol, and glucose concentrations. Maximal oxygen consumption (on the treadmill) was higher and body fat percentage (via DEXA) was lower in runners than in sedentary controls (both  $p < 0.05$ ); there were no differences between swimmers and sedentary controls. Central artery compliance (via simultaneous B-mode ultrasound and arterial applanation tonometry on the common carotid artery) was 67% greater ( $p < 0.05$ ) in runners than sedentary controls. There were no significant differences in central artery compliance between swimmers and sedentary controls ( $0.11 \pm 0.05$  vs.  $0.10 \pm 0.03$  mm<sup>2</sup>/mmHg). Systolic blood pressure was higher ( $p < 0.05$ ) in swimmers than in runners and sedentary controls. In the pooled population, central artery compliance was modestly associated with maximal oxygen consumption ( $r = 0.38$ ) and body fat percentage ( $r = -0.26$ ).

**CONCLUSIONS:** We concluded that middle-aged and older swimmers do not exhibit typical central arterial stiffness phenotypes that are often displayed in their running peers.

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**1614 Board #216 May 27 11:00 AM - 12:30 PM**  
**Examination Of Vascular Structure And Function In Collegiate Football Players**

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Cardiovascular disease remains the number one cause of morbidity and mortality in the United States. American football players engage in unique training regimens that may have unfavorable effects on vascular health and subsequently increase risk for future cardiac events. Interior lineman may be especially vulnerable due to high levels of body fat.

**PURPOSE:** To evaluate vascular structure and function in collegiate football players and to determine whether they are associated with traditional cardiovascular risk factors.

**METHODS:** Members of the Wake Forest University football team were recruited to participate in this study. Resting blood pressure and anthropometrics were assessed according to established guidelines. Brachial artery reactivity and carotid artery distensibility were evaluated using high resolution ultrasonography.

**RESULTS:** Thirteen "skill position players" (SP) ( $20 \pm 1.6$  yrs) and thirteen interior lineman (IL) ( $20 \pm 1.0$  yrs) completed all facets of the study. Significant group differences were observed for body weight (SP:  $86.7 \pm 3.1$  kg vs. IL:  $131.2 \pm 13.2$  kg), body fat (SP:  $11.7 \pm 1.8$  % vs. IL:  $24.9 \pm 4.3$  %), BMI (SP:  $26.4 \pm 1.6$  m·kg<sup>-2</sup> vs. IL:  $36.1 \pm 3.6$  m·kg<sup>-2</sup>) and resting systolic blood pressure (SP:  $121 \pm 5$  vs. IL:  $134 \pm 12$ ), (All  $p$ 's  $< 0.01$ ). In addition, carotid distensibility was significantly greater in SP compared to IL ( $p = 0.026$ ). There was no significant difference in brachial artery reactivity between the two groups. Interestingly, resting systolic blood pressure correlated with distensibility ( $r = -0.409$ ,  $p = 0.034$ ) and body fat percentage ( $r = 0.728$ ,  $p = 0.000$ ).

**CONCLUSIONS:** These findings suggest that collegiate interior linemen are at an elevated risk for cardiovascular disease compared to the skill position players based on measures of body fat and resting systolic blood pressure. The significant association between systolic blood pressure and carotid distensibility suggest that alterations in the mechanical properties of the vasculature may be involved in the development of hypertension in this cohort.

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**1615 Board #217 May 27 11:00 AM - 12:30 PM**  
**The Impact Of Exercise On Derived Central Measures Obtained From The Sphygmocor Device**

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(No relationships reported)

**PURPOSE:** To investigate whether measures derived from the SphygmoCor device and its associated transfer function are influenced by exercise-induced alterations in vascular tone. To do this, measurements were taken from either the exercised or the contra-lateral non-exercised limb, during repeated and identical incremental hand-grip protocols.

**METHODS:** Eight male subjects performed 3, 3-minute bouts of handgrip exercise, on two occasions. The exercise intensities were set at 3kg and 5kg, with a final 1.5kg bout performed during cuff ischaemia (1.5Isch). Blood pressure waveforms were recorded from the radial artery of either the exercised or non-exercised limb using applanation tonometry (SphygmoCor) during a 90 s rest period immediately after each exercise bout. Central blood pressures and augmentation indices, an index of arterial stiffness, were derived using the peripheral waveform and the inbuilt SphygmoCor transfer function (TF).

**RESULTS:** Augmentation index (AIx) was consistently ~10% higher in the exercised arm during all trials compared to the non-exercised limb. Similarly, there was a consistent and significant difference (~3 mmHg;  $P < 0.05$ ) between exercised and non-exercised arms for the derived central systolic and mean arterial blood pressures.

**CONCLUSIONS:** Despite similar central haemodynamic responses to the identical bouts of exercise, AI and well as central systolic and mean arterial blood pressures derived from applanation tonometry at the peripheral radial artery were statistically different when assessed at the exercising arm versus the non-exercising arm. Changes in vascular tone with exercise may modify the intrinsic characteristics of the vessel wall and could compromise the assumptions underlying transfer functions used to derive central measures using applanation tonometry.

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**1616 Board #218 May 27 11:00 AM - 12:30 PM**  
**Vasodilation Of Vascular Smooth Muscle At Different Temperatures**

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(No relationships reported)

**PURPOSE:** To examine the influence of vascular smooth muscle (VSM) on vasodilation during periods of increased temperature.

**METHODS:** Femoral arteries were excised from female, F-344 rats, and cut into two millimeter segments. These segments were mounted in a tissue bath containing modified Krebs-Henseleit buffer at a pH of 7.4. All vessels were stimulated for vasoconstriction using phenylephrine ( $10^{-5}$  M) or potassium chloride (40 mM). This precontraction phase was followed by the endothelium-independent vasodilator, sodium nitroprusside (SNP), which was administered in a series of increasing concentrations ( $10^{-9}$ - $10^{-5}$  M). Following the 37°C condition, the tissue bath temperature was increased to 41°C and allowed to equilibrate for 30 minutes before commencing with the SNP curve.

**RESULTS:** In experiments using phenylephrine as the precontractive stimulus, there were no differences in EC50 or slope between 37°C (EC50:  $-7.71 \pm .44$  log M SNP, slope:  $-1.38 \pm .42$  tension(g)/log M SNP) and 41°C (EC50:  $-7.59 \pm .30$  log M SNP, slope:  $-1.28 \pm .19$  tension(g)/log M SNP). Similarly, there were no EC50 or slope differences in the potassium chloride experiments between 37°C (EC50:  $-7.25 \pm .07$  log M SNP, slope:  $-.80 \pm .00$  tension(g)/log M) and 41°C (EC50:  $-6.90 \pm .14$  log M SNP, slope:  $-.75 \pm .07$  tension(g)/log M SNP).

**CONCLUSION:** These data suggest that VSM-mediated vasodilation is unaffected by increases in temperature.

*This research was Supported by the Arkansas Biosciences Institute and the National Institute on Aging.*

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**1617 Board #219 May 27 11:00 AM - 12:30 PM**  
**Comparison Of Brachial Artery Blood Flow To Total [hemoglobin+myoglobin] Response During Post-occlusive Reactive Hyperemia.**

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(No relationships reported)

The measurement of brachial artery blood flow (BABF) during post-occlusive reactive hyperemia (PORH) demands expertise and requires specialized equipment. Near-infrared spectroscopy (NIRS) is a non-invasive technology that allows for the measurement of total [hemoglobin + myoglobin] (as t[Hb+Mb]) in tissues of interest. Changes in t[Hb+Mb] of the forearm during PORH most likely reflect changes in total tissue hemoglobin, which would arise from changes in skeletal muscle microvascular hematocrit and/or microvascular blood flow. If true, t[Hb+Mb] could be a useful window into skeletal muscle microvascular function in health and disease.

**PURPOSE:** The purpose of this investigation was to explore the temporal relationship between t[Hb+Mb] and BABF during PORH. We hypothesized that the transient changes in brachial artery blood flow during PORH would be detectable in the downstream microvasculature as temporally similar changes in t[Hb+Mb].

**METHODS:** Fourteen healthy subjects of both sexes had concurrent assessment of brachial artery blood flow by Doppler ultrasound, and t[Hb+Mb] responses by NIRS, during post-occlusive reactive hyperemia.

**RESULTS:** The average correlation between these measurements was 0.90 (range 0.697-0.999). Because many of the subjects demonstrated a significant time lag between the peak BABF and the peak t[Hb+Mb] signal, a cross correlation analysis was also run to see if altering the time displacement improved the degree of correlation between these measurements. Cross correlation analysis showed that for 3 subjects there was no lag between the peak amplitudes for both measures. For 9 subjects the BABF values peaked prior to the t[Hb+Mb] signal; average lag time was 4 seconds (range 0.7-9.7 seconds). Two subjects showed BABF peaking after the t[Hb+Mb] signal with an average lag time of -2.4 seconds between the peaks.

**CONCLUSIONS:** These data demonstrate that, in healthy subjects, there is a close temporal association between changes in t[Hb+Mb] and changes in BABF, which suggests that changes in t[Hb+Mb] during PORH may reflect changes in microvascular flow.

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**1618 Board #220 May 27 11:00 AM - 12:30 PM**  
**Does Laughter Improve Endothelium-dependent Vasodilatation?**

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(No relationships reported)

The concept that humor or laughter can relieve stress and improve health has been around for more than centuries, and abundant anecdotal evidence supports such concept. However, the scientific evidence supporting the benefits of humor or laughter on various health aspects, particularly vascular function, is lacking.

**PURPOSE:** To determine whether laughter acutely increases endothelium-dependent vasodilatation.

**METHODS:** Using an interventional study design, 10 apparently healthy adults (9 males and 1 female, 23-42 years old) were randomly assigned to watch either 30 minutes of a comedy or a serious documentary to induce emotional stress (e.g., Nazi concentration camp) over 2 consecutive days. Brachial artery flow-mediated dilatation (FMD), an index of endothelium-dependent vasodilatation, was measured via B-mode ultrasound before (baseline), 30 minutes and 24 hours after each viewing session. Laughter was quantified by the analysis of subjects' breathing pattern (via Pneumotrace).

**RESULTS:** Baseline FMD values were not different before comedy and documentary viewing conditions. FMD at 30 minutes after viewing the comedy was 21% greater than the baseline values ( $p < 0.05$ ), and the elevated FMD remained significant ( $p < 0.05$ ) 24 hours after viewing the comedy. In contrast, FMD measured 30 minutes after documentary watching was 18% lower than the baseline values ( $p < 0.05$ ).

**CONCLUSION:** Laughter elicited by viewing a comedy has acute and sustaining favorable influence on endothelium-dependent vasodilatation.

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**1619 Board #221 May 27 11:00 AM - 12:30 PM**  
**Effect Of Acute Exercise On Circulating Endothelial Derived Microparticles**

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**PURPOSE:** Microparticles (MP) are cell fragments shed from formed elements such as circulating platelets, leukocytes, and vascular endothelial cells. Microparticles of different origin have been shown to play an important role in health and disease. For example, endothelial microparticles (EMP) are associated with endothelial dysfunction. Exercise is commonly used as a non-pharmacologic intervention in the primary and secondary prevention of cardiovascular disease. This study examined the effect of acute exercise on circulating EMPs.

**METHODS:** 10 healthy men ( $21 \pm 3.1$  yrs;  $VO_{2max}$ :  $58.8 \pm 6.6$  ml/kg/min; BMI:  $23.2 \pm 2.1$ ) exercised on a treadmill at 60%  $VO_2$  until they expended 400 kcal. Blood samples were taken before and immediately after the exercise and at 2 h, 4 h and 6 h after the end of the exercise bout. Subjects received a drink containing 400 kcal after the 2 hour blood sample to ensure consistent caloric intake during the 6 h post exercise recovery period. Circulating EMP were analyzed using flow cytometry.



**RESULTS:** Circulating EMPs as measured by flow cytometry using endothelial specific markers were elevated at 6 h post exercise. EMPs were 1.4 fold higher than baseline values, 1.6 fold higher than values immediately post exercise and 1.5 fold higher than values 2 h post exercise at the 6 h time point ( $p < 0.05$ ).

**CONCLUSIONS:** Acute exercise transiently increases EMPs 6 h post exercise in young healthy men. Understanding the cellular/molecular mechanisms by which interaction of exercise and EMP effect endothelial function is important if exercise is to be used in the prevention and treatment of cardiovascular disease.

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**1620 Board #222 May 27 11:00 AM - 12:30 PM**

**Responsiveness And Density Of Non-Adrenergic Receptors In Skeletal Muscle Of Young And Old Beagles**

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(No relationships reported)

A tonic increase in muscle sympathetic nerve activity (MSNA) has been associated with advancing age. Whether this tonic increase in efferent sympathetic nerve activity alters non-adrenergic protein expression and the responsiveness of non-adrenergic receptors in resting and contracting skeletal muscles has not been clearly established. Therefore, the purpose of the present study was to investigate the effect of aging on the density and responsiveness of neuropeptide Y - Y<sub>1</sub> (NPY) and purinergic (P2X) receptors in skeletal muscle. Young ( $n = 6$ ;  $22 \pm 3$ ) and old ( $n = 7$ ;  $119 \pm 22$  months) beagles were instrumented chronically with transit-time flow probes on the external iliac arteries and an indwelling catheter in a branch of the femoral artery. On separate days, flow-adjusted doses of selective NPY (Leu<sup>31</sup>-Pro<sup>34</sup> NPY; 1  $\mu\text{g}/\text{ml}/\text{min}$ ) and P2X (a-b-methylene ATP; 1  $\mu\text{g}/\text{ml}/\text{min}$ ) agonists were infused at rest and during treadmill running at 2.5 miles/h and 4 miles/h with 2.5% grade. Hindlimb blood flow (HBF) and mean arterial pressure (MAP) were recorded continuously and vascular conductance (VC) was calculated as HBF/MAP. After dissecting feed arteries from gracilis muscles, NPY and P2X receptor protein content was determined by Western Blot and adjusted for b-actin content. Infusion of NPY resulted in similar ( $p > 0.05$ ) declines in VC in young and old beagles at rest (Young:  $-40 \pm 18\%$ ; Old:  $-39 \pm 23\%$ ) and during exercise at 2.5 miles/h (Young:  $-47 \pm 14\%$ ; Old:  $-40 \pm 15\%$ ) and 4 miles/h with 2.5% grade (Young:  $-40 \pm 8\%$ ; Old:  $-38 \pm 5\%$ ). a-b-methylene ATP infusion also produced similar ( $p > 0.05$ ) decreases in VC in young and old beagles at rest (Young:  $-36 \pm 20\%$ ; Old:  $-40 \pm 10\%$ ) and during exercise at 2.5 miles/h (Young:  $-42 \pm 21\%$ ; Old:  $-40 \pm 23\%$ ) and 4 miles/h with 2.5% grade (Young:  $-47 \pm 12\%$ ; Old:  $-42 \pm 20\%$ ). NPY and P2X receptor protein expression were similar ( $p > 0.05$ ) in young and old beagles. These results demonstrate that the vascular response to selective NPY and P2X receptor agonists does not decline with advancing age. Moreover, the similar receptor protein expression suggests that the tonic increase in efferent MSNA with aging does not alter the density of post-synaptic receptors in canine feed arteries.

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**1621 Board #223 May 27 11:00 AM - 12:30 PM**

**The Impact Of Lower Limb Blood Flow Restriction On Hemodynamics During Low Intensity Aerobic Exercise**

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(No relationships reported)

"Kaatsu" (ie, blood flow restricted exercise) is a popular exercise modality in Japan and is spreading widely to the rest of the world. The underlying principle of this training is that under the conditions of restricted muscle blood flow, even low-intensity exercise can induce muscle strength and hypertrophy. One concern, however, is that blood flow restriction (BFR) would increase vascular resistance and could induce increase blood pressure as well as myocardial oxygen demand, which may be harmful for those with compromised cardiac function.

**PURPOSE:** To determine the effects of leg BFR on hemodynamic factors during low intensity aerobic exercise.

**METHODS:** Eight young ( $27 \pm 4$  years) healthy volunteers were studied under parallel conditions on 2 separate days. For each exercise session, the volunteer stood 3 minutes for baseline, followed by five 2 minute walking intervals, with one minute rest between intervals. During the BFR condition, two pneumatic cuffs (inflated to 160mmHg) were placed around the upper thighs. The order of experiments was randomized between the BFR condition and the control (without BFR cuff) condition.

**RESULTS:** Increases in systolic, mean, and diastolic blood pressure were 2- to 3-fold greater in the BFR session compared with the control session. The elevated blood pressure was associated with higher total peripheral resistance in the BFR session. Cardiac output was similar during both exercise sessions, but stroke volume increased less and heart rate increased more during exercise with the BFR cuffs. As a result, double product, an index of myocardial oxygen demand, was more than 2-fold higher during the BFR condition.

**CONCLUSION:** Blood flow restriction induces excessive blood pressure responses during low intensity aerobic exercise through increases in total peripheral resistance and cardiac afterload. These results suggest that "Kaatsu" may need to be more cautiously prescribed to those with compromised cardiac conditions.

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**1622 Board #224 May 27 11:00 AM - 12:30 PM**

**Comparison Of 8 Months Aerobic Versus Resistance Training On Endothelial Function In Apparently Healthy Adults**

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Selye's theory of stress-response-adaptation suggests an exercise stress, when applied to the vascular system, results in an increased delivery of blood flow to active skeletal muscle, and if the stress is repeated over time contributes to a series of vascular adaptations. There is a consensus of studies demonstrating improvements in endothelial function with short term ( $< 12$  weeks) aerobic exercise (AE) training but relatively little data on longer term training effects ( $> 6$  months) and/or resistance training (RT).

**PURPOSE:** To examine the effects of 8 months AE versus RT on brachial artery flow-mediated dilation (BAFMD-a non-invasive measure of endothelial function).

**METHODS:** Thirty-five subjects (26-66yr) were randomly assigned to AE (1200kcal/week, 60-80%  $\text{VO}_{2\text{peak}}$ ,  $n=17$ ) or RT (3 sets/day, 8-12 reps/set of 8 exercises; 3 sessions/wk with progressive wt increase). BAFMD was performed at baseline, post training and following 2 weeks of detraining.

**RESULTS:**

		Base Diam (mm)	Peak Diam (mm)	Dilation (%chg)
AE Group (n=17)	Pre Tx	3.36 $\pm$ 0.12	3.60 $\pm$ 0.12	7.21 $\pm$ 0.73
	Post 8m Tx	3.67 $\pm$ 0.11*	3.91 $\pm$ 0.11*	6.67 $\pm$ 0.74
	Post 2wk DeTx (n=8)	3.78 $\pm$ 0.15**	4.01 $\pm$ 0.15**	6.08 $\pm$ 0.98
RT Group (n=18)	Pre Tx	3.34 $\pm$ 0.17	3.52 $\pm$ 0.17	5.72 $\pm$ 0.52
	Post 8m Tx	3.26 $\pm$ 0.17	3.51 $\pm$ 0.16	7.95 $\pm$ 0.82*
	Post 2wk DeTx (n=10)	3.36 $\pm$ 0.20	3.60 $\pm$ 0.20	7.56 $\pm$ 0.98

Mean $\pm$ SE, \* =  $p < 0.05$  compared to pre Tx, \*\* =  $p < 0.01$  compared to pre Tx.

AE showed increases in immediate hyperemic blood volumes ( $341.93 \pm 27.20$  v  $480.99 \pm 39.17$  ml,  $p < 0.05$ ) but no changes in calculated shear stress.



**CONCLUSION:** AE demonstrated an increase in vessel caliber (structural adaptation) and hyperemic flow possibly commensurate with the ability to meet increased muscle demands during exercise. AE had no changes in endothelial responsiveness (stress response). Alternately RT showed no changes in vessel caliber (structural adaptation), but had increased reactivity (stress response). This may be reflective of the more intermittent nature of the exercise stimulus and relatively lower blood flow demands.

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**1623 Board #225 May 27 11:00 AM - 12:30 PM**

**P2y Receptors Play An Important Role In Skeletal Muscle Blood Flow Regulation In Exercising Swine**

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Skeletal muscle blood flow is closely regulated to match O<sub>2</sub> delivery to the metabolic demand, but the precise mechanisms involved in this regulation remain unclear. Plasma nucleotides (ATP, UTP, ADP and UDP) could play an important role in skeletal muscle blood flow regulation by activating endothelial P2Y receptors.

**PURPOSE:** To investigate the role of P2Y receptors in skeletal muscle blood flow regulation.

**METHODS:** Regional blood flow and systemic hemodynamics were measured before and after arterial infusion of Reactive Blue 2 (RB2; P2Y antagonist; 1.0 and 3.0 mg/kg) in exercising (5.2km/h) female Yucatan miniature swine (~30kg).

**RESULTS:** Mean blood flow during exercise from the 16 sampled skeletal muscle tissues was 137±39 ml/min/100g (mean±SE), and it was reduced by 17 and 28% when RB2 was infused at the low and high dose, respectively ( $P<0.05$ ). The reduced skeletal muscle blood flow with RB2 infusion was paralleled by an increase in arterial lactate concentration from 1.6±0.5 to 3.4±0.6 (low dose) and 3.9±1 (high dose) mmol/L ( $P<0.05$ ). Infusion of RB2 did not alter arterial blood pressure or visceral blood flow.

**CONCLUSIONS:** These results indicate that P2Y receptors play an important role in regulating skeletal muscle blood flow during exercise.

Supported by the Novo Nordisk Foundation and NIH grants HL36088 and HL52490

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**1624 Board #226 May 27 11:00 AM - 12:30 PM**

**Relationship Between Endothelial Function And Oxidative Damage In Hypercholesterolemic Pigs**

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(No relationships reported)

Increased levels of oxidative stress are known to impair endothelium-dependent dilation, promoting endothelial dysfunction and leading to the development of cardiovascular disease.

**PURPOSE:** To characterize the relationship between endothelial function and oxidative stress status in a hereditary hypercholesterolemic (HH) swine model.

**METHODS:** Sixteen adult pigs were randomly assigned into either exercise trained (EX) or sedentary groups (SED). Exercise training consisted of 16 weeks of treadmill running. Upon sacrifice brachial (BR) and femoral (FEM) arteries were harvested. In vitro assessment of endothelium-dependent dilation (EDD) was determined by administering increasing doses of acetylcholine to BR and FEM rings. Oxidative damage was quantified by immunohistochemistry using macrophage scavenger receptor A (SRA), adipophilin, and nitrotyrosine antibodies.

**RESULTS:** Endurance exercise training increased EDD in both the BR and FEM. The average percentage for SRA, Adipophilin, and Nitrotyrosine were not significantly different between EX and SED swine in the BR and FEM arteries. Interestingly, significant relationships were found between the BR and FEM-EDD and two of the antibodies, SRA and Adipophilin.

**CONCLUSIONS:** These findings demonstrate that EX increases EDD in the BR and FEM arteries, but did not alter markers of inflammation (SRA) or oxidant stress in arteries of HH swine.

Supported by NIH HL36088 and HL52940.

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**1625 Board #227 May 27 11:00 AM - 12:30 PM**

**Physical Training Attenuates Ischemic Pressor Response In Swine With Bilateral Femoral Artery Occlusion**

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(No relationships reported)

Patients with intermittent claudication exhibit elevated systemic blood pressure (BP) during increased physical activity. The increased BP is likely due to the perception of pain and the ischemic pressor response that trigger greater sympathetic nerve activation that exacerbates an increase in peripheral resistance.

**PURPOSE:** To determine whether physical training could alleviate this pressor response in a swine model of peripheral arterial insufficiency. **METHOD:** Yucatan male pigs received bilateral femoral artery occlusion and placement of flow probes on both iliac arteries and the left distal femoral arteries. BP was monitored through a catheter in the thoracic aorta. Pigs were either limited to cage activity (Sed) or walked about 30 min/d (3 mph) on treadmill for 8wks (Tr). Blood flows (BFs) and BP response to a progressive treadmill stress test (1,2,3,4, & 5 mph) were performed twice/wk.

**RESULTS:** Treadmill exercise for 8 wks greatly reduced peak BP responses during the stress test (Sed/Tr group: @ wk1:159±3/ 142±1, @wk8:148±11/101±13 mmHg). BFs through the iliac arteries of the Tr pigs increased just as much as measured in the arteries of the Sed pigs, even though systemic perfusion pressure was ~25% lower. Angiograph showed similar collateral vessel growth over this relatively short period of training.

**CONCLUSION:** Our data demonstrate that exercise training helps mitigate the pressor response observed in animals with peripheral arterial insufficiency during increased activity. If our results are applicable to humans, then chronic exercise programs provide yet another benefit to patients with peripheral arterial insufficiency that should help reduce their risk of cardiovascular accidents.

Supported by NIH grant P01 HL 52490.

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**1626 Board #228 May 27 11:00 AM - 12:30 PM**

**Differential Effects Of Exercise Training On Endothelial Phenotype In Porcine Conduit Arteries and Veins.**

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(No relationships reported)

**PURPOSE:** We previously reported (*J Appl Physiol* 90:501, 2001) that exercise training (EX) produced differential effects on expression of endothelial nitric oxide synthase (eNOS) and superoxide dismutase (SOD) protein in different sized coronary arteries. This study tested the hypothesis that EX produces similar increases eNOS and SOD expression in endothelial

cells (EC) of conduit arteries and veins of the porcine systemic vascular tree.

**METHODS:** Aorta and vena cava (thoracic and abdominal portions), brachial, femoral, and renal arteries & veins, carotid artery and jugular vein were isolated from 3 EX and 3 sedentary (SED) pigs and EC were scraped from each artery & vein providing 12 EC samples/pig. Samples were processed for immunoblot analysis with gels loaded with equal numbers of SED and EX samples of each artery & vein for analysis of expression levels of eNOS, and SOD-1-3.

**RESULTS:** Results reveal that eNOS expression was increased by EX only in the aorta, but decreased in the carotid artery and renal vein. Aortic ECs contained the greatest amount of eNOS of any artery or vein studied. EX decreased SOD-1 content in the aorta but did not alter SOD-1 expression in any other artery or vein. SOD-3 (ecSOD) content was not changed in any vessel except for a decrease in brachial vein and in renal artery and vein.

**CONCLUSIONS:** These results indicate that EX-induced changes in EC phenotype are different among conduit arteries & veins of the systemic circulation. Combined with previous results the results indicate that EX induces differential effects on arteries and vein's throughout the vascular tree.

(Supported by NIH grants HL36088 and HL52490)

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**1627 Board #229 May 27 11:00 AM - 12:30 PM**

**The Effect Of Resistance Training On Vascular Function And Central Blood Pressure In African American Men**

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**PURPOSE:** Young African American men have stiffer large central arteries, impaired dilation of smaller peripheral arteries and greater central blood pressure (BP) when compared to their white peers. The purpose of this study was to examine the effect of resistance exercise training (RT) on vascular function and central BP in young (age 22 yrs) African American and white men.

**METHODS:** Vascular and hemodynamic measures were made in 19 African American and 18 white men at baseline and following 6-weeks of RT. Carotid BP and carotid artery beta-stiffness were measured by tonometry and ultrasonography respectively. Aortic BP and augmentation index (AIx) were measured by radial artery tonometry and a generalized transfer function. Aortic and brachial stiffness were measured by pulse wave velocity (PWV). Brachial blood flow was assessed by Doppler ultrasonography. Forearm blood flow was measured by strain-gauge plethysmography at rest and during reactive hyperemia (RH) induced by 5-min of upper arm occlusion.

**RESULTS:** There were similar reductions in aortic systolic BP, carotid systolic BP, forearm vascular resistance and brachial vascular resistance in both African American and white men following training ( $p < 0.05$ ). There were similar increases in peak forearm blood flow and forearm blood flow area under the curve measured during RH in both African American and white men following training ( $p < 0.05$ ). There were no changes in brachial systolic BP, carotid stiffness, aortic AIx, aortic PWV, and brachial PWV in either group ( $p > 0.05$ ).

**CONCLUSIONS:** RT reduced central BP while having no effect on brachial BP in young African American and white men. Resistance exercise training appears to be a useful lifestyle intervention for improving peripheral vascular function while not detrimentally affecting central vascular function in young African American men.

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**1628 Board #230 May 27 11:00 AM - 12:30 PM**

**Long-term Effects of Lifestyle Modification on Cardiovascular Function and Subsequent Drug Treatment in High-risk Individuals**

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(No relationships reported)

**PURPOSE:** To assess 1) the long-term effects of lifestyle modification, and 2) the effects of an angiotensin receptor blocker (telmisartan) on central artery stiffness and endothelial function in people at increased risk for cardiovascular disease (CVD).

**METHODS:** This is a follow-up study of the SNAC (Staged Nutrition and Activity Counseling) study that originally examined the effects of lifestyle modification prescribed by family physicians on cardiovascular structures and function in people at increased risk for CVD. Twenty-four subjects ( $58.5 \pm 8.4$  yrs, 12F) were assessed following (mean of 26.3 months) discontinuation of the 1-year SNAC study. Carotid artery stiffness and flow-mediated dilation (FMD) of the brachial artery were assessed by Doppler ultrasound. Components of the metabolic syndrome (MS) [triglycerides (TG), high-density lipoprotein cholesterol, blood pressure (BP), fasting glucose (FG), and waist circumference] and exercise capacity ( $\text{VO}_2\text{max}$  by treadmill test) were also assessed. Subsequently, 17 subjects ( $58.0 \pm 7.9$  yrs, 7F) were reassessed following the 24-week telmisartan treatment.

**RESULTS:** The reduction in carotid artery stiffness observed at 1-year was still maintained at the time of follow-up, whereas the improved FMD at 1-year returned to the pre-intervention level ( $p < 0.05$ ). Similarly, the reductions in TG and FG seen at 1-year were maintained at the time of follow-up ( $p < 0.05$ ). Following the 24-week telmisartan treatment, carotid artery stiffness and FMD significantly improved even after adjusting for confounders. While BP was significantly reduced (DSBP  $13.6 \pm 16.3$  mmHg, DDBP  $7.9 \pm 5.6$  mmHg,  $p < 0.05$ ), other MS components and  $\text{VO}_2\text{max}$  remained unchanged throughout the drug treatment.

**CONCLUSIONS:** These results show that 1) our lifestyle modification strategy can maintain a reduction in carotid artery stiffness as well as TG and FG even after the active intervention, and 2) the telmisartan treatment may be another option to reduce carotid artery stiffness and improve endothelial function in this population. Future study will answer whether the reduction in central artery stiffness would lead to a reduction in the occurrence of CVD.

Supported by a grant from Lawson Health Research Institute.

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**1629 Board #231 May 27 11:00 AM - 12:30 PM**

**Effects Of Combined Exercise With Ace-i On Blood Pressor Responsivity And Plasma Volume In Shr**

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(No relationships reported)

**PURPOSE:** The present study investigated the effects of a single treatment with exercise and combination treatment with exercise and an antihypertensive drug, angiotensin converting enzyme inhibitor captopril (ACE-I, Capt), on blood pressor responsivity and circulating plasma volume (CPV) in SHR as a model of human essential hypertension.

**METHODS:** Sixty-two male SHR and twelve normotensive WKY rats were used in this study. SHR rats were assigned to exercise, Capt, or combined exercise with Capt, and sedentary control groups. WKY rats were also assigned to an exercise group or a sedentary control group. Voluntary exercise was performed daily using a rotatory wheel from 7 to 23 weeks of age. Approximately 20 mg/kg/day of Capt was given dissolved in tap water. Both exercise and the administration of Capt were conducted daily in the combination treatment group. Body weight and blood pressure (BP) were measured during treatment. Blood pressor responsivity and CPV were examined before and after treatment. In anesthetized animals, blood pressor responsivity (BPR) test was performed by monitoring the responses of arterial pressure via a transducer inserted into the left carotid, while pressor agents, phenylephrine and angiotensin II, were infused into the left jugular vein. CPV was determined by dilution of  $^{131}\text{I}$ -RISA, according to the method described by Trippodo et al.

**RESULTS:** While the increase in BP with aging in SHR was inhibited by combination treatment, it was not inhibited by exercise alone. Further, even in WKY rats, exercise alone did not inhibit the increase in BP with aging. The present BPR test showed that responsiveness to pressor agents accelerated with aging, and voluntary exercise had no

effects on blood pressor responsivity in either SHR or WKY rats. Furthermore, Capt attenuated responsiveness to pressor agents in SHR with and without exercise. Further, neither age, nor voluntary exercise produced any effects on CPV in either SHR or WKY rats.

**CONCLUSION:** The single treatment with exercise could not lower increased BP, and did not produce any effects on blood pressor responsivity and CPV with aging in both SHR and WKY rats. On the contrary, the combination treatment inhibited increases in BP and pressor responsivity, without any effects on CPV.

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**1630 Board #232 May 27 11:00 AM - 12:30 PM**  
**Influences Of Dehydration On The Sympathetic Nervous System In Humans: Role Of Angiotensin**

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(No relationships reported)

Exercise induced dehydration increases incidence of blood pressure (BP) dysfunction, particularly orthostatic hypotension and syncope, impairing performance. Dehydration (DEH) affects the sympathetic nervous system (SNS) and volume regulating hormones, e.g. angiotensin II (ang II). Animal data suggests these hormones have a mechanistic role in the effects of DEH on the SNS. Since the SNS is key to baroreflex control of BP, mechanisms underlying the changes in the SNS during DEH in humans are key to understanding this dysfunction.

**PURPOSE:** To determine the effects of DEH on the SNS and to determine whether ang II has a mechanistic role in these changes.

Hypothesis: (1) Muscle sympathetic nerve activity (MSNA) and baroreflex control of MSNA are increased during DEH (vs euhydration[EUH]); (2) Blockade of ang II receptors with Losartan reverses these changes.

**METHODS:** 15 subjects were studied on 2 separate study days, during EUH and DEH by 24 hour fluid restriction. MSNA was recorded by microneurography at the peroneal nerve. Blood samples were obtained and MSNA, BP, electrocardiogram, and central venous pressure (CVP) were recorded continuously. Pharmacologic tests of the baroreflex were performed. Losartan was then administered and measurements were repeated. MSNA and baroreflex sensitivity were compared between DEH and EUH as well as between pre-Losartan and post-Losartan measurements.

**RESULTS:** Blood tests were consistent with mild to moderate dehydration (increased Hct, osmolality, renin activity and arginine vasopressin). CVP was lower during DEH ( $2.8 \pm 3.0$  vs  $5.3 \pm 3.1$  mmHg,  $p=0.05$  vs EUH). MSNA showed a strong trend to be higher during DEH (burst incidence and burst frequency of  $43.1 \pm 19.4$  and  $25.5 \pm 11.0$  respectively during DEH vs  $34.6 \pm 15.9$  and  $20.2 \pm 8.4$  during EUH) ( $p=0.07$  for BI and BF). The baroreflex was not consistently more responsive in the dehydrated state. Losartan did not influence any of these variables.

**CONCLUSIONS:** Sympathetic neural mechanisms appear to contribute to maintenance of BP in the dehydrated condition by increasing tonic firing rate of sympathetic vasoconstrictor nerves. Potential interactions between neural mechanisms and hormones other than ang II during dehydration in humans require further study.

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**1631 Board #233 May 27 11:00 AM - 12:30 PM**  
**Obesity Is Associated With Increased Blood Pressure And Decreased Vascular Function In Firefighters**

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(No relationships reported)

Acute myocardial infarction is the most common cause of death in firefighters (FFs) during firefighting. Obesity is associated with cardiovascular health problems including vascular dysfunction. This association is of particular concern in FFs as cardiovascular stress intensifies during firefighting due to smoke exposure, physical exertion, and heat stress.

**PURPOSE:** To determine the impact of obesity on BP and vascular function in FFs.

**METHODS:** 110 young (mean age=29.7 yrs), current FFs were classified for obesity and overweight according to WHO BMI criteria (lean 18.5-24.9; overweight 25.0-29.9; obese >30.0), and underwent assessments of aortic pulse wave velocity (aPWV), carotid beta stiffness (cb), carotid intima media thickness (cIMT), brachial blood pressure (BP), aortic blood pressure (aBP), carotid blood pressure (cBP), conduit artery (brachial) flow mediated dilation (bFMD) and microvascular function (peak forearm blood flow following reactive hyperemia (RH)).

**RESULTS:** Obese FFs had increased BP, aBP and cBP, increased arterial stiffness of both the aorta and carotid artery and increased carotid IMT compared to lean FFs ( $p<0.05$ ). Indices of conduit artery and microvascular endothelial function were not different between groups.

Table 1. Mean (SD)

Variable	Lean (n= 28)	Overweight (n=50)	Obese (n=32)
BMI (kg/m <sup>2</sup> )	23.0 (1.7)	27.7 (1.4)	33.3 (3.1)
aPWV (m/s) * # +	5.8 (0.9)	6.3 (1.0)	6.9 (0.8)
cβ # +	4.48 (1.16)	5.10 (1.38)	6.32 (2.52)
cIMT (mm) # +	0.44 (0.08)	0.46 (0.07)	0.53 (0.11)
SBP / DBP (mmHg) # +	122 (9) / 67 (7)	126 (8) / 69 (8)	130 (10) / 75 (11)
aSBP / aDPB (mmHg) # +	103 (11) / 68 (7)	106 (9) / 70 (8)	111 (11) / 76 (11)
cSBP / cDPB (mmHg) # +	114 (10) / 67 (7)	115 (9) / 69 (8)	120 (9) / 75 (11)
bFMD (%)	6.47 (3.14)	7.23 (3.83)	7.22 (4.34)
Peak RH (ml/100 ml tissue/min)	28.52 (8.34)	31.21 (7.92)	29.93 (8.20)

\* lean different from overweight; + overweight different from obese; # lean different from obese

**CONCLUSION:** At a relatively young age, obese FFs show increased central and peripheral BP, cIMT, and arterial stiffness, showing increased cardiovascular risk, while maintaining normal conduit artery and microvascular endothelial function. These data suggest that obesity is detrimental to vascular health in FFs and may increase the risk for acute events during firefighting.

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**1632 Board #234 May 27 11:00 AM - 12:30 PM**  
**Vascular Function Changes Following An Acute Bout Of Resistance Exercise In Obese And Non-obese Males**

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(No relationships reported)

One of the earliest sub-clinical stages associated with atherosclerosis is endothelial dysfunction, which has been shown to predict future cardiovascular events. Chronic exercise is thought to improve vascular function (VF); however, few studies have evaluated the effects of acute resistance exercise (RE) on VF. In addition, there are no studies to date that have compared VF responses in obese and non-obese individuals following acute RE.

**PURPOSE:** The purpose of this study was to evaluate VF, as determined by the assessment of forearm blood flow (FBF) and vascular reactivity (VR) before and after a single bout of RE in obese and non-obese males.

**METHODS:** Seven non-obese ( $21.4 \pm 2.1$  yrs;  $22.5 \pm 1.2$  kg/m<sup>2</sup>) and seven obese ( $23.8 \pm 2.9$  yrs;  $36.3 \pm 2.4$  kg/m<sup>2</sup>) males volunteered to participate. FBF was assessed prior to (PRE) and immediately after (POST) 3 sets of arm curls to fatigue (70% of 1-RM) using strain-gauge plethysmography before and after 5 min of upper arm occlusion and subsequent reactive hyperemia. Total excess flow, calculated as the difference between baseline FBF and FBF during reactive hyperemia, was used as an indicator of VR. A One-Way ANOVA was performed to determine differences within each group. A multivariate ANOVA was used to test between-subject factors.

**RESULTS:** In non-obese males, FBF was significantly increased in response to reactive hyperemia during the PRE ( $P = 0.021$ ) and POST ( $P = 0.007$ ) trials. However, this increase was not observed in obese males (PRE,  $P = 0.147$ ; POST,  $P = 0.341$ ). There was no significant difference observed in VR for both non-obese and obese males PRE and POST. Between-subject analysis revealed that only POST FBF ( $\text{ml } 100 \text{ ml}^{-1} \cdot \text{s}$ ) was significantly different between non-obese and obese subjects at baseline ( $1782.7 \pm 169.6$  vs.  $1272.1 \pm 92.6$ ,  $P = 0.021$ ) and during reactive hyperemia ( $2796.4 \pm 265.8$  vs.  $1503.5 \pm 214.4$ ,  $P = 0.003$ ). Additionally, a significant difference in VR was observed between non-obese and obese males POST ( $1013.7 \pm 208.5$  vs.  $231.4 \pm 220.4$ ,  $P = .024$ ).

**CONCLUSIONS:** VR was increased during reactive hyperemia following a single bout of RE in non-obese, but not obese males. The different responses suggest that adiposity may have a detrimental effect on VF during acute exercise. Future studies that investigate the effects of obesity on cardiovascular health are warranted.

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**1633 Board #235 May 27 11:00 AM - 12:30 PM**  
**Adjusting Flow-mediated Dilation For Shear Stress Allows Detection Of Endothelial Dysfunction In A Moderate-risk Population**

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(No relationships reported)

Although normalization of brachial artery flow-mediated dilation (FMD) to individual shear stress (FMD:shear stress ratio) has been proposed to improve this measure of endothelial function, the clinical utility of FMD normalization has not yet been demonstrated.

**PURPOSE:** We tested whether 1) FMD:shear stress ratio would discriminate a population with moderate cardiovascular risk (MR) from a low risk (LR) population; and 2) dose-response profile (slope and y-intercept) relating shear stress to FMD would be different between both populations.

**METHODS:** Five different magnitudes of reactive hyperemia-induced shear stress were applied in a randomized order to 20 MR and 20 LR subjects by manipulating forearm cuff occlusion duration (1, 2, 3, 4, and 5 min). Brachial artery diameters and velocities were measured via high-resolution ultrasound. To quantify the hyperemic stimulus, shear stress area under the curve was individually calculated for the duration to peak dilation.

**RESULTS:** Following 5-min of forearm occlusion, FMD:shear stress ratio ( $p=0.041$ ), but not FMD ( $p=0.286$ ), discriminated MR from LR. The slope of shear stress-FMD regression line was lower in MR compared to the LR ( $p<0.001$ ).

**CONCLUSIONS:** FMD:shear stress ratio distinguishes endothelial dysfunction in a population with MR; and dose-response profile of shear stress-FMD relationship differs between populations of distinct cardiovascular risk.

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**1634 Board #236 May 27 11:00 AM - 12:30 PM**  
**Normalization Of Flow Mediated Dilation To Time-to-Peak Improves Measurement Sensitivity**

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(No relationships reported)

Background: Brachial artery flow-mediated dilation (FMD) has become a popular clinical measure of endothelial function. The ability of the traditional FMD procedure to detect differences between groups with apparently different arterial health remains inconclusive. Time-to-peak dilation (TTP) was introduced as a method able to detect differences between young and old individuals. Although TTP is a simple method, it may not assess nitric oxide (NO) production, which is the concept behind the traditional FMD. TTP may only be assessing the responsiveness of the endothelial and smooth muscle cells to NO. Because a large FMD is reflective of increased NO production and a short TTP is reflective of vascular responsiveness, the FMD/TTP ratio may increase FMD sensitivity in the clinical setting.

**PURPOSE:** To test the hypothesis that subjects with low cardiovascular disease risk (LR) would have a greater FMD/TTP ratio than subjects with moderate cardiovascular disease risk (MR).

**METHODS:** Subjects were categorized as LR ( $n=20$ , age= $23.3 \pm 0.6$  yrs) or MR ( $n=20$ , age= $55.9 \pm 1.9$  yrs) for cardiovascular disease by ACSM guidelines. Subjects were tested using current FMD guidelines. Continuous brachial artery diameters were obtained using high-resolution ultrasound for 1min prior to cuff occlusion and for 2min post occlusion. Edge-detection software was used to analyze brachial artery diameter. An independent sample t-test was used to determine differences in FMD and FMD/TTP ratio between groups with  $p < 0.05$ .

**RESULTS:** There were no differences between LR FMD ( $6.67 \pm 3.0\%$ ) and MR FMD ( $5.63 \pm 3.1\%$ ) ( $p = 0.29$ ). The TTP was significantly different between the LR ( $40.65 \pm 15.2$  s) and the MR ( $53.70 \pm 22.5$  s) groups ( $p = 0.04$ ). When the FMD/TTP ratio was compared, LR ( $0.18 \pm 0.08$ ) had a higher ratio than MR ( $0.13 \pm 0.08$ ) ( $p = 0.04$ ).

**CONCLUSION:** The FMD/TTP ratio may provide a more sensitive clinical marker of endothelial function when compared to traditional FMD. The FMD/TTP ratio may also offer a better perspective on overall conduit artery function when compared to TTP because it accounts for not only the change in arterial dilation but also the TTP (vascular responsiveness).

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**1635 Board #237 May 27 11:00 AM - 12:30 PM**  
**As A Bioassay, Should Flow-mediated Dilation Be Measured In Triplicate?**

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The flow-mediated dilation (FMD) test is considered by many to be a functional bioassay of NO bioavailability and endothelial function. Typically, bioassays are measured in duplicate or triplicate which allows for removal of outlying values and subsequent data averaging; however, only a single FMD measurement has traditionally been performed. Although there have been multiple studies evaluating the reproducibility of FMD, concern regarding the reliability of this ultrasonic assessment still exists reflected by its absence in the clinical environment.



**PURPOSE:** This study sought to evaluate the impact of applying the typical assay approach of triplicate measurements to reduce variance in FMD, with the ultimate goal of improving both statistical power in research and clinical relevance.

**METHODS:** Eight, young, apparently healthy, college aged males (ages  $23 \pm 1$  years; BMI  $23 \pm 1$  kg/ht<sup>2</sup>) participated in this investigation. On three separate days, FMD was assessed following 5 minutes of forearm ischemia and the single outlier was removed (triplicate approach). Reproducibility of FMD was assessed by coefficient of variation (CV %) and intra-class correlation coefficient (ICC).

**RESULTS:** The initial FMD performed on all subjects (single measurement) revealed an FMD of  $5.4 \pm 0.6$ , which was not statistically different ( $p=.532$ ) from the averaged FMD data utilizing the triplicate approach ( $6.4 \pm 1.3$ ). The mean  $\pm$  SEM CV % for the single FMD assessment was  $34.9 \pm 8.6\%$  and the intra-class correlation coefficient (ICC) was 0.63;  $p=0.07$ . With the triplicate approach the FMD CV % was greatly reduced to  $6.8 \pm 4.3$  while the ICC improved significantly to 0.975;  $p<0.001$ .

**CONCLUSION:** Considering the continued skepticism regarding the robust nature of FMD testing, the results of the present study advocates a triplicate approach when assessing FMD which significantly improves reliability, but does not alter the group mean response. With the previously documented efficacy of 30 minutes between FMD measurements without a carry over effect, and the possibility that the time between measurements can be further reduced, the triplicate approach for FMD can improve the statistical power and may even be suitable for clinical use.

*Supported by TRDRP 15RT-0100 and Parker B Francis Fellowship Program.*

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**1636 Board #238 May 27 11:00 AM - 12:30 PM**

**Normalizing Flow-mediated Dilation For Shear Rate Unveils The Vascular Effect Of A Nutritional Intervention.**

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Endothelium-dependant flow mediated dilation (FMD) of the brachial artery is a frequently used, noninvasive measurement that provides an index of vascular function. However, there is currently uncertainty as to whether the measured FMD should be normalized for the invoked shear stimulus.

**PURPOSE:** This study sought to determine the impact of controlling for shear rate on the FMD response following a relatively high fat nutritional intervention likely to have simultaneous effects upon hyperemia and oxidative stress.

**METHODS:** Thirteen healthy males ( $31.7 \pm 6.0$  yrs) participated in two brachial artery FMD trials before (PRE) and after (POST) ingestion of a 12 ounces of cooked beef. Vessel diameter, blood velocity, and calculated shear rate were determined with ultrasound Doppler following 5 minutes of suprasystolic cuff occlusion of the brachial artery. Differences between PRE and POST measurements were made using paired-samples t-tests.

**RESULTS:** FMD when traditionally expressed as % dilation revealed no difference between PRE FMD ( $10.0 \pm 4.0\%$ ) and POST FMD ( $7.6 \pm 4.9\%$ ). However, when FMD was normalized mathematically to shear rate, POST FMD was significantly reduced compared to the PRE FMD (PRE:  $4.8 \times 10^{-4} \pm 2.3 \times 10^{-4} \% \text{D/s}^{-1}\text{s}$ ; POST:  $3.2 \times 10^{-4} \pm 2.2 \times 10^{-4} \% \text{D/s}^{-1}\text{s}$ ;  $p<0.01$ ).

**CONCLUSION:** Vascular function was significantly reduced following a beef meal (POST) when compared with baseline (PRE) values only when normalized for shear rate. These data reinforce the importance of assessing and normalizing brachial artery FMD for shear rate. Without normalizing FMD for shear rate in the present study, a post-prandial attenuation in FMD following ingestion of the beef meal would not have been unveiled.

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**1637 Board #239 May 27 11:00 AM - 12:30 PM**

**Induced Inflammation Impairs Endothelial Function In Healthy Individuals**

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Acute systemic inflammation transiently increases the risk of cardiovascular events, but the mechanism is not clear. Impaired dilation of the brachial artery in response to shear stress is an indication of endothelial dysfunction and has been linked to chronic low grade inflammation in cross-sectional studies. Impaired endothelial function may be the link between inflammation and CVD, but there is a lack of experimental evidence to confirm this hypothesis.

**PURPOSE:** The purpose of this study was to examine the change in endothelial function after induced inflammation in healthy individuals.

**METHODS:** Sixteen ( $25 \pm 9$  yrs; BMI:  $24.6 \pm 3.0$ ) men ( $n=8$ ) and women ( $n=8$ ) volunteered for this study. In a randomized, cross-over design, participants received either a sham placebo shot (Sham) or influenza vaccination (Flu). There was a one-week washout period between the trials. Flow mediated vasodilation (FMD) and C-reactive protein (CRP) were assessed 24-hours before (Pre) and 24- (24-Post) and 48-hours (48-Post) after each treatment condition. CRP data were log transformed and FMD was calculated as the percent increase in brachial artery diameter above baseline (%). Data were analyzed with 2x3 (condition x time) ANOVA.

**RESULTS:** There were significant interactions ( $p<0.05$ ) for changes in both CRP and FMD.

**CONCLUSIONS:** The influenza vaccination increased CRP confirming an acute inflammatory response. Endothelial function decreased following the vaccination, but this decrease occurred before significant changes in circulating levels of CRP. This finding supports the link between inflammation and endothelial dysfunction and indicates that endothelial dysfunction may precede increases in systemic biomarkers of inflammation.

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**A-37 Free Communication/Poster - Whole Body Vibration and Performance**

MAY 27, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**1638 Board #240 May 27 9:30 AM - 11:00 AM**

**Acute Effects Of Various Whole-body Vibration Frequencies On Squat Jump In Men And Women**

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(No relationships reported)

Whole-body vibration (WBV) has been developed recently as a neuromuscular training method and has been popularly used from/by athletes, as a performance enhancement. However the most optimal / effective protocol / prescription has not been yet determined. **PUPROSE:** To investigate the acute effects of difference vibration frequencies on squat jump (SJ), as well as the differences in gender. **METHOD:** Seventeen trained subjects, 8 males (age  $23.4 \pm 1.5$  yrs, height  $173.4 \pm 4.5$  cm, weight  $72.3 \pm 6.9$  kg) and 9

females (age  $23.9 \pm 3.4$  yrs, height  $165.7 \pm 6.4$  cm, weight  $56.5 \pm 5.5$  kg) after participated in two familiarization sessions, they were randomly assigned into three groups and executed the WBV treatments in three different days, in order to avoid learning effect and fatigue. The WBV treatment consisted of static isometric squat ( $90^\circ$ ) on a vibration platform (PowerPlate<sup>®</sup>) in three different vibration frequencies (30Hz, 40Hz & 50Hz). The vibration amplitude was low (2mm) and each session lasted for 120 s ( $2 \times 60$  s with a rest period of 30 s). Three maximal squat jumps were performed before and 6min after the WBV treatment where the best trial was selected for further analysis.

**RESULTS:** Repeated one-way Anova showed that 50Hz vibration frequency significantly improved SJ performance in men by 7.05% and in women by 2.01% ( $F=13.330$ ,  $p=0.02$ ) whereas there was not significant changes on SJ in 30Hz and 40Hz vibration frequency. Additionally, there was a significant frequency by gender interaction ( $F=6.041$ ,  $p=0.27$ ) indicating that changes in men were greater comparing to women.

**CONCLUSION:** Two minutes isometric squat ( $90^\circ$ ) vibration exposure of 50 Hz produced significant improvements in SJ performance, whereas this vibration frequency was more productive in men than in women.

**1639 Board #241 May 27 9:30 AM - 11:00 AM**  
**Effects Of Whole Body Vibration On Vertical Jump In Female Collegiate Club Volleyball Players**

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(No relationships reported)

Studies report an increased vertical jump following whole-body vibration (WBV) with expensive, club-quality platforms. Low-cost versions of WBV platforms have become available.

**PURPOSE:** To determine if acute exposure to WBV using a low-cost vibration platform affects vertical jump height for two jump types in female collegiate volleyball players.

**METHODS:** Seventeen female collegiate club volleyball players completed four trials of two different vibration treatments - WBV for 60 s at 50 Hz on a low-cost WBV platform {Vib}, and non-vibration {NV} for 60 s; and each of two different vertical jumps - the counter-movement jump (CMJ), and one-step jump (1-step). Subjects performed either the Vib or NV trials for both the 1-step or CMJ, followed by 5 min rest, then performed the opposite treatment and repeated the two jump types. The order of vibration treatment, and jump type within a vibration treatment were randomized for each subject.

**SUMMARY OF RESULTS:** Table 1 provides the average  $\pm$  std error of the vertical jump (inches) for the two jump types and vibration treatments.

	NV	Vib	
CMJ (inches)	16.4 $\pm$ 0.48	16.5 $\pm$ 0.50	n.s.
1-step (inches)	17.7 $\pm$ 0.51*	17.6 $\pm$ 0.49*	n.s.

Acute vibration produced no significant effect with either CMJ or 1-step vertical jump ( $P > 0.05$ ). As expected, the 1-step vertical jump was significantly greater than CMJ in both vibration treatment conditions ( $P < 0.001$ ).

**CONCLUSIONS:** Acute WBV (50 Hz for 60 s) with the low-cost WBV platform failed to show an effect on vertical jump in female collegiate club volleyball players. Furthermore, there were no injuries or impairment of vertical jumping performance associated with the acute WBV.

**1640 Board #242 May 27 9:30 AM - 11:00 AM**  
**The Acute Effects Of Whole Body Vibration On Hamstring Flexibility**

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(No relationships reported)

The use of whole body vibration (WBV) platforms has been shown to increase flexibility in acute and chronic exercise studies. However, the vibratory settings used in these studies have varied considerably in terms of the frequency, displacement, and platform type. **PURPOSE:** The purpose of this study is to find the optimal frequency and displacement of WBV that elicits the greatest increase in hamstring range of motion on a triplanar WBV platform.

**METHODS:** Six male (25  $\pm$  6 yrs) and 5 female (22  $\pm$  2 yrs) participants volunteered for this study. Participants attended a total of nine days, with each day used to examine the effects of a unique WBV setting on hamstring flexibility. Conditions were combinations of 4 frequencies (30, 35, 40, and 50Hz) and Low vs. High Amplitudes (2 vs. 5mm), with one day during which stretching was performed with no vibration (NV). During training participants were instructed to bend forward at the waist keeping their knees at a 180 degree angle in an attempt to maximally stretch the hamstring muscle group. Flexibility was assessed using a modified sit and reach test, before vibration (pre), immediately after vibration, one minute post, two minutes post, and five minutes post vibration. A two-way repeated measures ANOVA (condition  $\times$  time) controlling for pre-test measures, was used to analyze the data.

**RESULTS:** The repeated measures analysis revealed no significant differences for stretching condition ( $F(8, 8) = 2.21$ ,  $p=.141$ ) or for time ( $F(3,3) = .932$ ,  $p=.522$ ) however, power levels were .484 and .115, respectfully for the full model. Separate ANOVAs comparing selected stretching conditions over time revealed a significant main effect for condition ( $F(1,8) = 6.23$ ,  $p=.037$ ) but not for time. Post hoc analyses revealed that 50 Hi elicited a significantly greater improvement than NV, ( $p=.040$ ).

**CONCLUSION:** Acute stretching of the hamstrings musculature during WBV resulted in a significant increase in hamstring flexibility over stretching without vibration. The setting 50 Hi condition proved to be the best setting to elicit positive changes in hamstring flexibility. These findings should be considered preliminary, due to the low sample size in this preliminary study.

**1641 Board #243 May 27 9:30 AM - 11:00 AM**  
**Vibration, Split Stretching, And Static Vertical Jump Performance In Young Male Gymnasts**

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Low frequency vibration has been shown to dramatically improve split range of motion (ROM) and to enhance vertical jumping ability.

**PURPOSE:** To investigate the effects of vibration and stretching-induced increases in ROM on subsequent single-leg static vertical jump (SLSVJ) performance.

**METHODS:** Fifteen male gymnasts [11.1(2.1) yr, 144.3(15.6) cm, 36.5(12.2) kg] participated. All tests were randomized for tests and treatment condition. Pretests consisted of two SLSVJ trials on each leg from 90 deg knee flexion on a force platform. Then two trials of a forward split test were conducted on each leg. In the split test the rear leg was flexed vertically 90 deg at the knee to limit pelvic misalignment. The anterior superior iliac spine (ASIS) was palpated with height from the floor measured as the ROM criterion variable. Both sides forward splits were treated by vibration on a custom device (30 Hz, 2mm displacement) for one minute (10s stretch, 5s rest, four times). The vibration device was placed under the forward ankle and under the rear thigh in each treatment. In the experimental condition the vibration device was turned on (V) while in

the control condition the device was turned off (NV). Following vibration treatment, the gymnasts repeated the split tests and the SLSVJ tests. Analysis consisted of multiple 2x2 ANOVAs with repeated measures of splits ROM, allometrically scaled SLSVJ variables, and descriptive statistics.

**RESULTS:** There was a greater improvement in split ROM in the V [29.4 (6.6) cm pre, 23.4 (6.2) cm post] vs NV [27.7 (7.3) cm pre, 25.0 (5.8) cm post] splits ( $P=0.002$ ), however all SLSVJ variables showed a decrease pre-post ( $P<0.05$ ) with no effect of condition and no significant interaction V by NV (all  $P>0.05$ ).

**CONCLUSION:** Vibration-enhanced stretching improved split ROM but did not show a protective effect nor enhancement of subsequent SLSVJ performance.

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**1642 Board #244 May 27 9:30 AM - 11:00 AM**  
**Effects Of Acute Whole Body Vibration On Fatigue During Leg Press Exercise Session**

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(No relationships reported)

**INTRODUCTION:** Often these athletes experience fatigue in between sets and this fatigue leads to poor biomechanics and lesser gains in strength. Whole-body vibration (WBV) training has been used to improve strength and vertical jump height in various athletes. Several studies had suggested an increase in sports performance after whole-body vibration training program either acutely or chronically. However, is of our knowledge that little data exists on the effects of WBV training on mechanisms of fatigue during muscular strength activities.

**PURPOSE:** To examine whether implantation of WBV during normal rest periods affects the fatigue associated with resistance exercise by measures of power, force, velocity and the force-velocity curve during a series of dynamic leg presses until failure.

**METHODS:** Ten sedentary college students ( $N = 5$  males,  $19 \pm 1.3$  yrs), and  $N = 5$  females,  $19 \pm 0.5$  yrs) participated in three trial sessions of 3 sets of dynamic leg press exercise to failure with 3.5 min rest in between sets. Subjects on the WBV trial were exposed to 60 sec vibration and 30 sec rest during their 3.5 min rest. Control subjects were stationary between sets and rest intervals. Statistical analyses utilized a two-way ANOVA with repeated measures for power, force, velocity, and force-velocity curves.

**RESULTS:** No significant differences ( $p > 0.05$ ) were observed for the dependent variables power, force, velocity and force-velocity curve between WBV and CON groups. However, a significant block effect ( $p > 0.05$ ) as well as a significant test x block interaction ( $p > 0.05$ ) was observed. The second block in each set of three blocks/test has the greatest power.

**CONCLUSIONS:** Acute WBV exposure in between sets had no effects on fatigue during leg press exercise as indicated by the measures power, force, velocity and force-velocity curve. The force/velocity curve shows that little resistance at a high velocity will not produce the greatest power, and high force at a slower resistance will not elicit the highest power either.

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**1643 Board #245 May 27 9:30 AM - 11:00 AM**  
**Effects Of Muscular Strength, Exercise Order, And Acute Whole-body Vibration Exposure On Bat Swing Velocity**

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(No relationships reported)

**PURPOSE:** 1) investigate effects of acute WBV exposure and exercise order on bat velocity; 2) examine relationship between muscular strength and bat velocity.

**METHODS:** Male subjects ( $n=16$ ;  $22 \pm 2$  yrs;  $181.4 \pm 7.4$  cm;  $84.7 \pm 9$  kg) were tested for 1-RM strength in squat and bench press. Subjects participated in four randomized trials, each consisting of three sets of five bat swings. Exercises (upper and lower body dynamic and static movements related to bat swing) with or without WBV exposure were applied following sets 1 and 2. Trials were: Control (CTRL), Arm (Arm-NOVIB) followed by Leg (Leg-NOVIB) exercises without WBV (A+L-NOVIB), Arm (Arm-VIB) followed by Leg exercises (Leg-VIB) with WBV (A+L-VIB), and Leg (Leg-VIB) followed by Arm (Arm-VIB) exercises with WBV (L+A-VIB). One-way repeated measures ANOVA assessed statistical differences across sets and trials. Linear regression analyzed relationship between strength and bat velocity.

**RESULTS:** Significant relationship existed between bat velocity and 1-RM squat ( $r^2 = 0.406$ ,  $p = 0.008$ ) but not with bench press. Arm-VIB alone did not significantly change bat velocity ( $p = 0.198$ ), but A+L-VIB significantly increased bat velocity by 2.6% ( $p = 0.02$ ). Performing the identical order of exercises without vibration significantly decreased bat velocity in ensuing sets (Arm:  $p = 0.004$  and with Leg:  $p = 0.039$ ).

Table 1			
A+L-VIB			
Set	Bat Velocity (m/s)	Change from Set #1	p-value
1	$27.85 \pm 2.28$		
2	$28.11 \pm 2.22$	+0.26	0.198
3	$28.58 \pm 1.80$	+0.73	0.020*
A+L-NOVIB			
1	$28.49 \pm 2.58$		
2	$27.88 \pm 2.89$	-0.61	0.004*
3	$27.91 \pm 3.20$	-0.58	0.039*

**CONCLUSIONS:** Leg strength has direct correlation to bat velocity suggesting that increasing leg strength may be beneficial for increasing bat velocity. Adding vibration to total body exercises can provide acute enhancements in bat velocity. This data suggests WBV exercises may enhance bat velocity and perhaps contribute to improving a hitter's performance.

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**1644 Board #246 May 27 9:30 AM - 11:00 AM**  
**The Effects of Platform Vibration On Upper Body Muscle Activity During Pushups**

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Whole body vibration (WBV) platform training studies have reported increases in lower body skeletal muscle electromyography (EMG) activity during both static and dynamic squatting postures, but little if any effect on upper body skeletal muscle activity. In contrast to this, studies using vibrating cables or vibrating dumbbells have reported an improvement in upper body muscular performance. These data suggest that proximity to the vibrating stimulus was critical to the activation of selected muscle groups.

**PURPOSE:** To investigate the effects of vibration stimulus from a WBV platform on the upper body EMG muscle activity of recreationally trained males during the pushup exercise.

**METHODS:** To determine changes in muscle activity during dynamic pushups, EMG data was recorded from the pectoralis major (PM), latissimus dorsi (LD), triceps brachii (TB), & biceps brachii (BB) with results expressed as a % of maximum voluntary exertion (MVE). Subjects (n=15) performed pushups at no vibration (NV) or 6 random pairings of frequency (25, 35 & 45 Hz) and amplitude (2 or 4 mm). Ratings of perceived exertion (RPE) were determined using the Borg RPE scale following each condition.

**RESULTS:** With NV, ANOVA of the PM ( $45.8 \pm 3.4\%$ MVE) and TB ( $42.5 \pm 3.4\%$ MVE) showed significantly greater activity ( $p < .05$ ) than the LD ( $12.0 \pm 3.4\%$ MVE) and BB ( $7.0 \pm 3.4\%$ MVE). There were no statistically significant increases in EMG muscle activity of the PM or LD at any vibration setting over the NV condition. However, the pairing of 45Hz and 4mm resulted in statistically significant increases ( $p < .05$ ) in the EMG muscle activity of the TB ( $4.37 \pm 1.48\%$ MVE), and BB ( $7.64 \pm 2.5\%$ MVE) over the NV condition. RPE data confirmed that subjects perceived the WBV stimulus to be statistically more intense than NV.

**CONCLUSIONS:** Our data indicate that performing pushups on a WBV platform is similar to squatting on a WBV platform with the proximal muscles responding significantly to vibration set at 45Hz and 4mm. However, the data also indicate that the pushup position limited the transmissibility of the vibration stimulus to the muscles furthest away from the platform. Though RPE data indicate a perceived increase in effort during vibration training, an effective posture to increase the transfer of the vibration stimulus to the distal muscles in the upper body core remains unknown.

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**1645 Board #247 May 27 9:30 AM - 11:00 AM**  
**Cardiorespiratory Responses During Whole Body Vibration**

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(No relationships reported)

Whole body vibration (WBV) has various effects on human. WBV on foot has an effect on human standing posture regulation and makes it difficult to keep the position. Blood pressure, heart rate, and ventilation decrease when local vibration is imposed on the tendon of agonist during isometric contraction; however, little is known whether WBV imposed on foot decreases cardiorespiratory responses in static and dynamic tasks.

**PURPOSE:** To investigate the difference of cardiorespiratory responses in no-vibration (NV), low amplitude vibration (LV, amplitude 2 mm; frequency 35 Hz), and high amplitude vibration (HV, amplitude 4 mm; frequency 35 Hz) and to examine the effects of vibration on three different tasks.

**METHODS:** Five healthy subjects ( $40.2 \pm 18.4$  yrs) kept two different 45 sec static squat positions (knee angle of task I was 60 deg flexion; that of task II was 90 deg flexion) and 45 sec dynamic squat in cycles of four sec to 90 deg knee flexion for three sets respectively on the vibration platform(task III). Each interval was 60 sec in the same task and the interval between two different tasks was 120 sec. They performed these tasks in NV, LV, and HV on separate day and the order of tests was randomized. Breath-by-breath oxygen consumption and heart rate were measured. Statistical analysis was made using two-way ANOVA.

**RESULTS:** In all tasks, HV (Vo2 was  $9.5 \pm 1.9$ ,  $11.9 \pm 4.5$ ,  $13.5 \pm 4.7$  ml/min/kg; heart rate was  $98.2 \pm 21.4$ ,  $107.7 \pm 26.5$ ,  $104.8 \pm 28.3$  bpm, task I to task III respectively) was higher than NV (Vo2 was  $8.8 \pm 1.8$ ,  $10.0 \pm 2.1$ ,  $12.4 \pm 2.7$  ml/min/kg; heart rate was  $87.5 \pm 19.5$ ,  $94.4 \pm 22.6$ ,  $93.9 \pm 22.9$  bpm, respectively) and LV (Vo2 was  $8.5 \pm 1.5$ ,  $10.9 \pm 2.3$ ,  $11.6 \pm 1.9$  ml/min/kg; heart rate was  $89.2 \pm 16.0$ ,  $101.6 \pm 20.4$ ,  $98.1 \pm 23.0$  bpm, respectively) although there were no significant differences.

**CONCLUSIONS:** These data suggest that low frequency-high amplitude WBV imposed on foot increase oxygen consumption and heart rate and low frequency-low amplitude WBV don't increase oxygen consumption as high as no-vibration.

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**1646 Board #248 May 27 9:30 AM - 11:00 AM**  
**Effect Of Acute, Whole-body Vibration On An Isometric One Repetition Maximum Biceps Curl**

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(No relationships reported)

Vibration plates have been used in combination with conventional resistance training to achieve improvements in strength. There is limited published data regarding the acute effects of vibration on absolute strength; most studies focus on the long-term training effects of vibration.

**PURPOSE:** to evaluate the acute effects of whole body vibration (WBV) on muscle strength during a one repetition maximum (1RM) isometric biceps curl.

**METHODS:** 32 college-age (mean age of  $21 \pm 2$  yrs) students (17 male, 15 female) completed two protocols for assessment of isometric biceps strength while undergoing vibration on a low-cost, home-use WBV platform. Subjects were familiarized with the apparatus and testing was completed to establish 1RM for biceps curl on a preacher curl bench. Treatment order was randomized for assessment of 1RM biceps strength during 5 minutes of vibration vs. 1RM measurement directly after a 5 minute session of vibration. A crossover design was used to perform the alternative treatment after 10 minutes of rest.

**RESULTS:** No significant difference in muscle strength was found during vibration vs. immediately post vibration ( $66.9 \pm 5.1$  vs.  $64.4 \pm 4.3$  in females)( $138.2 \pm 10.5$  vs.  $139.4 \pm 8.9$  in males). There was no order effect. As expected, male subjects were significantly stronger than female subjects. ( $138.7 \pm 7.8$ kg males at baseline vs.  $65.8 \pm 4.6$  kg females at baseline,  $p < .001$ ).

**CONCLUSION:** Acute WBV using a low-cost, home-use platform had no significant effect on biceps strength whether applied directly BEFORE or DURING muscle contraction.

*Supported by a Central Michigan University Undergraduate Research Grant.*

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**1647 Board #249 May 27 9:30 AM - 11:00 AM**  
**Effects Of Six Weeks Squat Training, With Or Without Vibration Upon Measures Of Body Composition.**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to compare the effects of combined resistance exercise and Whole Body Low Frequency Vibration (WBLFV) applied prior too, and then intermittently between sets upon select measures of body composition over a seven week period.

**METHODS:** Thirty men (n = 30) aged between 20 and 30yrs completed the study. Subjects were randomly assigned to one of three groups. Group one (CG, n=6) acted as an



active control, only participating in testing sessions. Group two (SQTV, n=13) performed 6 weeks of squat training while receiving WBLFV (50Hz), prior to, and in-between sets. The third group (SQT, n=11) performed six weeks of squats only. Over the training period subjects completed twelve workouts with variable loads (55% - 90% 1RM) and sets (3 - 5) with 4 minutes between sets. Squats were performed twice weekly separated by 72 hours. WBLFV was applied while subjects stood on a vibrating platform holding an isometric quarter squat position (knee angle  $135 \pm 5^\circ$ ). Initially, WBLFV was applied at 50hz for 30 seconds (s) at a low amplitude (2-4 mm) prior to exercise. WBLFV was then applied intermittently (3 X 10 s) at 50 Hz, high amplitude (4-6 mm) at 60s, 120s, and 180s into the 240s rest period. Measures of body composition were collected using DXA (Lunar Prodigy, General Electric) on weeks one and seven and consisted of Body Weight (BW), Total Lean Body Mass (TLBM), Trunk Lean Mass (TLM), Leg Lean Mass (LLM), Trunk Fat percentage (TRF%), and Leg Fat percentage (LF%).

**RESULTS:** Significant differences were seen at week one between groups for TLBM, TLM and LLM. Two way repeated measures ANCOVA (Time (2) X Group (3)) were utilized using the respective week one values as covariates to analyse changes, W1 to W7. Two way repeated measures ANOVA were used to analyse measures of Wt, TF %, and LF % between W1 and W7. A significant group by trial and group effect was seen for TLBM, SQTV > CG at week seven ( $p = .044$ ). A significant main effect for time was seen for LF%, T1 < T2, ( $p = .047$ ). No other significant differences were seen ( $p > .05$ ).

**CONCLUSIONS:** The addition of WBLFV to a six week squat training regimen significantly increased total lean body mass as measured by DXA. Applying WBLFV prior to, and then in between sets of exercise may further facilitate the anabolic effects of resistance exercise resulting in increased total body muscular hypertrophy.

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**1648 Board #250 May 27 9:30 AM - 11:00 AM**

**Can Whole-body Vibration Plus Exercise Improve Functional Deficits In Post Hip Surgery Patients**

C. Nathan Dodge<sup>1</sup>, Johnny W. Galver<sup>2</sup>, Laura J. Shriver<sup>1</sup>, Aaron D. Horowitz<sup>1</sup>, Simon A. Merila<sup>1</sup>, Gianni F. Maddalozzo<sup>1</sup>. <sup>1</sup>Oregon State University, Corvallis, OR. <sup>2</sup>BPM Physical Therapy Center INC, Salem, OR.

(No relationships reported)

Functional deficits often exist in older adults following hip replacement surgery.

**PURPOSE:** To determine the effect of whole-body vibration (WBV) plus progressive resistance exercise on lower limb power, balance, and physical performance in older adults following hip replacement surgery.

**METHODS:** 37 community dwelling adults, 27 who were 1-3 years post hip replacement surgery, were recruited for this study (mean age =  $69.1 \pm 8.2$ ). The hip replaced participants were randomly assigned to one of two experimental groups: WBV plus exercise ( $n = 14$ ) or No-WBV plus exercise ( $n = 13$ ). The control group, consisted of age-matched non-hip replaced healthy individuals ( $n = 10$ ). The experimental groups exercised 90 min, 2day/ wk for 24-weeks. The WBV group performed supervised progressive resistance exercises on a Pneu-Vibe T vibration platform (Pneumex, Sandpoint, ID), low amplitude (4mm peak to peak) at 30-40 Hz. The No-WBV exercise group performed an identical supervised progressive resistance exercise program. Repeat measures MANOVA was conducted to evaluate between-subjects effects for lower limb power, balance, and physical performance.

**RESULTS:** Whole-body vibration resulted in significant statistical differences among the three experimental groups ( $p < 0.05$ ) with respect to outcome measures of balance (Sensory Organization Test, Neurocom Smart Balance Master), lower limb power (Bassey Power Rig) and physical performance (Timed Get Up & Go). Compared to those in the no-WBV plus exercise or control groups, participants in the WBV plus exercise intervention group showed significant improvement in balance (somatosensory) (meandiff = 0.05 %), Bassey Power Rig (meandiff = 39 Watts), and Timed Get Up & Go (meandiff = 1.99 sec.).

**CONCLUSIONS:** These findings suggest that whole-body vibration training may have potential beneficial effects on balance, lower limb power, and physical performance in individuals having undergone hip replacement surgery. Low injury risk makes whole-body vibration training a beneficial, well-tolerated supplement to exercise interventions intended to accelerate recovery from functional deficits in older adults following surgery.

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**1649 Board #251 May 27 9:30 AM - 11:00 AM**

**Increased Oxygen Consumption During Whole Body Vibration In Older Men**

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(No relationships reported)

The combination of WBV and strength training can increase oxygen consumption ( $VO_2$ ); however, limited data exist concerning its effectiveness in older persons.

**PURPOSE:** To examine the effectiveness of WBV at increasing  $VO_2$  in older persons.

**METHODS:** Five untrained men ( $76.0 \pm 5.4$  yrs;  $84.9 \pm 12.2$  kg) took part in the study.  $VO_2$  was collected using 4 different exercise protocols performed on separate days. A 12hr fast preceded each visit. The testing involved three stages: resting (sitting for 15 min), exercise (active squats for 8 min), and recovery (sitting for 15 min). During the exercise stage, six 30s sets of active squatting were performed with one min of passive recovery between sets. Squatting speed was set at one squat per 3 seconds, controlled by matching the sound of a metronome. The four training protocols were the combination of load and vibration: body weight with no vibration (BW-NV), BW with vibration (BW-V), BW plus and additional load of 20% BW with NV (20%-NV) and 20%BW with vibration (20%-V). Triplanar WBV was applied at 35Hz and 2-3mm amplitude and load was applied at shoulder level. Testing order was randomized and testing days were separated by at least 48 hours.

**RESULTS:** Repeated measures analysis for  $VO_2$  revealed stage x vibration ( $p = .003$ ) and stage x load ( $p = .022$ ) interactions. The exercise stage was significantly higher than the resting ( $p < .001$ ) and recovery ( $p < .001$ ) stages; also the recovery stage was higher than the resting stage ( $p < .001$ ). When separate analyses were performed by training stage, no significant differences were seen among conditions at baseline. During the exercise stage, WBV produced a higher  $VO_2$  than NV ( $p = .056$ ). Although no significant vibration x load interaction was seen, pairwise comparisons showed a significantly higher  $VO_2$  for the 20%-V ( $9.8 \pm 1.3 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ) compared to the BW-NV ( $8.4 \pm 0.4 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ) condition ( $p = .047$ ); while, the 20%-NV condition ( $8.8 \pm 0.7 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ) failed to significantly increase  $VO_2$  ( $p = .152$ ). Additionally, the BW-V condition ( $9.20 \pm 0.8 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ) produced a higher, albeit non-significant,  $VO_2$  than the 20%-NV condition.

**CONCLUSION:** At the moderate training loads well-tolerated by older individuals, the addition of WBV during resistance training can produce a significantly greater increase in  $VO_2$  than the addition of load alone.

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**1650 Board #252 May 27 9:30 AM - 11:00 AM**

**The Acute Effects Of Whole Body Vibration On Electromechanical Delay And Rate Of Force Development**

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Changes in muscular performance following whole-body vibration (WBV) have been attributed to adaptations in the neuromuscular system. However, due to a lack of standardization of WBV protocols and exposure time used in previous studies, the responsiveness of the muscular system to acute exposure to WBV remains unclear.

**PURPOSE:** To examine the acute effect of WBV on two functional muscular variables [rate of force development (RFD) and electromechanical delay (EMD)].

**METHODS:** Forty young healthy individuals were randomly assigned to an experimental or control groups. The experimental group received acute WBV (3 bouts of 2 minute)

while standing on a vibration platform. The control group adopted the same position (semi squat position) for equal time but received no vibration. During each of the testing sessions (before and after acute WBV), rate of force development and electromechanical delay were measured while subjects were isometrically plantar flexing their ankle on the plate of an isokinetic dynamometer.

**RESULTS:** After 3 bouts of 2 minute WBV, the experimental (WBV) group demonstrated a significant group by test interaction for the EMD ( $p=0.02$ ) and RFD ( $p=0.03$ ). The experimental group decreased EMD by 16% (from  $23.42 \pm 7.54$  ms to  $19.3 \pm 8.08$  ms) and increased RFD by 15.6% (from  $274.13 \pm 137.77$  N/sec to  $323.02 \pm 161.98$  N/sec) while the control group didn't change both EMD (from  $21.25 \pm 7.63$  to  $21.11 \pm 6.49$  ms) and RFD (from  $318.41 \pm 145.42$  to  $315.54 \pm 137.99$ ).

**CONCLUSION:** Our findings suggest that acute WBV had an effect on the functional performance of the soleus muscle as measured with EMD and RFD in young healthy subjects.

Supported by TurboSonic Korea.

## B-22 Free Communication/Poster - Age and VO2 Max

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

### 1651 Board #1 May 27 3:30 PM - 5:00 PM

#### Effect Of Age On Oxygen Uptake Kinetics, Power Output And Oxygen Pulse.

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**PURPOSE:** To determine which parameter may represent the best indicator of cardiopulmonary capacity along with aging we decided to compare the peak rate of oxygen consumption ( $VO_2$  (peak)), peak power output ( $W$  (peak)) and peak Oxygen pulse ( $VO_2 \times HR(-1)$  (peak)) obtained during incremental cycle exercise tests from three different age groups.

**METHODS:** Fifty male cyclists were carefully matched in which concerns training (12 - 15 hours/week) and tested in a protocol that would achieve maximum uptake or exhaustion in 10 to 12 minutes. They were split in three groups based on their age: twenty one in Group A (under 25 yrs) - age:  $19.1 \pm 3.1$  yrs, body mass:  $66.9 \pm 6.2$  Kg and height:  $174.9 \pm 5.6$  cm; twelve in Group B (between 25 - 34 yrs) - age:  $29.1 \pm 3.3$  yrs, body mass:  $72.0 \pm 7.4$  Kg and height:  $174.0 \pm 4.3$  cm and seventeen in Group C (above 35 yrs) - age:  $41.5 \pm 5.8$  yrs, body mass:  $69.2 \pm 7.7$  Kg and height:  $172.4 \pm 6.0$  cm (means  $\pm$  SD).

#### RESULTS:

Age Group	$VO_2$ (peak) ml/min/kg	W (peak) (watts)	$VO_2 \times HR(-1)$ (peak) (ml/beat)
A (under 25 yrs)	$63.3 \pm 7.6^*$	$369.8 \pm 64.7^*$	$23.6 \pm 3.7^{**}$
B (between 25 - 34yrs)	$53.1 \pm 17.2^*$	$308.2 \pm 90.4^*$	$20.6 \pm 5.3$
C (above 35 yrs)	$44.3 \pm 11.9^*$	$272.4 \pm 64.9^*$	$20.8 \pm 5.3$

\*Significantly greater ( $P < 0.05$ ). \*\*Significantly greater ( $P < 0.01$ ).

The  $VO_2$  (peak) ( $ml \times kg(-1) \times min(-1)$ ) and the  $W$ (peak) ( $W$ ) in group A were significantly ( $p < 0.05$ ) higher than group B and C and in group B were significantly ( $p < 0.05$ ) higher than group C. In which concerns the  $VO_2 \times HR(-1)$  (peak) ( $ml/beat$ ) group A was again significantly ( $p < 0.001$ ) higher than group B and C, however there was no significant difference between the group B and group C.

**CONCLUSIONS:** These data suggest that  $VO_2$  kinetics at the end of an incremental cycle exercise are affected by aging as well as the peak power output, however, in the oxygen pulse, that influence was not reflected suggesting that it may represent the best indicator of cardiopulmonary capacity along with aging.

### 1652 Board #2 May 27 3:30 PM - 5:00 PM

#### Psycho-social Differences In Attainment Of Physiological Criteria For Maximal Oxygen Uptake

Nikhil Satchidanand. *The University of Pittsburgh School of Education, Pittsburgh, PA.* (Sponsor: Elizabeth F. Nagle, FACSM)

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(No relationships reported)

**PURPOSE:** Accurate assessment of maximal oxygen uptake ( $VO_{2max}$ ) as an objective measure of aerobic fitness is essential in research and clinical settings. The purpose of this analysis was to examine psycho-social factors among subjects who differ in attainment of physiological criteria for  $VO_{2max}$ .

**METHODS:**  $VO_{2max}$  was assessed in 231 young adults (mean age  $29.0 \pm 1.1$  yrs., 53% female) using a treadmill graded exercise test, with a subject determined end-point corresponding to volitional exhaustion. Attainment of physiological criteria for  $VO_{2max}$  was defined as achieving one or both of the following: a respiratory exchange ratio  $> 1.10$  and heart-rate  $+ 10 b \cdot min^{-1}$  of age-adjusted maximal value. Psycho-social variables assessed were enjoyment of physical activity (PA), social support, self-efficacy, decisional balance, depression, perceived stress, perceived benefits of PA, and perceived barriers to PA.

**RESULTS:** Fifty-one subjects (22%) did not attain physiological criteria for  $VO_{2max}$ . Enjoyment of PA and perceived benefits of PA were significantly ( $p < .05$ ) lower in subjects who did not meet physiological criteria for  $VO_{2max}$ . Additionally, depression and perceived stress were significantly higher in this group ( $p < .05$ ).

Attnd. Crit.	Enjoyment			Perceived Benefits			Depression			Perceived Stress		
	M	p	U	M	p	U	M	p	U	M	p	U
YES	103.5			38			5.5			12		
NO	93.0	.03	3193	36	.005	3342	7.0	.005	2772	17	<.01	2474

\*M = Median Score, U = Mann-Whitney U-value, p = p-value

**CONCLUSIONS:** Findings indicate that individuals who enjoy PA and report more benefits of PA attained physiological criteria for  $\text{VO}_{2\text{max}}$ . In contrast, individuals who report depression and higher levels of perceived stress, at the time of testing were less likely to attain physiological criteria for  $\text{VO}_{2\text{max}}$ .  
*Supported by NCI (CA109895)*

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**1653 Board #3 May 27 3:30 PM - 5:00 PM**  
**Measurement Reproducibility Of Exercise Tolerance And  $\text{VO}_{2\text{peak}}$  In Male Sprague- Dawley Rats**

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(No relationships reported)

The rat model of exercise performance is an invaluable tool for the investigation of experimentally and pathologically induced alterations in exercise tolerance and  $\text{VO}_{2\text{peak}}$ . Interpretation of such data often presumes knowledge of the within-rat reproducibility of these performance measures, however, the literature is bereft of this information. The development of reliable and reproducible measures of exercise performance in the rat would improve experimental design and strengthen confidence in data interpretation.

**PURPOSE:** We tested the hypothesis that within-rat exercise tolerance and  $\text{VO}_{2\text{peak}}$  are highly reproducible across 5 separate weekly measurements when assessed with specifically designed protocols.

**METHODS:** On a custom motor-driven treadmill, 13 male Sprague-Dawley rats (initial age: 2-3 months, weight:  $352 \pm 13$  g) performed 5 progressive endurance runs to fatigue for determination of exercise tolerance, and 5 maximal exercise tests for determination of  $\text{VO}_{2\text{peak}}$  (ml/min/kg) via a metabolic chamber. The coefficient of variation (CV) was used to assess within-rat reproducibility.

**RESULTS:** There were no differences ( $P = 0.47$ ) in average time or distance run to fatigue among any of the 5 exercise tolerance tests, and the average within-rat CV for the 5 runs was 0.13 (avg. exercise tolerance range, 45.9 - 52.1 min). Additionally, there was no difference ( $P > 0.05$ ) among the average CV from any two consecutive weekly exercise tolerance tests (CV range, 0.06-0.1). As expected with the increase in body mass,  $\text{VO}_{2\text{peak}}$  decreased ( $P < 0.05$ ) over the course of the 5 maximal exercise tests. However, there were no differences ( $P = 0.64$ ) in the average within-rat CV among any of the consecutive  $\text{VO}_{2\text{peak}}$  tests (CV range, 0.03-0.04) and the average within-rat CV for all 5 tests was 0.06 (avg.  $\text{VO}_{2\text{peak}}$  range, 75.8 - 80.1 ml/min/kg).

**CONCLUSIONS:** We have demonstrated that, using the protocols described herein, within-rat measurements of exercise tolerance and  $\text{VO}_{2\text{peak}}$  are highly reproducible. The results of this study mandate the adoption of similar specific, reproducible protocols for use in the rat model of treadmill exercise performance and, therefore, have significant implications for improving and refining exercise testing and experimental designs.

Support: Cytokinetics Inc., San Francisco, CA and AHA 750090Z

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**1654 Board #4 May 27 3:30 PM - 5:00 PM**  
**Estimates Of Cycling Efficiency At Low Power Outputs**

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Efficiency at low power outputs, comparable to daily living activities, is relevant to understanding obesity. Calculating muscular efficiency has remained controversial due to the difficulties of isolating the energy expenditure associated with the skeletal muscle mass performing mechanical work. While subtracting baselines (e.g. metabolic rate at rest or during zero load cycling) is common, these subtractions are problematic.

**PURPOSE:** To investigate the effects of different baseline subtractions on the calculation of efficiency during cycling, particularly at low power outputs.

**METHODS:** 15 active subjects (age 18-35) completed a one-visit cycle-ergometer protocol. They performed 13, 5-minute trials including: seated rest, motor-driven (passive) cycling, no chain cycling, no load cycling, and cycling at low (10-30W), medium (40-60W), and high (80-120W) power outputs. All cycling trials were performed at 90 revolutions per minute (rpm) on a pan-loaded, mechanically braked cycle ergometer. During each trial, we continuously performed indirect calorimetry.

**RESULTS:**  $\text{VO}_2$  during rest was  $0.29, \pm 0.06$  L/min, and nearly doubled during passive cycling ( $0.57, \pm 0.14$  L/min).  $\text{VO}_2$  values for no chain ( $0.76, \pm 0.12$  L/min) and no load ( $0.79, \pm 0.11$  L/min) trials were not statistically different from each other. Thus, active muscle contraction constituted only about half of the increased cost of no load cycling vs. rest. Regression equation for  $\text{VO}_2$  vs. power output for 10-120 Watt trials was  $0.007x + 0.752$ , ( $R^2 = 0.994$ ). Mean delta efficiency for low power outputs was 68.4%, compared to 36.3% and 36.9% for middle, and high power outputs. Means for gross (3.6%) and net (5.6%) efficiencies were rather low at low power outputs. Furthermore, at low power outputs, delta and work efficiencies demonstrated large individual variations exceeding theoretical values for muscular efficiency.

**CONCLUSION:** No method of baseline subtractions gave satisfactory values for muscular efficiency at low power outputs.

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**1655 Board #5 May 27 3:30 PM - 5:00 PM**  
**Age Trends In Professional Tennis Players**

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**BACKGROUND & OBJECTIVE:** Top-ranked professional tennis players are usually young athletes. Their peak performance age has been previously studied but limited data exist on longitudinal age-related development of tennis players. The objective of this study was to explore the relationship between age and ranking position in tennis players during their professional career.

**MATERIAL & METHOD:** Professional players ranking during five years (2002-2006) were studied. Male and female subjects were divided in four groups according to their year-end ranking position. Their ranking position at the ages of 18, 21 and 24 year and their highest career position were determined and compared (*t*-test for independent samples).

**RESULTS:**

Groups	Age	Ranking Position at 18 y-old	Ranking Position at 21 y-old	Ranking Position at 24 y-old	Highest Ranking Position	Age of Highest Ranking
Male A (1 <sup>st</sup> -10 <sup>th</sup> )	24.8 (sd 3.5; n=50)	297.9 (sd 243.6; n=23)	46.1 (sd 54.7; n=23)	24.8 (sd 28.2; n=21)	3.6 (sd 2.4; n=23)	24.1 (sd 2.7; n=23)
Male B (91 <sup>st</sup> -100 <sup>th</sup> )	24.8 (sd 3.4; n=50)	715.2 (sd 416.3; n=50)	193.8 (sd 175.0; n=49)	134.2 (sd 135.2; n=47)	48.3 (sd 28.7; n=50)	24.6 (sd 2.6; n=50)

p A/B	1.00	0.00003	0.0001	0.0005	0.0000	0.4784
Female C (1°-10°)	23.4 (sd 3.3; n=50)	35.1 (sd 38.8; n=20)	23.3 (sd 30.0; n=18)	9.4 (sd 5.8; n=15)	2.9 (sd 2.3; n=21)	21.5 (sd 3.0; n=21)
Female D (91°-100°)	23.4 (sd 3.2; n=50)	256.5 (sd 218.0; n=46)	147.2 (sd 118.8; n=45)	110.7 (sd 70.5; n=40)	46.2 (sd 22.0; n=50)	23.9 (sd 3.0; n=50)
p C/D	1.00	0.00003	0.00000	0.000001	0.00000	0.0036
p A/C	0.046	0.000024	0.120	0.045	0.341	0.004

**CONCLUSIONS:** Age of peak performance of “top-ten” male and female professional tennis players was  $24.1 \pm 2.7$  and  $21.5 \pm 3.0$  years, respectively. “Top-ten” male and female players ranked significantly higher than other successful players at ages of 18, 21 and 24 years. Female “top-ten” were significantly younger than male athletes at ages of 18 and 24 years; they also reached their highest ranking position at early ages. Analyzing the relationship between age and ranking position could help to identify potential tennis champions and monitor their development during the professional career.

## B-23 Free Communication/Poster - Biomechanics

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

### 1656 Board #6 May 27 3:30 PM - 5:00 PM

#### Regular Physical Exercise Prevents Age Related Decline In Knee Proprioception

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(No relationships reported)

There is evidence that proprioception decline with age. However, literature indicates that regular exercise might be an effective strategy to attenuate the age-related decline in proprioception.

**PURPOSE:** To investigate the effects of aging and regular physical exercise on the knee joint position sense.

**METHODS:** Fifty male subjects, 28 young and 22 older, were recruited and divided, according to the practice of physical exercise in the year before the study, in 4 groups: young sedentary (N = 10;  $21.1 \pm 2.1$  yrs of age), young active (N = 18;  $21.3 \pm 2.8$  yrs of age), older sedentary (N = 12;  $67.9 \pm 3.3$  yrs of age) and older active (N = 10;  $67.3 \pm 3.9$  yrs of age). The technique of open-kinetic chain and active knee positioning was used to evaluate knee joint position sense. Subjects were seated, with the legs hanging freely, and blindfolded. One test position between  $40^\circ$  and  $60^\circ$  of flexion was investigated. Each subject performed three trials trying to reproduce the target position. The target and the response positions were recorded with a video camera. The Ariel Performance Analysis System software was used to measure the knee angle from videotape records. Joint position sense was reported as: the absolute angular error (AAE), defined as the absolute difference between the target position and the three response positions; and, the relative angular error (RAE), defined as the signed arithmetic difference between the test and the three response positions.

**RESULTS:** The mean AAE score of young active ( $2.1 \pm 0.9^\circ$ ) is significantly inferior to young sedentary ( $4.8 \pm 2.2^\circ$ ,  $p < .001$ ). Likewise, older sedentary ( $7.1 \pm 1.0^\circ$ ) had higher AAE than older active ( $4.5 \pm 2.0^\circ$ ,  $p = .002$ ). Active subjects had better joint position sense, indicated by smaller mean AAE score, than their sedentary counterparts. Differently from the results of the comparison of young active and sedentary active (significant difference,  $p = .001$ ), the comparison of young sedentary and older active indicated no difference in knee AAE. The RAE showed that all the groups ( $3.4 \pm 4.0^\circ$  young active;  $6.5 \pm 4.6$  older sedentary;  $6.5 \pm 4.3$  older active) except young active ( $-0.4 \pm 2.2^\circ$ ) clearly underestimate the test position.

**CONCLUSION:** Aging lead to a significant decrease of the knee proprioception, however regular physical exercise seems to prevent age-related decline in knee proprioception.

### 1657 Board #7 May 27 3:30 PM - 5:00 PM

#### Acute Effects Of A Low-stretching Dynamic Protocol In The Upper Body Force Production

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Previous research has shown that dynamic stretching in the warm-up can enhance several muscular performance variables, while performing a static stretching protocol has been shown to decrease performance. The dynamic stretching seems to be an effective way of warm-up, although there is a lack of research about this topic.

**PURPOSE:** The purpose of this study was to investigate the acute effect of a low-stretching dynamic protocol on maximal isometric force, time to maximal isometric force, rate of force development, and EMG amplitude of main agonist muscles acting on the bench press exercise.

**METHODS:** 20 participants were randomly allocated into two equivalent groups (no stretch, and dynamic stretch). The maximal voluntary isometric contraction (MVC) on the bench press exercise was measured before and after (immediately, 10 min, 20 min, and 30 min) the dynamic stretching, and nonstretching. The average amplitude of the surface EMG of the pectoralis major, long and lateral heads of the triceps brachii was measured during MVC.

**RESULTS:** There was a significant decrease ( $p < 0.05$ ) in the maximal isometric force from the pre to the post-stretching in the dynamic group. This decrease was nearly 4%, with an initial value of  $762.0 \pm 155.4$  N and achieving  $734.6 \pm 136.6$  N immediately after stretching. There were no significant differences in the time to maximal isometric force, rate of force development and EMG amplitude of the three investigated muscles between the pre to the post-stretching. No significant differences were found in the control group in the force or in the EMG parameters between the pre and the post-stretching. Force did not remain significantly decreased for 30 min in both groups: dynamic and control.

**CONCLUSION:** The results suggest that the dynamic stretching have the ability to adversely affect efforts of muscle maximal strength dependence and that the reduction in performance does not appear to be caused by the reduction of muscle activation.



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**1658 Board #8 May 27 3:30 PM - 5:00 PM**

**Effects of Exercise Training on Behavior and Oxidative Stress in Diazepam Treated Rats.**

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(No relationships reported)

Diazepam (DZP) is an effective tranquilizing, due to its muscular relaxant and hypnotic properties. Reactive oxygen species (ROS) and other free radicals are produced during the cellular metabolism. Exercise training (ET) modulates positively oxidative stress, by improving antioxidant status (AO) and it could also modulate several functions of the central nervous system, such as behavior.

**PURPOSE:** To investigate the influence of an eight week-exercise training protocol on locomotor behavior (LB) and systemic oxidative stress (OS) in rats treated chronically with DZP.

**METHODS:** Thirty two male Wistar rats (160-180g) were assigned into four groups: sedentary control (SC), sedentary DZP (SD), trained control (TC) and trained DZP (TD). Diazepam, 5mg/kg i.p. was injected daily during eight weeks. ET consisted of running sessions on an adapted rodent treadmill, five times a week at 0.6-0.9Km/h and 0% grade, during 60min, through eight weeks. Exercise was performed at least 8h after drug administration. LB was assessed through the open field (OF) test. Systemic OS was evaluated in erythrocytes through lipid peroxidation (LPO) via a chemiluminescent technic (CL) and antioxidant enzyme activities of catalase (CAT) and glutathione S-transferase (GST). The statistical package Graphpad was used

**RESULTS:** TD animals presented an increase in CL (cps/mgHb) values ( $14.2 \pm 0.5$ ) when compared to SD ( $12.7 \pm 0.3$ ;  $p < 0.05$ ) and TC ( $11.3 \pm 0.5$   $p < 0.01$ ) animals. CAT activity (pmol/mg prot) from TD group has also shown elevated values ( $35.0 \pm 4.0$ ) when compared to SD ( $22.4 \pm 1.5$ ;  $P < 0.05$ ). Not only diazepam but also the exercise training protocol promoted an increase on GST activity, being SD ( $1.5 \pm 0.1$ ;  $P < 0.01$ ) TC ( $1.3 \pm 0.1$ ;  $P < 0.05$ ) and TD ( $1.7 \pm 0.4$   $P < 0.001$ ) when compared to SC ( $0.9 \pm 0.08$ ). DZP training animals showed higher total locomotion values ( $82.6 \pm 4.9$ ) than SD ( $54.5 \pm 4.8$ ) and TC ( $31.4 \pm 6.2$ ) animals. There was no association among the variables studied.

**CONCLUSIONS:** DZP has induced an increase in oxidative damage and a consequent adaptation of the AO defenses, and the ET was not able to avoid these changes. Besides that, the locomotion capacity was not depressed by chronic DZP treatment, and the exercise training protocol significantly improved this values on DZP treated animals.

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**1659 Board #9 May 27 3:30 PM - 5:00 PM**

**Peak Torque And sEMG Responses To 5x10 Exhaustive Knee Extension Exercises In Male College Students**

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(No relationships reported)

Surface EMG signals (sEMG) are often used to investigate fatigue-induced changes at the muscle fiber membrane level. Post static exercise or isokinetic exercise fatigue sEMG measures have been studied, but little is known about sEMG measures of fatigue muscles caused by dynamic exercise.

**PURPOSE:** To investigate sEMG features of quadriceps femoris during the course of muscular acute fatigue caused by exhaustive dynamic knee extension exercise on isometric torque.

**METHODS:** Ten healthy male college students ( $M \pm SD$ : Age =  $20.80 \pm 1.40$  yr., HT =  $174.3 \pm 7.27$  cm, WT =  $64.99 \pm 5.22$  kg) performed isometric maximal voluntary left knee extension at  $120^\circ$  joint angle (MVC120) with HUR machine (3530) first. After a 5-min rest, they performed five sets of 10-RM exhaustive knee extensions, with a 2-min break between sets. The loads were adjusted during the course of the session due to fatigue so that each subject could perform 5 sets. Post-test MVC120 was then performed. The sEMG signal from the biceps femoris (BF), rectus femoris (RF), vastus lateralis (VL), vastus medialis (VM) and knee extension torques of the left leg were collected during the entire trial, simultaneously with torque.

**RESULTS:** Average peak knee extension torque of each sets declined with the progress of the test ranging from  $419.13 \pm 5.57$  at the 1st set to  $360.62 \pm 5.54$  peak torque at 5<sup>th</sup> set and statistical difference was found from third set ( $p < .05$ ). Correspondingly, there was a reduction in mean power frequency (MPF) and Median Frequency (MF) of EMG signal of VM, RF and VL. Average EMG (aEMG) of VM, RF and VL increased during each set. Peak torque of MVC120 ( $668.70 \pm 50.29$  vs.  $615.90 \pm 52.98$  Nm,  $p < .05$ ) declined significantly after 5x10 knee extension exercise. simultaneously, MPF (VM:  $66.50 \pm 5.13$  vs.  $56.50 \pm 4.90$ ,  $p < .05$ ; RF:  $76.60 \pm 5.74$  vs.  $67.10 \pm 4.28$ ,  $p < .01$ ; VL:  $68.50 \pm 7.98$  vs.  $59.20 \pm 5.65$ ,  $p < .01$ ), MF (VM:  $87.90 \pm 11.41$  vs.  $76.70 \pm 11.46$ ,  $p < .05$ ; RF:  $96.30 \pm 7.24$  vs.  $80.90 \pm 13.91$ ,  $p < .01$ ; VL:  $83.70 \pm 10.40$  vs.  $71.40 \pm 7.59$ ,  $p < .01$ ) of EMG signal in VM, RF and VL decreased significantly after 5x10 knee extensions; significant increase was found only in aEMG of RF ( $308.40 \pm 63.07$  vs.  $387.20 \pm 65.00$ ,  $p < .05$ ).

**CONCLUSIONS:** sEMG is an effective measure to study muscle fatigue during dynamic exercise. The excise mode employed can cause acute muscular fatigue on quadriceps femoris.

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**1660 Board #10 May 27 3:30 PM - 5:00 PM**

**Quadriceps Strength Does Not Decrease With Knee Osteoarthritis Progression**

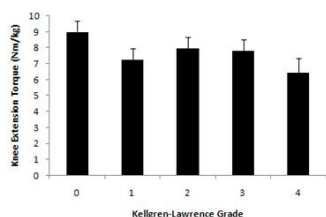
Abbey C. Thomas, MaryFran Sowers, Carrie Karvonen-Gutierrez, Riann M. Palmieri-Smith. *University of Michigan, Ann Arbor, MI.* (Sponsor: Christopher D. Ingersoll, PhD, ATC, FACSM)

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(No relationships reported)

Quadriceps weakness has been implicated as a potential risk factor for the development and progression of knee osteoarthritis (OA); however minimal data are available to demonstrate quadriceps dysfunction is present during the early stages of the disease. Further, if quadriceps weakness is a major determinant of disease progression it follows that muscle strength may diminish as OA severity worsens, but evidence supporting this hypothesis is lacking.

**PURPOSE:** To determine if quadriceps strength decreases as OA severity increases.



**Figure 1.** Average (±SE) knee extension torque (Nm/kg) for each OA grade.

**METHODS:** Ninety-one women (age  $56.49 \pm 2.8$  yrs; height  $1.63 \pm 0.07$  m; mass  $83.51 \pm 14.12$  kg) participated in this study and underwent radiographic evaluation and strength testing. Semi-flexed standing A-P x-rays were taken and graded for tibiofemoral OA severity using the Kellgren-Lawrence scale. Quadriceps strength was assessed isometrically at  $90^\circ$ . Subjects performed three maximum voluntary isometric knee extension contractions and the peak torque values from those trials were averaged. Statistical analysis was performed via a 1x5 ANOVA.

**RESULTS:** Quadriceps strength (Nm/kg) was not statistically different between the five OA grades ( $P > 0.05$ ) (Figure 1). While there appears to be a modest decline in strength associated with great knee OA severity (grade 4), the test for trend was not statistically significant ( $P = 0.09$ ).

**CONCLUSION:** Contrary to our hypothesis, quadriceps weakness did not worsen with increasing OA severity. Albeit the data come from a cross-sectional study design, absence of a statistically significant association calls into question the importance of quadriceps strength in the etiology of tibiofemoral osteoarthritis.

Supported by The Michigan Arthritis Foundation (N007718)

**1661 Board #11 May 27 3:30 PM - 5:00 PM**  
**Supraspinal Fatigue After A Low- Force Fatiguing Contraction In Men And Women**

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 (No relationships reported)

Supraspinal fatigue contributes to neuromuscular fatigue during a low-force fatiguing contraction; however, the influence of the sex of the individual is not understood.

**PURPOSE:** The purpose was to quantify supraspinal fatigue of men and women before and after performance of a low - force isometric fatiguing contraction.

**METHODS:** Thirteen young men and women (5 men [ $21.20 \pm 2.39$  yrs], 8 women [ $20.4 \pm 4.2$  yrs]) attended one experimental session after a familiarization session. Subjects performed a low-force isometric fatiguing contraction at 20% of maximum voluntary contraction (MVC) force with the elbow flexor muscles until task failure. Voluntary activation was quantified using the force of a superimposed twitch evoked with transcranial magnetic stimulation during MVC's performed before and after the fatiguing contraction.

**RESULTS:** Men had greater MVC torque compared with women ( $90.6 \pm 19.4$  Nm vs.  $36.9 \pm 5.5$  Nm,  $P < 0.05$ ). There was a significant reduction in MVC torque at termination of the task for both men and women ( $P < 0.05$ ); however, men had a greater reduction in strength than women (47% vs. 37% respectively,  $P < 0.05$ ). Women had a longer time to task failure for the fatiguing contraction when compared with men ( $12.3 \pm 5.5$  min vs.  $7.0 \pm 1.3$  min  $P < 0.05$ ). The amplitude of the superimposed twitch (%MVC) increased significantly after the fatiguing contraction ( $P < 0.05$ ), with no difference between men and women ( $P > 0.05$ ). Consequently, voluntary activation was similar for men and women before the fatiguing contraction ( $P > 0.05$ ) and decreased similarly for both sexes after the fatiguing contraction ( $94 \pm 4\%$  before to  $70 \pm 21\%$  after,  $P < 0.05$ ). Force fluctuations (coefficient of variation of force, CV) during the fatiguing contraction increased at a similar rate for both men and women ( $1.6 \pm 0.5\%$  at the start vs.  $4.8 \pm 1.7\%$  at task failure,  $P < 0.05$ ).

**CONCLUSION:** Supraspinal fatigue during a low-force fatiguing contraction with the elbow flexor muscles was not influenced by the sex of the individual.

**1662 Board #12 May 27 3:30 PM - 5:00 PM**  
**Whole Body Vibration: Mapping Of Transmission With High Speed Motion Analysis**

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Whole body vibration (WBV) is used for its potential benefits in flexibility training and musculoskeletal strengthening. While bone-pin accelerometers have been used, vibration characteristics typically are assessed using skin mounted accelerometers which require corrections to the signal to minimize the effects of local skin-accelerometer resonance. Recent advances in camera technology allow measurement of small, low-mass skin mounted marker positions to a small fraction of a mm at sufficiently high sampling frequency to characterize local vibration.

**PURPOSE:** Evaluate the capability of a motion analysis system to measure local vibrations over bony landmarks during WBV.

**METHODS:** In this pilot study, two subjects experienced WBV while standing on a Freemotion iTonic machine which was set to vibrate under four conditions: low and high frequency (28 and 42 Hz) with low and high amplitude (about 1.5 and 3 mm displacement). Small (9 mm diameter) reflective markers were mounted on the vibration plate and on bony landmarks (lateral malleolus, tibial tuberosity, ASIS, sternum and forehead). Marker positions were measured using six Vicon T-20 cameras operating at 500 Hz. Each condition involved about 10 seconds of vibration exposure from which 40 consecutive cycles were extracted and analyzed. Mean ( $\pm$ SD) of vertical vibration amplitude was determined for each condition and subject. During measurement, knees were extended and feet were flat on the plate.

**RESULTS:** Motion at the ankle closely matched the plate vibration however attenuation occurred at other points. Tibial vibration was about 0.8 mm and 1.0 - 1.5 mm under low and high amplitude conditions. ASIS and sternum vibrations ranged between 0.2 to 0.6 mm. At the head, high frequency vibrations had amplitude of about 0.7 mm while low frequency was transmitted more strongly ( $1.9 \pm 0.4$  mm for the high amplitude condition).

**CONCLUSIONS:** High speed motion analysis has sufficient spatial precision to easily detect vibration of sub mm amplitude. When used with small, low-mass markers over bony landmarks, vibration transmission can be mapped across the body without the challenges associated with skin or bone mounted accelerometers.

**1663 Board #13 May 27 3:30 PM - 5:00 PM**  
**A Kinematic Comparison Of The Digi-jump Machine Versus Rope Jumping.**

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Pursuant to the recent Surgeon General's report identifying bone health as priority and its recommendation of repetitive jumping as a preferred exercise for ameliorating this

growing problem, this study investigated kinematic variables with use of the Digi-Jump (DJ) machine. The DJ machine is designed to regulate jumps per minute as well as height per jump in order to simulate rope jumping.

**PURPOSE:** To compare the kinematic parameters of the DJ machine and standard rope jumping.

**METHODS:** Twenty-eight subjects (age: 21.1±1.8 yrs; bf: 12.7±6.4%; ht: 170.7 ±22.6 cm; wt: 75.6±12.9 kg) performed in counterbalanced order both a 120 JPM trial on the DJ machine and a concrete floor (FL). Subjects were required to reach a minimum of 1/2" height for each jump. Cadence was monitored through a series of lights and audible "beeps," while height was regulated by infrared beams. Data were recorded with a three camera motion capture system. The kinematics (joint angles, velocities, and accelerations) for both trials were calculated and compared using repeated measures ANOVA.

**RESULTS:** Overall, the body and segmental motions were similar in both trials. However, significant differences ( $p < 0.05$ ) between trials were found for peak vertical velocity (DJ: 149.1±20.3 mm/sec versus FL: 163.6±23.9 mm/sec), peak angular velocity of the knee (DJ: 296.2±59.5 deg/sec versus FL: 352.5±92.9 deg/sec) and ankle (DJ: 417.6±83.2 deg/sec versus FL: 501.1±106.2 deg/sec), peak angular acceleration of the knee (DJ: -4504.2±1588.4 deg/sec<sup>2</sup> versus FL: -5981.1±2917.8 deg/sec<sup>2</sup>) and ankle (DJ: -7960.9±2426.3 deg/sec<sup>2</sup> versus FL: -8141.2±2426.5 deg/sec<sup>2</sup>), and mean angular acceleration at the knee (DJ: -974.2±172.0 deg/sec<sup>2</sup> versus FL: -1234.4±323.8 deg/sec<sup>2</sup>) and ankle (DJ: -1423.8±353.6 deg/sec<sup>2</sup> versus FL: -1773.9±521.5 deg/sec<sup>2</sup>).

**CONCLUSIONS:** Parameters measured on the DJ machine are similar to standard rope jumping, but not directly equivalent. Peak velocities are higher on a concrete floor versus the DJ machine. This indicates that the floor of the machine may provide some return of strain energy, allowing the subject to maintain the correct jump height and cadence with less energy expenditure. These findings provide indirect evidence that jumping on the DJ machine may be safer due to lower impulse upon landing.

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**1664 Board #14 May 27 3:30 PM - 5:00 PM**  
**The Effects Of Whole-body Vibration On Spinal Excitability And Intrinsic Pre-synaptic Inhibition**

Kristof Kipp, Jeffrey R. Doeringer, Sam T. Johnson, Mark A. Hoffman, FACSM. *Oregon State University, Corvallis, OR.*

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(No relationships reported)

Researchers have reported that whole-body vibration (WBV) affects neural excitability. However, it is unknown if these effects are due to changes in motor neuron pool excitability (H-reflex) or intrinsic pre-synaptic inhibition (IPI). Further, the time course of these changes remains to be elucidated.

**PURPOSE:** To identify the effect and time course of WBV on H-reflex and IPI.

**METHODS:** H-reflexes and IPI were measured in the soleus muscle of 10 participants during quiet standing using a paired pulse conditioning protocol. Stimulation intensity was set to evoke an H-reflex equivalent to 10% of motor neuron pool output (10% of  $M_{max}$ ). The first stimulation (S1) produced an unconditioned H-reflex that was used as a measure of neural excitability. S1 was followed 100 ms later by a second stimulation of the same intensity (S2). The ratio of S2 to S1 determined the amount of IPI. Prior to WBV, each participant received 10 pairs of stimulations, one every 15 sec. The averaged peak-to-peak H-reflex responses of these stimulations and the IPI ratio served as baseline values. Participants then stood on a vibration plate that vibrated at a frequency of 25 Hz and 2-4 mm amplitude for 5 min. Immediately following WBV, participants received paired stimulations every 15 sec for 10 mins. Reflex responses were averaged at one minute increments. Two 1x4 [baseline, 1-min, 5-min, and 10-min post-WBV] repeated measures ANOVAs were used to test for the effects of WBV across time on H-reflex and IPI means. Post-hoc testing used Bonferroni-corrected paired t-tests.

**RESULTS:** Baseline, 1-min, 5-min, and 10-min H-reflex values were .61±.25, .46±.29, .63±.25, and .72±.34, respectively. The ANOVA detected a significant difference among H-reflex values, but post-hoc tests showed no differences between comparisons ( $p > .053$ ). Baseline, 1-min, 5-min, and 10-min IPI values were .24±.26, .41±.39, .32±.35, and .26±.26, respectively. The ANOVA did not detect differences in IPI values.

**CONCLUSIONS:** Changes in IPI are thought to represent a time-dependent modulation of Ia afferent input from the muscle spindle and may explain previously reported changes in neural excitability after WBV. However, in our study neither excitability nor inhibition changed, which suggests that other mechanisms may also modulate neural excitability after WBV.

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**1665 Board #15 May 27 3:30 PM - 5:00 PM**  
**The Short-term Effect Of Whole-body Vibration On The Spinal Reflex Activation**

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(No relationships reported)

Whole-body vibration (WBV) training is suggested to cause neuromuscular changes. Investigators report modulation of the soleus H-reflex after WBV, but have not examined simultaneous changes in multiple muscles after a single vibration exposure.

**PURPOSE:** To determine the effects of an acute bout of WBV on the H-reflex of the soleus (Sol), medial head (MG), and lateral head (LG) of the gastrocnemius over time.

**METHODS:** H-reflexes were measured in the Sol, MG, and LG of 10 subjects during quiet standing. Each subject received 10 stimulations at intensity equal to 10% of  $M_{max}$  at an interval of 15s. The reflex responses were averaged and served as baseline. Subjects then stood on a WBV plate (Turbosonic) that vibrated at a frequency of 25 Hz and 2-mm amplitude for 5 min. Immediately after the WBV subjects received a stimulation every 15s for 10 min at the pre-vibration intensity. Peak-to-peak reflex responses were averaged at one minute increments and served as the dependent variable. The independent variables were time (baseline, 1 min, 5 min, and 10 min) and muscle (Sol, MG, LG). A 3x4 (muscle x time) ANOVA ( $\alpha = 0.05$ ) with repeated measures on time was used to analyze the data and followed up with post-hoc paired t-tests.

**RESULTS:** In the Sol the H-reflex amplitude decreased significantly at 1 min and increased at 10 min ( $p < 0.05$ ) [base =  $0.61 \pm 0.25$ , 1 =  $0.46 \pm 0.29$ , 5 =  $0.63 \pm 0.25$ , 10 =  $0.72 \pm 0.34$ ]. In the MG the H-reflex decreased significantly following WBV ( $p < 0.05$ ) [base =  $0.26 \pm 0.26$ , 1 =  $0.19 \pm 0.21$ , 5 =  $0.19 \pm 0.11$ , 10 =  $0.21 \pm 0.15$ ]. In the LG the H-reflex amplitude decreased significantly 1 min and increased at 10 min ( $p < 0.05$ ) [base =  $0.30 \pm 0.18$ , 1 =  $0.24 \pm 0.19$ , 5 =  $0.32 \pm 0.21$ , 10 =  $0.36 \pm 0.22$ ]. The paired t-test showed significant decrease in all muscles below baseline at 1 min. However at the 5 min interval no difference existed between baseline measures in any of the muscles. Sol and LG H-reflexes increased at 10 min post intervention but not in the MG.

**CONCLUSIONS:** Similar changes in H-reflexes were observed in the Sol and LG following WBV. We observed a similar trend between muscles with different fiber types.

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**1666 Board #16 May 27 3:30 PM - 5:00 PM**  
**Bilateral Deficit In Peak Cycling O<sub>2</sub> Consumption But Not Maximum Cycling Power**

Jason D. Miller, Steven J. Elmer, Stephen J. Ives, Timothy A. VanHaitisma, L. Nathan Thomas, Melissa A. Hayman, Arwen A. Fuller-Hayes, James C. Martin, FACSM. *University of Utah, Salt Lake City, UT.*

(No relationships reported)

**PURPOSE:** Evidence for the presence of bilateral deficits during assessments of maximal power ( $P_{max}$ ) and maximal aerobic capacity ( $VO_{2peak}$ ) during cycling has been previously reported. To our knowledge bilateral deficits in  $P_{max}$  and  $VO_{2peak}$  have not been assessed in the same individual. The purposes of this study were to 1) compare the summed (right + left leg) unilateral  $P_{max}$  with bilateral  $P_{max}$  and summed unilateral  $VO_{2peak}$  with bilateral  $VO_{2peak}$  and 2) identify the potential difference in unilateral asymmetry when measuring  $P_{max}$  and  $VO_{2peak}$ .

**METHODS:** Seven trained participants ( $VO_{2peak} = 54 \pm 11$  ml·kg<sup>-1</sup>·min<sup>-1</sup>), 6 males and 1 female (27±2 yrs, 176±7 cm, 82±21 kg) volunteered for this investigation.  $VO_{2peak}$  was

assessed during a ramped cycling protocol and  $P_{\max}$  assessed using inertial-load cycling. For  $P_{\max}$  and  $VO_{2\text{peak}}$  trials a 9.9 kg counter weight was attached to the ergometer to facilitate smooth single-leg cycling. Paired  $t$ -tests were used to identify unilateral asymmetry and bilateral deficit for  $P_{\max}$  and  $VO_{2\text{peak}}$ . The unilateral analysis compared the most powerful, most aerobic leg against the least powerful, least aerobic leg for each participant.

**RESULTS:** Bilateral  $P_{\max}$  and summed unilateral  $P_{\max}$  were not different ( $1139 \pm 288$  vs.  $1137 \pm 314$  W,  $p=.94$ ). Unilateral  $P_{\max}$  (strongest vs. weakest) ( $581 \pm 161$  vs.  $555 \pm 154$  W,  $p<.05$ ) as well as unilateral  $VO_{2\text{peak}}$  (more aerobic vs. least aerobic) ( $45 \pm 9$  vs.  $41 \pm 9$  ml $\cdot$ kg $^{-1}\cdot$ m $^{-1}$ ,  $p<.01$ ) differed significantly. Summed unilateral  $VO_{2\text{peak}}$  was significantly greater than bilateral  $VO_{2\text{peak}}$  ( $86 \pm 18$  vs.  $54 \pm 11$  ml $\cdot$ kg $^{-1}\cdot$ m $^{-1}$ ,  $p<.01$ ).

**CONCLUSIONS:** These trained individuals did not exhibit a bilateral deficit in maximum power which supports and extends previous work measuring bilateral deficit in strength training. However, the observed unilateral differences (both  $P_{\max}$  and  $VO_{2\text{peak}}$ ) imply that trained individuals may preferentially rely on one leg during cycling and raises the question of asymmetry during bilateral cycling. The difference in unilateral vs. bilateral  $VO_{2\text{peak}}$  values suggest bilateral aerobic cycling is likely limited by central factors while unilateral lower body cycling may be limited by local muscle factors.

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**1667 Board #17 May 27 3:30 PM - 5:00 PM**  
**Evaluating Symmetry Of Healthy Participants During Landing**

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Although landing is an important model for examining lower extremity injury mechanisms, little is known about symmetry during the landing. Most landing studies assume bilateral symmetry and use one side to describe landing behaviors.

**PURPOSE:** To investigate the symmetry of healthy subjects during drop landing and landing from a counter-movement jump using symmetry index (SI) and symmetry angle (SA).

**METHODS:** Sixteen healthy subjects (8 male, 8 female) performed drop landings from heights of 30 cm (C1) and 60 cm (C2), and counter-movement jumps to a height of 90% of maximum jump height (C3). Three-dimensional kinematics and ground reaction force (GRF) data were collected. Discrete events were selected from joint angle, velocity, and moment curves of the ankle, knee, and hip, as well as from GRF of both sides during the landing phase. For each of 29 selected variables, SI and SA values were calculated such that 0 would indicate perfect symmetry, negative values would indicate greater magnitude on the right side, and positive values indicate greater magnitude on the left side. Two separate MANOVAs, one for SI values and one for SA values, were used to evaluate the differences among conditions ( $p<0.05$ ).

**RESULTS:** The MANOVA results indicated that there was a difference in symmetry between conditions ( $p=0.0018$  for SI,  $p=0.0001$  for SA.) In the sagittal plane, the largest SI and SA values were for ankle, knee, and hip moments. SA of the second peak knee extension moment was the strongest representation of the trend between conditions (mean values of -9.57, -4.34, and -0.81 for C1, C2, C3 respectively) and the peak vertical GRF followed the same trend (mean values of -8.02, -6.29, and -1.49.) The peak hip adduction moment was the only frontal plane variable to show a significant effect for condition (mean SA values of 33.70, 24.09, and -2.70). Frontal plane SI values were highly variable with standard deviations ranging from 3123.44 to 38.44, most likely due to small values of the frontal plane variables.

**CONCLUSIONS:** The results suggest that healthy subjects tend to land more asymmetrically in drop landing compared to landing from a counter-movement jump. Factors that influence the symmetry of a landing may need to be investigated on an individual basis, due to high inter-subject variability.

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**1668 Board #18 May 27 3:30 PM - 5:00 PM**  
**Belly Loads Influence Minimum Cost Of Transport And Speed It Occurs In Walking Women**

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Central fat, insulin resistance and physical inactivity are linked in a pathological positive feedback cycle leading to ever-increasing levels of visceral abdominal fat (VAF). Our ultimate goal is to interrupt this cycle by developing walking regimes for women of different ages and mass distributions that maximize calories burned while minimizing load-induced gait disturbances.

**PURPOSE:** Our specific goal was to determine how the amount of mass carried around a woman's abdominal area (belly) affected her gait kinematics and metabolic cost during walking at different speeds.

**METHODS:** We measured metabolic cost in 10 young females (mean=20.9yr) and 10 older females (mean=51.4yr) as they walked on a treadmill unloaded and belly-loaded (two loads, 8% and 16% of body mass) at four speeds (self-selected from eight options) centered around optimal walking speeds. For each individual, we developed cost of transport (CoT) equations (cost vs speed) for each of the three loading conditions and determined the minimum CoT (minCoT) and the speed of minCoT (SPminCoT) at each loading condition. Kinematic measures were determined from videotape (Kinematic Analysis program) using 5 strides from each trial.

**RESULTS:** Both age cohorts showed the same pattern of significantly higher minCoT ( $p < 0.0001$ ), lower SPminCoT, and lower stride frequency ( $p < 0.0001$ ) as belly load increased. The shape of the metabolic cost vs speed curve was significantly ( $p<0.0001$ ) more acute (higher costs above and below SPminCoT) for loads of 16% body mass than for the unloaded condition, yielding a decidedly smaller range of "comfortable" walking speeds for women with sizable belly loads.

**CONCLUSIONS:** Our results show that the amount of centrally-located mass can influence the metabolic cost and kinematics of walking at a given speed, including the speed at which walking is least costly per distance. These findings will aid in developing individualized exercise prescriptions that could help women with significant visceral body fat maintain exercise levels that lower their risk for type 2 diabetes.

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**1669 Board #19 May 27 3:30 PM - 5:00 PM**  
**Concepts For Assessment Of Anterior Knee Pain In Relation To Muscle Function**

Hechmi Toumi<sup>1</sup>, Thomas M. Best, FACSM<sup>2</sup>, Mark Forster<sup>3</sup>, Sleem F'Guyer<sup>4</sup>, John A. Fairclough<sup>1</sup>. <sup>1</sup>University of Wales, Cardiff, United Kingdom. <sup>2</sup>Ohio State University, Ohio State, OH. <sup>3</sup>University of Wales Institute, Cardiff, Cardiff, United Kingdom. <sup>4</sup>University of Illinois at Chicago, Chicago, IL. (Sponsor: Thomas Best, FACSM)  
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**PURPOSE:** Anterior knee pain in the young adult is associated with patello femoral rather than femoral tibial dysfunction (Kristin M Houghton 2007). The relationship between vastus medialis oblique strength and anterior pain and disability has been suggested (S. O'Reilly 1998). The lack of consistent methodology in objective measurement of the quadriceps muscles have made evaluation of the link between pain and altered muscle function difficult to assess. Using a novel methodology we demonstrate a biomechanical protocol to assess the deficiency of the quadriceps muscles in patients with anterior medial knee pain.

**METHODS:** A biomechanical evaluation was conducted on 54 patients with anterior medial knee pain (34 females and 20 males). All patient x-rays were normal (alignment and joint space between the femur and the tibia as well as between the femur and the patella) through interpretation by a blinded radiologist. A Kistler force plate, a VICON



motion analysis system and surface electromyography were used to quantify biomechanical function during isometric, walking and squatting exercises.

**RESULTS:** For 42 of the 54 (78%) subjects, during isometric and walking exercises we observed that activation of the VMO, rectus femoris (RF) and vastus lateralis (VL) muscles of the symptomatic leg was not significantly different from those of the asymptomatic leg ( $p < 0.01$ ). However, for 31 patients (57%) during the eccentric phase of the squat exercises, the symptomatic leg presented with high activation of VL compared to VMO and RF ( $p < 0.01$ ). During the concentric phase, 45 patients (83%) presented with higher activation of the VL compared to the VMO.

**CONCLUSION:** VMO activity during squatting for the symptomatic (patient with anterior medial knee pain) leg differs fundamentally during walking and isometric exercise compared to squatting tasks. Moreover, the relative contribution of the VL compared to the VMO during the eccentric phase of the squat exercises was different to those recorded during the concentric phase. Therefore, we suggest that maximal isometric and/or isokinetic exercises are not sufficient to access the quadriceps function in relation to anterior knee pain. A thorough biomechanical assessment, including functional testing to reproduce the patient's pain and locate the nature of the symptoms is suggested.

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## **B-24 Free Communication/Poster - Built and Natural Environments: Observational and Intervention Studies**

MAY 27, 2009 1:00 PM - 6:00 PM  
ROOM: Hall 4F

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### **1670 Board #20 May 27 2:00 PM - 3:30 PM Neighborhood Socioeconomic Status And Changes In Walking Activity Among Adults Aged 50-75**

Naruepon Vongjaturapat<sup>1</sup>, Fuzhong Li<sup>2</sup>, Peter Harmer, FACSM<sup>3</sup>, Bradley J. Cardinal, FACSM<sup>4</sup>, Mark Bosworth<sup>5</sup>. <sup>1</sup>Burapha University, Chonburi, Thailand. <sup>2</sup>Oregon Research Institute, Eugene, OR. <sup>3</sup>Willamette University, Salem, OR. <sup>4</sup>Oregon State University, Corvallis, OR. <sup>5</sup>Portland Metro Regional Services, Portland, OR.  
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Research suggests that built and social environments influence physical activity such as walking, but the role of the neighborhood socioeconomic context is not fully understood.

**PURPOSE:** To examine the influence of neighborhood socioeconomic status on the relationships between built environment and psychosocial factors and changes in walking activity over time.

**METHODS:** Using a multilevel, prospective design, we collected data on walking activity assessed by self-report, both at baseline and 1-year follow-up, from 1,141 residents aged 50-75, across 120 neighborhoods in Portland, Oregon. Neighborhoods were divided into low and high socioeconomic status on the basis of median household income, percentage of population in poverty, and racial/ethnic composition. Within-neighborhood level measures were the objective measure of walkability, and residents' self-report of exercise self-efficacy and social cohesion. Change scores in walking were operationalized as values  $\geq 75^{\text{th}}$  percentile of positive change. The 2-level hierarchical data were analyzed using logistic regression with adjustments on neighborhood- and resident-level sociodemographic characteristics.

**RESULTS:** Among low-socioeconomic neighborhoods, residents living in low-walkable built environments were less likely to increase walking activity (adjusted odds ratio [AOR] = 0.68, confidence interval [CI] = 0.50, 0.95). However, the likelihood increased for residents reporting high exercise efficacy (AOR = 1.07, CI = 1.01, 1.14) and perceiving high neighborhood social cohesion (AOR = 1.22, CI = 1.01, 1.48).

**CONCLUSIONS:** Neighborhoods with low-socioeconomic status and low walkability are likely to be associated with reduced levels of walking. Efforts to increase exercise self-efficacy and foster social cohesion are likely to promote increases in walking activity in these neighborhoods.

Supported by NIH Grant R01 ES014252

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### **1671 Board #21 May 27 2:00 PM - 3:30 PM Density Of Neighborhood Public Transit, Built Environment Characteristics, And Residents' Time Spent In Commuting By Public Transit And Utilitarian Walking**

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There is a known association between built environment characteristics and physical activity. However, the extent to which features of the built environment are related to transportation use and walking for utilitarian purposes is not well understood.

**PURPOSE:** Determine whether the density of the public transit system (bus, light rail), walkability around people's homes, and people's perceptions of the built environment are related to the amount of time spent commuting (via public transit) and walking (for the purposes of transportation, errands, and social visits).

**METHODS:** We used a cross-sectional design in which we collected one-time observational data on 1221 participants residing in 120 neighborhoods in Portland, Oregon. These data included dependent measures of time spent commuting and walking (min/wk), a neighborhood-level measure of the density of public transportation systems, and resident-level measures of walkability, perceptions of neighborhood street connectivity, accessibility, safety from traffic, and aesthetics. We used multilevel logistic regression to examine associations among these variables in relation to the dependent measures.

**RESULTS:** In neighborhoods with high densities of public transportation, people who resided in highly walkable home environments were more likely to spend time commuting (OR=1.15) and engaging in utilitarian walking (OR=1.19). Perceived traffic safety was related to both behaviors (OR= 1.16 for transportation, OR=1.18 for walking). Participants perceiving high neighborhood street connectivity, accessibility, and aesthetics engaged in more frequent walking trips for utilitarian purposes (ORs ranging: 1.05-1.18).

**CONCLUSIONS:** In communities with well-established public transportation systems, a high-density public transit network and highly walkable neighborhood living environment are related to active commuting and increased walking behaviors among residents. In addition, individuals' perceptions of their built environment are also important to these behaviors, especially for walking activities.

Supported by NIH Grant R01 ES014252

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### **1672 Board #22 May 27 2:00 PM - 3:30 PM Relationships Between Objectively-measured Environmental Attributes And Step Counts Among Japanese Adults**

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Although an increasing number of studies examining the association between physical activity and environment have been reported, there have not been enough studies using objective methods of assessment both in environment and in physical activity.

**PURPOSE:** This study examined the associations between an objectively-measured environment and step counts assessed by pedometer among Japanese.

**METHODS:** A cross-sectional mail survey was conducted in four Japanese cities (Tsukuba, Koganei, Shizuoka and Kagoshima). A sample of 4,000 adults (male: 50%), aged from 20 to 69 yrs, was randomly selected from a registry of residential addresses. The survey consisted of self-administered questionnaire and 7-day accelerometer survey (Lifecorder, Suzuken). Among the 1508 respondents of the questionnaire survey, 819 (male: 46.4%, age: 48.3±14.2 yr) participated in the accelerometer survey. Environmental attributes (residential density, intersection density, existence of a train station, number of convenience stores, existence of parks and existence of exercise facilities) were assessed by the Geographic Information System (GIS), at the half-mile network buffer level. For statistical analysis, the odd ratios of walking ≥10,000 steps/day by environmental attributes were calculated using logistic regression models adjusted for gender, age, educational attainment, employment status and residential city.

**RESULTS:** Residential density (OR, 95% CI: 1.82, 1.30-2.55), existence of a train station (1.64, 1.12-2.41) and number of convenience stores (1.53, 1.10-2.13) were significantly related to walking ≥10,000 steps/day. According to stratified analyses by gender, residential density (2.15, 1.29-3.60) and number of convenience stores (1.65, 1.00-2.70) were related to walking ≥10,000 steps/day among men, while residential density (1.72, 1.06-2.71) and existence of a train station (1.95, 1.14-3.33) were related to walking ≥10,000 steps/day in women.

**CONCLUSIONS:** Associations between environmental attributes and step counts were observed using an objectively-measured environment and physical activity among Japanese.

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**1673      Board #23      May 27      2:00 PM - 3:30 PM**  
**Use And Perceptions Of Available Physical Activity Facilities In Sedentary Adults**

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Recent research has increasingly examined the impact of the environment on physical activity (PA) participation. Previous studies have demonstrated associations between PA and the availability of PA facilities. Little is known regarding frequency of use, type and desirable characteristics of neighborhood and community PA facilities in sedentary adults preparing to become more physically active.

**PURPOSE:** To examine perceived availability, frequency of use, type and desirable characteristics of PA facilities in sedentary, healthy adults enrolled in a PA intervention.

**METHODS:** Preliminary baseline survey data assessed perceptions of facility availability, frequency of facility use, and PA in 256 sedentary adults (32 males, 224 females; 18 to 65 years) enrolled in a 12 month PA intervention. Additionally, facility users responded to open-ended questions about the types of facilities used and desirable characteristics of PA facilities. Facility non-users were asked to report reasons for not using PA facilities and types of facilities they would be most interested in using. Analyses of survey data are ongoing but will include associations between change in PA and facility use and availability. Qualitative data were analyzed using the constant comparative method.

**RESULTS:** Based on preliminary analyses, 73% of participants reported using PA facilities for PA in the past year. The most commonly used facilities were walking trails, gyms, parks, and bike paths. The most commonly reported desirable characteristics of PA facilities included convenience, beauty, nature, presence of other people, and availability of multiple activities. Facility non-users cited cost and lack of time as primary reasons for not using PA facilities. The most desirable PA facilities for facility non-users included gyms with many workout options and classes such as aerobics or martial arts.

**CONCLUSION:** A majority of participants enrolled in this PA trial reported using PA facilities such as walking trails and gyms. Convenience was the most desirable facility characteristic while cost was the most common reason for not using PA facilities. Data on the current use and desirable characteristics of PA facilities are useful for the development of environmentally tailored PA promotion programs.

Supported by NIH Grant HL64342.

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**1674      Board #24      May 27      2:00 PM - 3:30 PM**  
**Characterization Of Activities Performed In Public Leisure Spaces In Curitiba City, Brazil.**

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(No relationships reported)

**PURPOSE:** To identify the activities performed by frequently users of parks (PK) and squares (SQ) in the city of Curitiba, BRAZIL.

**METHODS:** Data was obtained by interview with frequently users of PK and SQ. The interviews were conducted in four PK and four SQ representing neighborhoods with different socioeconomic and built environment characteristics using a translated version of the Park Survey questionnaire (Cohen, 2004). In order to identify the activities the subjects should select one or more options from a list of 15 possible activities. The interviews were conducted during two consecutive weeks, in three periods of the day, six days by week, with exception on Fridays. The data analysis was conducted with absolute and relative frequency distribution and users of PK and SQ were compared according the gender.

**RESULTS:** Participants were 438 individuals, 259 men (59.1%) 179 women (40.9%), 152 (34.7%) and 286 (65.3%) were users of PK and SQ respectively. Considering the total of activities reported, the predominance, was walking (men: 45.3% - PK and 37.8 - SQ; women: 73.7% - PK and 58.2% - SQ), stretching (men: 37.9% PK and 40.9% SQ; women: 42.1% PK and 37.7% SQ) and running (men: 40.0% PK and 30.5% SQ). The male SQ users reported the following activities: stretching, seating, reading, exercising in the gymnastics equipment, court sports and skating in higher proportion when compared with PK users. Also, among women, the activities differ from PK to SQ. The women SQ users performed in higher proportion activities as seating, reading, walking the dog, finding friends, exercising with gymnastics equipment, court sports, gymnasium activities and playing soccer, when compared with PK users.

**CONCLUSION:** The predominant activities in the public leisure spaces were walking, stretching and running. However, there are differences in proportion between the activities performed in PK and SQ. The differences observed are likely to be related to built and social characteristics within the public leisure spaces in Curitiba, Brazil.

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**1675      Board #25      May 27      2:00 PM - 3:30 PM**  
**Association Of Neighborhood Built And Social Environment And Depressive Symptoms Among Middle Aged And Older Adults**

Arissa Fitch-Martin<sup>1</sup>, Emily Sectar<sup>1</sup>, Fuzhong Li<sup>1</sup>, Peter Harmer, FACSM<sup>2</sup>, Bradley J. Cardinal, FACSM<sup>3</sup>, Mark Bosworth<sup>4</sup>. <sup>1</sup>Oregon Research Inst., Eugene, OR. <sup>2</sup>Willamette University, Salem, OR. <sup>3</sup>Oregon State University, Corvallis, OR. <sup>4</sup>Portland Metro Regional Services, Portland, OR.

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(No relationships reported)

Current research suggests that neighborhoods with few socioeconomic resources and unsafe conditions impose constant stress on the inhabitants, which can lead to increased risks for poor mental health conditions such as depression.

**PURPOSE:** To examine whether neighborhood walkability, socioeconomic status, and residents' perceptions of their neighborhood environment were associated with depressive symptoms among middle aged and older adults.

**METHODS:** The study used a cross-sectional, multilevel design involving neighborhoods as the primary sampling unit and residents as the secondary unit. A Geographic Information System-based measure of neighborhood walkability was constructed in 120 randomly selected neighborhoods in Portland, Oregon, from which 1145 adult residents 51-76 years of age completed a neighborhood environment and health survey. Depressive symptomatology defined by the Center for Epidemiologic Studies Depression Scale (CES-D) with a cut-off score of  $\geq 10$ . Multilevel logistic regression analyses were used to examine level-specific and cross-level associations between neighborhood-level measures of walkability and socioeconomic status and residents' perceptions of neighborhood safety, aesthetics, and social cohesion, and depressive symptoms.

**RESULTS:** High walkability and socioeconomically advantaged neighborhoods were associated with a reduced likelihood of depressive symptoms. However, residents of low-walkability neighborhoods who perceived their neighborhood as safe and socially cohesive and those in socioeconomically disadvantaged neighborhoods who perceived their neighborhoods as safe and having good aesthetics were also less likely to have depressive symptoms.

**CONCLUSIONS:** These findings provide new evidence of the importance of both the independent and joint influences of urban form and people's perceptions of the built and social environment to the development of depressive symptomatology. Promoting neighborhood built and social environments that are safe, pleasing, and cohesive may be an important intervention for enhancing residents' health and reducing the likelihood of developing depressive symptoms.

*Supported by NIH Grant R01 ES014252*

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**1676 Board #26 May 27 2:00 PM - 3:30 PM**

**Does The Perceived Home Environment Influence Levels Of Physical Activity In Hong Kong Residents?**

Duncan J. Macfarlane, Anson K.C. Chan, Kelvin S.K. Wong, Chris H.F. Ng, Daniel C.W. Ho. *The University of Hong Kong, Pokfulam, Hong Kong.*

(Sponsor: H. S. S. Wong, FACSM)

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*(No relationships reported)*

There is growing evidence that the neighborhood built environment can play an important role in influencing how residents chose to be physically active. Public health professionals also recognize that the indoor home environment has a role in causing or mediating some human diseases. However, it is not apparent whether the home built environment contributes to public health by helping determine how its residents choose to be physically active.

**PURPOSE:** To use a recently-devised self-completed Building Environment Quality Questionnaire (BEQQ), that has been proven to be valid and reliable, to examine the association between the perceived home environment and the levels of objectively-determined physical activity.

**METHODS:** A total of 85 ethnic Hong Kong Chinese (39 men and 46 women with a mean age = 41.1 years; range 16-66 years), accepted an invitation to participate in this study. They were occupants from 22 residential buildings across Hong Kong that were considered representative examples of four types of neighborhoods that varied in extremes of socio-economic status (high v low) and "walkability" (high v low). Each resident completed a self-report BEQQ and was then asked to wear a uniaxial accelerometer for 7 consecutive days.

**RESULTS:** The 25th and 75th percentiles of the overall average BEQQ score was used to classify the perceived building environment as "High", "Moderate", or "Low", with light and moderate physical activity classified using 694-2019 and 2020-5999 accelerometer counts/minute respectively. ANOVA showed no statistically significant differences between the three levels of perceived indoor quality (high, medium, low) and time residents spent in light or moderate physical activity, nor with the average number of steps accumulated per day. Pearson correlations between accrued activity and the BEQQ scores were also not significant.

**CONCLUSIONS:** These preliminary results suggest there is no association between the perceived quality of the home environment and the levels of light or moderate habitual physical activity of these Hong Kong residents as recorded by accelerometry.

*This research was funded by the University of Hong Kong's URC-Strategic Research Theme (Public Health).*

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**1677 Board #27 May 27 2:00 PM - 3:30 PM**

**The Development, Validity And Reliability Of The Building Environment Quality Questionnaire**

Anson K.C. Chan, Duncan J. Macfarlane, Kelvin S.K. Wong, Chris H.F. Ng, Daniel C.W. Ho. *The University of Hong Kong, Pokfulam, Hong Kong.*

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For many years the built environment has been considered to have a significant role in public health, but it is unclear whether the indoor home environment has a significant influence on the levels of habitual physical activity we accrue. Such research is restricted due to the lack of valid and reliable instruments that allow residents to self-report the nature of the home built environment.

**PURPOSE:** To develop a new self-completed Building Environment Quality Questionnaire (BEQQ) on the perceived indoor built environment, and to examine the reliability and validity of the BEQQ.

**METHODS:** After reviewing extant literature and conducting pilot interviews of residents, the new BEQQ was devised to include sections on perceived air and water quality, hygiene, space, lighting, noise, temperature/humidity, and property management. A total of 108 ethnic Hong Kong Chinese (47 men and 71 women with a mean age = 41.9 years; range 16-81 years), were then recruited to participate in the study to examine the reliability and validity of the BEQQ. They were residents from 12 residential buildings that had been audited using a semi-objective Building Health and Hygiene Index (BHHI), and chosen to represent 4 buildings with a high, medium, and low index. Intra-class correlations (ICC) were used to analyze both the reliability and intra-building validity of the BEQQ, with Pearson correlations used to analyze the criterion validity between the BEQQ and BHHI.

**RESULTS:** The BEQQ had good test-retest reliability ( $r = 0.70$ ). The intra-building validity testing generated moderate to high ICC values for all sub-categories ( $r = 0.7-0.9$ ). Furthermore, the BEQQ was significantly correlated with the criterion BHHI ( $r = -0.68$ ,  $p = 0.016$ ).

**CONCLUSIONS:** The BEQQ is a valid and reliable self-report tool for investigating the indoor home environment in a high density Asian city like Hong Kong. Further research examining the possible association between the indoor built environment and the levels of habitual physical activity accrued by the residents is therefore encouraged. This research was funded by the University of Hong Kong's URC-Strategic Research Theme (Public Health).

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**1678 Board #28 May 27 2:00 PM - 3:30 PM**

**Step It Up: A Multi-component Intervention To Increase Stair Use In A University Residence Building**

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*(No relationships reported)*

Few physical activity interventions have targeted college-aged adults. Point-of-decision prompts have increased stair usage in public stairwells such as shopping malls but have had less success in worksites. No stair climbing intervention has been implemented in residential buildings.

**PURPOSE:** To examine the effects of a multi-component intervention on stair usage in a large college dormitory compared with a control dormitory.

**METHODS:** Stair use was measured through direct observation in both dormitories for one week each at baseline, mid-intervention, and one week post-intervention. Observations were made at high traffic times between noon and two in the afternoon and five and seven in the evening. The two week "Step it UP" campaign utilized poster prompts, flyers, and fun/competitive challenges with incentives to promote residents to use the stairs instead of the elevators.

**RESULTS:** A total of 5,711 direct observations were made and coded for gender. Stair use at baseline was equivalent in the experimental and control dormitories (24.9% and 27.8%). Stair use increased in the experimental dorm during the intervention as compared to the control (+8.3%, vs. -2.6%, Chi Square = 14.34,  $p < 0.001$ ). Stair use returned to baseline at follow-up (25.4% vs. 26.3%). There was no significant difference between genders or time of day.

**CONCLUSION:** This short-duration intervention significantly increased stair usage during the campaign in a college population relative to the control dorm, but was unable to sustain stair use. Formative assessment is needed to determine which single component is most cost effective for future interventions. Campaigns to increase sustained stair use are needed.

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**1679 Board #29 May 27 2:00 PM - 3:30 PM**  
**Active Commuting At A Large University Campus**

Pamela R. Wittman, Melissa Bopp, Andrew T. Kaczynski. *Kansas State University, Manhattan, KS.* (Sponsor: Thomas J. Barstow, FACSM)  
(No relationships reported)

Regular physical activity (PA) is known to contribute to physical and mental health benefits and recent research has shown several short bouts of leisure-time or transportation PA accumulated daily are effective in obtaining health benefits.

**PURPOSE:** to understand patterns of and influences on active commuting (AC) behavior.

**METHODS:** An online survey of AC patterns was conducted at a large Midwest university campus. Students, faculty, and staff answered questions about frequency of walking, biking, and driving to campus. Respondents were asked about current PA, influences on commuting habits, and geographic characteristics related to commuting. The IR<sup>2</sup> for walking and biking behavior was tested with linear regression for 3 sets of independent variables (demographics, psychosocial, and environmental).

**RESULTS:** 901 respondents participated. 55.7% were female, 50.8% were students, and 75.1% met PA recommendations. The full model explained 31.3% of variance in walking ( $p < 0.01$ ). The demographic set explained 2.8% of variance; meeting PA recommendations was a significant predictor, and age was a negative predictor. The psychosocial set explained 18% of variance; self efficacy for AC was a significant positive predictor, time constraints were a negative predictor. The environmental set explained 10.5% of variance; barriers to parking on campus (cost, availability) were a positive predictor, perceived distance to campus was a significant negative predictor. The full model explained 26.7% of variance in biking ( $p < 0.01$ ). The demographic set explained 3.1% of variance; sex was a significant predictor (males greater AC), age was a significant negative predictor. The psychosocial set explained 23.4% of variance; eco-friendly concerns and self efficacy for AC were positive significant predictors. The environmental set explained .2% of variance; perceived distance to campus was a significant negative predictor.

**CONCLUSION:** Psychosocial variables explained the greatest percentage of both walking and biking. With current economic and ecological concerns, AC should be considered a viable and sustainable behavior to target with future health promotion initiatives. Strategies for the greatest public health impact could include both individual and community level approaches.

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**1680 Board #30 May 27 2:00 PM - 3:30 PM**  
**Walkability Of A University Campus**

Marie H. Murphy, FACSM<sup>1</sup>, José M. Saavedra<sup>2</sup>, Yolanda Escalante<sup>2</sup>. <sup>1</sup>*University of Ulster, Jordanstown, Uruguay.* <sup>2</sup>*University of Extremadura, Cáceres, Spain.*  
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(No relationships reported)

**PURPOSE:** Walking is a popular inexpensive physical activity that can be easily incorporated into lifestyle and has therefore become a cornerstone of many workplace physical activity promotion campaigns. A recent study suggests that increasing employee's opportunities to walk in the working day may improve productivity (Gilson et al., 2008). The purpose this study was to audit the walkability audit of Campus of Jordanstown, University of Ulster, Northern Ireland, UK.

**METHODS:** Major pedestrian routes on the university's main campus were audited by five independent observers using pedometer and an established walkability audit tool (Dannenberg et al., 2005) The audit assessed 10 routes on nine individual components (pedestrian facilities, vehicle conflicts, crossings, route-maintenance, walkway width, roadway buffer, universal accessibility, aesthetics and shelter). Each component was scored on a five-point scale (1=poor, 5=excellent). Total scores combined and weighted for each route were used to indicate of poor (20-39), fair (40-69) or good (70-100) walkability.

**RESULTS:** The 10 routes identified ranged in distance from 155-177 steps. 90% provided were considered fair and the remainder good for employee walking (range 51-88). Route averages for individual items were as follows: pedestrian facilities (3.25+1.31), vehicle conflicts (3.27+1.40), crossings (3.58+1.30), route-maintenance (3.41+1.20), walkway width (3.04+1.29), roadway buffers (2.83+1.39), universal accessibility (3.12+1.20), aesthetics (3.10+1.14) and shade (3.35+1.30). Kendall coefficient of concordance among five observers was calculated ( $k > 0.600$ ,  $p < 0.001$ ).

**CONCLUSIONS:** Overall physical infrastructure was found to be well suited to supporting workplace walking at the campus of Jordanstown, University of Ulster. The majority of the routes are safe and agreeable, providing suitable opportunities for university employees and students to engage in workplace walking. The results of the audit will also be used to reduce barriers to walking on the campus. The audit will now be replicated at partner sites and date used to inform the design and evaluation of our multi-site intervention.

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**1681 Board #31 May 27 2:00 PM - 3:30 PM**  
**The Illinois Cross-campus Bicycle Program (iccb): Facilitating Lifestyle Physical Activity At A Public University**

Kyungo Kim, Leticia Malavasi, Timothy Wolfe Bretl, Morgan Johnston, Andriana Schwingel, Wojtek Chodsko-Zajko, FACSM. *University of Illinois at Urbana-Champaign, Urbana, IL.*  
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The Illinois Cross-Campus Bicycle Program (ICCB) is demonstration project designed to assess the feasibility and cost-effectiveness of implementing an environmentally-friendly, healthy, and relatively inexpensive cross-campus transportation system for university employees. The program made available to participating faculty and staff departmentally-owned and maintained bicycles equipped with baskets, lights, and helmets. A key aim of the study was to determine whether employees would be willing to adopt healthier transportation options if they were made available at no cost.

**PURPOSE:** This study was designed to determine employee attitudes and responses to the availability of departmentally-owned bikes on a major university campus.

**METHODS:** Using a mixed method design, we used surveys and focus groups to determine if employees will use bicycles to get around campus on job-related activities and to learn whether some routes were more or less likely to be selected for bicycle transportation. In addition, Global Positioning System (GPS) monitors were attached to each of the

six bicycles and were used to record the details of each bicycle trip taken by the study participants.

**RESULTS:** Eighteen faculty and staff members volunteered to participate in the study. Participants used the bikes to help them get around campus for a variety of purposes including teaching classes, attending meetings, running errands, and taking a lunch break. In addition to interviewing faculty and staff members who used the bikes regularly, focus groups also sought input from infrequent, and never-users of the program. Differences in attitudes and values between the distinct cohorts were identified.

**CONCLUSIONS:** Strategies that encourage staff and faculty to select healthy transportation options while at work have the potential to not only reduce the demand for parking and the university's impact on the environment, but also to improve the health of the participants. The primary reasons given for choosing automobile transportation included time, distance, weather, convenience, and "being too tired to walk." However, others report that bicycle transportation may be an ideal form of transportation on campus that saves time and reduces stress by eliminating wait time for buses and parking woes.

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## **B-25 Free Communication/Poster - Immunology**

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### **1682 Board #32 May 27 3:30 PM - 5:00 PM**

#### **Variability Of Plasma Interleukin-6, Soluble Interleukin-6 Receptor And Soluble Glycoprotein 130 Response To A Run Pre-load Time Trial Protocol**

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(No relationships reported)

During exercise, IL-6 is actively produced. Elevations in IL-6 levels can impair athletic performance and increase sensation of fatigue. Nutritional interventions can alter the IL-6 response to exercise but the impact this may have on performance is yet to be investigated. To test the hypothesis that an altered IL-6 response to exercise influences athletic performance, studies should employ an exercise preload followed by a time trial.

**PURPOSE:** The aim of this study was to provide data on the variability of IL-6 and its signalling molecules; sIL-6R and sgp130 response to a specific pre-load time trial protocol.

**METHODS:** Ten trained fasted runners with mean (SD) age: 27 (5) yr, body mass: 72.4 (8) kg,  $VO_{2max}$  59 (5)  $ml \cdot kg^{-1} \cdot min^{-1}$ , completed a pre-load of 120 min running at 60%  $VO_{2max}$  and followed by a 5 km time trial on 3 occasions separated by one week. The first trial was a habituation trial. Venous blood samples were drawn prior to exercise, immediately following both the pre-load and time trial. Plasma samples were analysed in duplicate for IL-6, sIL-6R and sgp130.

**RESULTS:** Coefficient of variation between trial A and B for time to complete 5 km was 3.8% (see Table 1 for C of V% for IL-6, sIL-6R and sgp130).

**CONCLUSION:** Despite attempts to standardise conditions such as pre-exercise glycogen levels, food intake and exercise training between trials, our results indicate that there is considerable variability in the IL-6, sIL-6R, sgp130 response to exercise. This variability must be taken into account in future studies attempting to explore the relationship between these variables and performance using a pre-load time trial protocol.

*Supported by Biotechnology and Biological Research Council (UK) and GlaxoSmithKline Nutritional Healthcare (UK).*

Table 1. Coefficient of variation % in plasma parameters between trials			
	Pre-ex	Post pre-load	Post time-trial
IL-6	21.8	25.4	27.7
sIL-6R	16.8	14.6	20.5
sgp130	13.9	11.8	6.4

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### **1683 Board #33 May 27 3:30 PM - 5:00 PM**

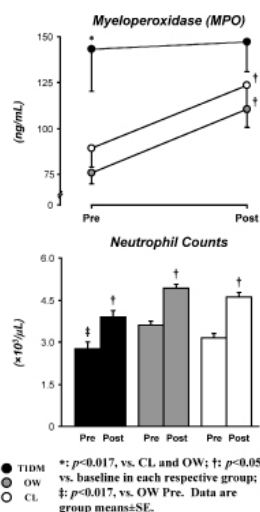
#### **Myeloperoxidase And Neutrophil Responses To Exercise In Healthy, Overweight, And T1dm Children**

Jaime S. Rosa, Stacy R. Oliver, Rebecca L. Flores, Andria M. Pontello, Timothy D. Minh, Shirin Heydari, Milagros Ibarrolaza, Pietro R. Galassetti. *University of California, Irvine, Irvine, CA.* (Sponsor: Dan Cooper, FACSM)

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(No relationships reported)





**PURPOSE:** Myeloperoxidase (MPO), an oxidative enzyme mostly derived from neutrophils (PMN), has been associated with the

pathogenesis of cardiovascular disease (CVD), a common outcome in type 1 diabetes (T1DM) and obesity (OW). While regular exercise is believed to reduce CVD risk in these conditions, the role of PMN activation and MPO secretion in this context is unclear, especially in children.

**METHODS:** For 37 T1DM (13.8 $\pm$ 0.2 yrs, 16F), 55 OW (12.7 $\pm$ 0.3 yrs, 25F, BMI% $\geq$ 95<sup>th</sup>), and 43 healthy (CL, 13.4 $\pm$ 0.5 yrs, 25F, BMI% $<$ 85<sup>th</sup>) children, blood PMN and plasma MPO were measured at baseline and after 30-min of intense, intermittent exercise (2-min cycling @ ~80% VO<sub>2</sub>max followed by 1-min rest, x10); all subjects were euglycemic for  $\geq$ 90 min prior to and during exercise.

**RESULTS:** Baseline MPO (ng/mL) was higher in T1DM (143 $\pm$ 23) than OW (76 $\pm$ 6) and CL (89 $\pm$ 10). During exercise, MPO increased in OW and CL but was unchanged in T1DM; nevertheless, end-exercise values were highest in T1DM. The greater MPO levels in T1DM occurred despite slightly lower PMN counts (2.8 $\pm$ 0.2  $\times 10^3/\mu\text{L}$  vs. 3.1 $\pm$ 0.2 in CL and 3.6 $\pm$ 0.2 in OW) and similar exercise-induced PMN increases in all 3 groups.

**CONCLUSION:** Despite normal baseline counts and exercise mobilization pattern of PMNs, both pre- and post-exercise MPO were markedly elevated in T1DM children. This may reflect an enhanced pro-oxidative state throughout the duration of exercise in this group, potentially altering its overall health effects. Our data underscore the importance of a complete characterization of oxidative responses to exercise so that the full benefits of physical activity could be achieved for OW and T1DM pediatric patients.

Supported by grant NIH M01-RR00827-28, NIH K-23 RR018661-01, JDRF #11-2003-332.

#### 1684 Board #34 May 27 3:30 PM - 5:00 PM

##### Relationship Between Autonomic Nerve Activity And Distribution Of Leukocyte Subsets During Intensive Training.

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(No relationships reported)

The neutrophil and lymphocyte counts in the peripheral blood show opposite circadian patterns. These changes reflect corresponding changes in sympathetic and parasympathetic nerve activity, respectively.

**PURPOSE:** We determined the impact of intensive training on autonomic nerve activity and the distribution of leukocyte subsets, by examining changes in heart rate variability (HRV) and concentrations of catecholamine and cortisol, and leukocyte subset distributions.

**METHODS:** Eight college-level female volleyball players undertook one-month of heavy pre-season training. Volleyball drills were performed 5 h/day, 6 days per week. Four morning resting blood samples were taken pre-training, on the 10th day of training, one day before the end of training and one week after training. Before collecting each blood sample, the R-R interval was also measured in a sitting position.

**RESULTS:** Circulating neutrophil and lymphocyte counts did not change throughout the experiment, except for a small subset of natural killer (NK) cell (CD56<sup>bright</sup> NK cell), that we previously reported. Peripheral blood concentrations of adrenaline, noradrenaline and cortisol also remained unaltered. HRV data showed no changes in natural log transformed (ln) high frequency (HF), low frequency (LF), LF/HF or total power (TP) but when data were pooled and plotted together, the levels of neutrophils ( $r=0.562$ ,  $p<0.001$ ), adrenaline ( $r=0.375$ ,  $p=0.034$ ) and noradrenaline ( $r=0.471$ ,  $p=0.007$ ) were negatively correlated with ln TP.

**DISCUSSION:** Our previous report showed increased CD56<sup>bright</sup> NK cells with decreased cytotoxicity at the end of training. On the other hand, in the present study we found no impact of intensive training on autonomic nerve activity and leukocyte subsets. However, homeostatic regulation might be reflected in the relationships between autonomic nerve activity and neutrophil and catecholamine concentrations.

**CONCLUSION:** The results suggest that one-month of intensive training does not affect HRV indices, concentrations of catecholamines, cortisol or major components of leukocyte at rest.

Supported by the Grant-in-Aid for Scientific Research C-2, 11680058, Japan Society for the Promotion of Science.

#### 1685 Board #35 May 27 3:30 PM - 5:00 PM

##### Phytochemical-induced Cytokine Synthesis By Peripheral Blood Mononuclear Cells Increases From Pre- To Post-vo<sub>2</sub>Max Testing

David S. Sencina<sup>1</sup>, Justus E. Hallam<sup>2</sup>. <sup>1</sup>Drake University, Des Moines, IA. <sup>2</sup>Iowa State University, Ames, IA. (Sponsor: Warren D. Franke, FACSM)

(No relationships reported)

Use of dietary botanical supplements by both recreational and professional athletes has grown in the last decade. Few studies have examined exercise-associated immune responses to supplements.

**PURPOSE:** To examine the effects of a single, intense burst of exercise (VO<sub>2</sub>max test) on *in vitro* production of TNF, IL-1b, and IL-10 in the presence of commonly used herbal medicine extracts.

**METHODS:** Twelve males (24.1  $\pm$  2.9 years of age) not currently taking any supplements participated in a graded VO<sub>2</sub>max test on a cycle ergometer. Blood was drawn pre- and post-testing. Peripheral blood mononuclear cells were isolated, standardized to 1.0  $\times 10^6$  cells/mL, and cultured with purple coneflower (*Echinacea tenesseeensis*) or

bloodroot (*Sanguinaria canadensis*) extracts using multiple extraction schemes, or solvent vehicle controls.

**RESULTS:** The average  $\text{VO}_2\text{max}$  was  $53.5 \pm 6.9$  mL/kg. For all cytokines, there was a main effect of stimulant (all  $p < 0.001$ ) such that *Sanguinaria canadensis* extracts elicited greater cytokine production than *Echinacea tennesseensis* extracts or controls, possibly due to high benzophenanthridine alkaloid content such as berberine and sanguinarine. Both ethanol and water bloodroot flower extracts elicited higher levels of cytokine production than root extracts. For TNF and IL-1b, but not IL-10, there was a main effect of exercise (both  $p = 0.011$ ) such that cytokine production was greater post-testing. No exercise  $\times$  stimulant interactions were uncovered.

**CONCLUSIONS:** Brief, intense exercise such as that experienced during  $\text{VO}_2\text{max}$  testing may be associated with a change in *in vitro* peripheral blood mononuclear cell response to compounds such as those in herbal medicine extracts.

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**1686 Board #36 May 27 3:30 PM - 5:00 PM**

**Cycling For 90 Minutes At 85% Ventilatory Threshold Decreases Immunogen-induced Cytokine Synthesis By Peripheral Blood Mononuclear Cells**

Justus E. Hallam<sup>1</sup>, David S. Sencina<sup>2</sup>. <sup>1</sup>Iowa State University, Ames, IA. <sup>2</sup>Drake University, Des Moines, IA. (Sponsor: Warren D. Franke, FACSM)  
(No relationships reported)

High school and college athletes are increasingly consuming dietary botanical supplements to improve health or performance although little is known about their effects on immune function in the context of exercise.

**PURPOSE:** To examine the effects of 90 minutes of cycling at 85% ventilatory threshold (VT) on *in vitro* production of TNF, IL-1b, and IL-10 in the presence of immunogenic phytochemicals.

**METHODS:** Eight males ( $24.0 \pm 3.3$  years of age) not currently taking any supplements participated in a graded  $\text{VO}_2\text{max}$  test on a cycle ergometer to determine VT (using the  $\text{VE}/\text{VO}_2$  method) and then in a 90-minute cycling bout at 85% of VT. Peripheral blood mononuclear cells were isolated from pre- and post-exercise blood samples, standardized to  $1.0 \times 10^6$  cells/mL, and cultured with extracts from bloodroot, echinacea, or solvent vehicle controls. Cells were cultured for 24, 48, and 72 h and supernatants were assayed for TNF, IL-1b, and IL-10 production, respectively, via ELISA.

**RESULTS:** The average  $\text{VO}_2\text{max}$  was  $50.3 \pm 5.0$  mL/kg and the average workload corresponding to 85% VT was  $2.1 \pm 0.2$  kP ( $164.0 \pm 28.2$  W). For all cytokines, there was a main effect of exercise (all  $p \leq 0.02$ ) such that the exercise bout decreased cytokine synthesis and a main effect of stimulant (all  $p < 0.001$ ) such that bloodroot extracts were significantly different than all other stimulants or controls, possibly due to presence of benzophenanthridine alkaloids.

**CONCLUSIONS:** Cycling for 90 minutes at 85% VT decreases *in vitro* peripheral blood mononuclear cell production of TNF, IL-1b, and IL-10 in a stimulant-specific manner.

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**1687 Board #37 May 27 3:30 PM - 5:00 PM**

**Marathon Running Enhances The Migratory Behavior And Proliferation Of Pc-3 Cells**

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(No relationships reported)

Epidemiological studies have shown that physical activity and exercise can reduce the risk to develop cancer and that cancer patients benefit regarding different physiological and psychological aspects. However, our knowledge about the mechanisms and the effect of physical activity/exercise on tumour migration and growth is rather limited.

**PURPOSE:** To analyse the effect of prolonged endurance exercise on the migratory behaviour, proliferation/apoptosis and intracellular calcium homeostasis of the prostate cancer cells PC-3.

**METHODS:** Serum was taken from 10 healthy trained male subjects ( $43 \pm 14$  yrs), pre, 1, and 2 hours after a marathon run. PC-3 tumour cells were incubated with these serums and various cellular functions were analysed. Migratory behaviour was analysed by performing a 3D-migration assay in a collagen type I matrix. For the investigation of proliferation, aliquots of the cells were cultured until one group reached the confluent state. Apoptosis was measured by flow cytometry using annexin V and propidium iodide after 24 h incubation. Intracellular calcium concentration ( $[\text{Ca}^{2+}]_i$ ) was measured using the  $\text{Ca}^{2+}$  sensitive fluorescent dye Fura-2. Statistical significance was calculated using Student's t test (two-tailed, paired).

**RESULTS:** 1 and 2 h post serums increased the relative migratory activity ( $127 \pm 5.8$  &  $117 \pm 5.8$  vs.  $100 \pm 0\%$ ,  $p < 0.05$ ) and the relative migrated distance ( $129 \pm 11.8$  &  $121 \pm 6$  vs.  $100 \pm 0\%$ ,  $p < 0.05$ ) compared to pre serum. The relative velocity of the migrating cells remained unchanged. Treatment of the cells with pre serum lead to a significantly ( $p < 0.01$ ) higher  $[\text{Ca}^{2+}]_i$  level at peak ( $668 \pm 60$  vs.  $437 \pm 59$  nmol/l) and the following plateau compared to 1h post. Incubation with post serums increased the proliferation, but was only significant ( $p < 0.05$ ) for 1h post ( $932,143 \pm 34,810$  vs.  $1,253,571 \pm 96,583$  (1h) &  $1,068,080 \pm 109,505$  (2h) cells/ml). In contrast, measurement of apoptosis revealed a significantly ( $p < 0.05$ ) higher percentage of survived cells by pre serum compared to 1h post serum ( $92.5 \pm 0.7\%$  vs.  $90.8 \pm 0.87\%$ ). There were no significant differences of apoptotic & necrotic cells between all time points.

**CONCLUSIONS:** Prolonged endurance exercise may increase the migratory behaviour and proliferation of PC-3 cells. This enhancement is associated with a reduced  $[\text{Ca}^{2+}]_i$ .

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**1688 Board #38 May 27 3:30 PM - 5:00 PM**

**Aerobic Fitness And Age-related Changes In Human Lymphocytes Mitochondria Respiration And Peroxyde Production**

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**PURPOSE:** To determine the influence of aerobic fitness on age-related changes in mitochondria respiratory chain complex I and II and its relation with peroxide production in healthy human lymphocytes.

**METHODS:** Fifty healthy and nonsmokers men, aged between 19 and 59 yrs ( $35.3 \pm 11.4$  yrs) participated in this study. Maximal aerobic capacity ( $\text{VO}_2\text{max}$ , mL $\cdot$ kg<sup>-1</sup>·min<sup>-1</sup>) was assessed by spirometry until exhaustion according to Bruce protocol. Lymphocyte mitochondria respiration of complex I and II were assessed after permeabilization with digitonin (1%) with a Clark electrode (Hansatech Instruments, Norfolk, UK). Peroxyde release from lymphocyte mitochondria into the overlying medium was assayed by fluorescence in a spectrofluorimeter (Jasco FP 777). A Pearson test was used to find correlation between age,  $\text{VO}_2\text{max}$  and mitochondria complex I, complex II and  $\text{H}_2\text{O}_2$  production.

**RESULTS:**  $\text{VO}_2\text{max}$  decreased significantly with age ( $r = -0.453$ ,  $p = 0.001$ ) and was negatively correlated with  $\text{H}_2\text{O}_2$  production ( $r = -0.346$ ,  $p = 0.01$ ). No correlation was found between age and mitochondria complex I, complex II and  $\text{H}_2\text{O}_2$  production. Mitochondria complex I and II were positively correlated ( $r = -0.400$ ,  $p = 0.003$ ) and complex I was positively correlated with  $\text{H}_2\text{O}_2$  production ( $r = -0.309$ ,  $p = 0.023$ ).

**CONCLUSIONS:** Concerning our results, we may conclude that high aerobic fitness is associated with lower levels of  $\text{H}_2\text{O}_2$  production due to a minor activity of complex I.

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**1689 Board #39 May 27 3:30 PM - 5:00 PM**

**Il-1ra Response To Brief (6-8 Min) Exercise In Asthmatic And Healthy Children**

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(No relationships reported)

Interleukin (IL)-1RA is one of the most powerful endogenous anti-inflammatory agents. It abrogates airway inflammation and bronchial hyper-responsiveness in asthma and may act to modulate asthma expression with therapeutic potential for the treatment of asthma. Exercise is a robust stimulant of IL-1RA and intense exercise can trigger exercise-induced asthma.

**PURPOSE:** To determine if brief exercise, which most closely mimics children at play, would stimulate IL-1RA in healthy and asthmatic children.

**METHODS:** One hundred nineteen children [16-female asthmatics (FA), mean age 13.6 years; 32 female controls (FC), mean age 13.7 years; 39 male asthmatics (MA), mean age 13.6 years; 32-male controls (MC), mean age 14.9 years] performed a standardized test designed to elicit exercise-induced bronchoconstriction (6-8 minutes of cycle ergometry at about 70% peak work rate). Blood was sampled at pre- and end-exercise. IL-1RA levels were measured by ELISA.

**RESULTS:** The median baseline values for IL-1RA were: FA - 138.3 pg/mL, FC - 177.7 pg/mL, MA -180.2 pg/mL, and MC - 131.8 pg/mL. A significant difference was observed between MC versus MA ( $p<0.0001$ ), and MC versus FC ( $p=0.001$ ). A significant increase in IL-1RA was observed in response to acute exercise in FA ( $p=0.004$ ; median D=6.2) and MC ( $p<0.001$ ; median D=4.6) participants. There were no group differences observed in response to exercise.

**CONCLUSIONS:** This is the first study to demonstrate differences in IL-1RA at baseline and in response to exercise between asthmatic and healthy participants. The interplay between inflammatory mediators and exercise may be important in the induction of exercise-induced asthma.

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**1690 Board #40 May 27 3:30 PM - 5:00 PM**

**Resistance Training Decreases C-reactive Protein Without Changing Inflammatory Cytokines Or Body Mass Index**

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**PURPOSE:** The purpose of this project was to investigate the influence of 12 weeks resistance exercise training (RT) on inflammatory markers associated with cardiovascular disease (CVD) in obese, post-menopausal women (PMW).

**METHODS:** Obese PMW ( $65.6 \pm 2.7$  yr, BMI:  $33 \pm 3.9$  kg\*m<sup>-2</sup>) completed a resistance exercise bout (RE, 10 exercises, 3 sets, 80% estimated 1RM) both before (BT) and after (AT) 12 weeks RT (EX, N=12) or weekly social meetings (CON, N=11). RT consisted of 3 sets of 10 exercises working all major muscle groups (80% estimated 1RM, 3 days/week). Blood samples were collected pre-exercise (PR), immediately post-exercise (PO), and at 2 (2H) and 24 (24H) hr of recovery (same time points for CON) both BT and AT. The following were measured BT and AT by ELISA: plasma IL-6 (PR, PO, 2H, 24H), and resting (PR) LPS-stimulated TNF- $\alpha$  production (LPS-TNF) and plasma C-reactive protein (CRP). TLR-4 mRNA expression was assessed in whole blood at rest BT and AT using real time PCR.

**RESULTS:** We observed no change in body mass or body composition, but saw an exercise x group interaction ( $P<0.001$ ) for plasma IL-6 (pg\*mL<sup>-1</sup>). RE increased IL-6 in EX at PO. By 2H, IL-6 was not different than PR in EX. EX IL-6 was lower than CON at 2H and 24H. IL-6 was greater in CON at 2H compared to other time points. (EX: PR  $1.9 \pm 0.2$ , PO  $2.9 \pm 0.3$ , 2H  $2.3 \pm 0.2$ , 24H  $1.7 \pm 0.1$ ; CON: PR  $2.5 \pm 0.3$ , PO  $2.4 \pm 0.3$ , 2H  $3.4 \pm 0.5$ , 24H  $2.5 \pm 0.3$  (pg\*mL<sup>-1</sup>)). BT and AT LPS-TNF were not different in EX ( $29 \pm 5$  vs.  $42 \pm 6$  fg\*mono<sup>-1</sup>) or CON ( $32 \pm 5$  vs.  $39 \pm 5$  fg\*mono<sup>-1</sup>). RT decreased resting (PR) CRP in EX (N=10,  $P=0.026$ ) while no change occurred in CON (EX: BT  $1.64 \pm 0.6$ , AT  $1.1 \pm 0.5$ ; CON: BT  $2.1 \pm 0.6$ , AT  $2.2 \pm 0.5$  mg/L, N=8). TLR4 mRNA expression was not different between groups when expressed as "fold change" (EX: -1.12, N=7; CON: 1.17, N=7) nor when expressed in arbitrary units and adjusted for number of monocytes in whole blood (EX: BT  $3.6 \pm 0.7$ , AT  $3.1 \pm 0.8$ ; CON: BT  $2.8 \pm 0.7$ , AT  $2.8 \pm 0.8$ ).

**CONCLUSION:** A single bout of RE using major muscle groups increased plasma IL-6 immediately post-exercise, but blunted an apparent diurnal increase observed in resting CON at 2H. Consistent RE training reduces CRP in obese PMW without a concomitant decrease in inflammatory cytokines, body fat or BMI. These positive RT-induced changes in plasma inflammatory profile may reduce the risk of inactivity-related disease.

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**1691 Board #41 May 27 3:30 PM - 5:00 PM**

**Changes In The Frequency Of Senescent Blood T-cells During 6-months Training Preparation For An Ironman Triathlon**

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It is well-known that athletes are at an increased susceptibility to illness when adhering to arduous training regimens in preparation for endurance events. Senescent T-lymphocytes are antigen-experienced cells that accumulate with age and fail to clonally expand following further antigenic stimulation, thus predisposing the individual to a greater risk of infection. Although acute exercise is known to alter the frequency of senescent T-cells in blood, less is known about the effects of long-term endurance training.

**PURPOSE:** To examine the effects of 6-months training preparation for an Ironman triathlon on the frequency of senescent blood T-cells.

**METHODS:** Ten club-level triathletes (9 males; 1 female: Age:  $42.9 \pm 3.1$  yrs) provided a fasted resting blood sample in the morning at 27 (DEC), 21 (JAN), 15 (MAR), 9 (MAY) and 3 (JUN) weeks before the 2008 Zurich Ironman Triathlon. An additional sample was collected 2-weeks post-competition (AUG). Total training hours completed by the participants over the 6-month period was  $284.4 \pm 122.9$ . Isolated blood lymphocytes were labelled with monoclonal antibodies to assess cell surface expression and co-expression of the T-cell senescence markers KLRG1, CD57 and CD28; and the naïve and memory T-cell markers CD45RA and CD45RO on CD3+, CD3+/CD4+ and CD3+/CD8+ T-cells using four-colour flow cytometry. Data was analyzed for time-change using a repeated measures linear mixed model.

**RESULTS:** Compared to DEC, the percentage of CD4+ T-cells expressing KLRG1 increased by 71% (MAR), 20% (MAY) and 71% (AUG). CD4+ T-cells co-expressing KLRG1 and CD57 was 192% greater in AUG compared to DEC. No changes in senescent markers were found on CD8+ T-cells. The proportion of transitional T-cells (CD45RA+/CD45RO+) increased from MAY to JUN by 141% and 115% for CD4+ and CD8+ T-cells respectively. The proportion of memory CD8+ T-cells (CD45RA-/CD45RO+) was 40% (MAY) and 55% (AUG) greater than DEC.

**CONCLUSION:** Adherence to a 6-month training program in preparation for an Ironman triathlon leads to an increased frequency of senescent CD4+ T-cells (KLRG1+/CD57+) and a greater proportion of naïve to memory transitional CD4+ and CD8+ T-cells in blood. These changes could have important implications for athlete infection risk during periods of arduous training.

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**1692 Board #42 May 27 3:30 PM - 5:00 PM**

**Effect Of Exercise On Gene Expression In Peripheral Blood Mononuclear Cells (PBMCs) In Girls**

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In children and adults, both beneficial (e.g., reduced cardiovascular diseases risk) and dangerous (e.g., bronchoconstriction) effects of physical activity are likely mediated by circulating immune cells. Intriguingly, recent studies show that brief exercise alters circulating neutrophil and PBMC gene expression ranging from cell growth to both pro- and anti-inflammatory

processes. These initial observations were made solely in adult males.

**PURPOSE:** To study the effects of exercise on PBMC gene expression in early pubertal (EP) and late pubertal (LP) girls.

**METHODS:** The girls (EP, n=10, range 8-11 y.o.; LP, n=10, 14.5-17 y.o.) performed 10 consecutive 2-min bouts of cycle ergometry (~90% peak HR) interspersed with 1-min rest intervals. Blood was obtained at rest and again after all exercise bouts were completed. RNA was hybridized to Affymetrix Human Genome U133 Plus 2.0 Arrays. Statistical criterion to identify gene expression changes was <5% false discovery rate with 95% confidence.

**RESULTS:** Lactate and PBMCs increased significantly after exercise within each group with no significant difference between groups. Exercise induced significant changes in PBMC gene expression in EP (1321 genes) and LP (878 genes). 622 genes had a similar direction of change in both groups. From this list we identified 6 gene pathways classified by Kegg with an Ease score  $\leq 0.05$ : antigen processing and presentation (11 genes, e.g., HSPA1B, HLA-DOB, HLA-DOA, and CIITA); natural killer cell mediated cytotoxicity (14 genes, e.g., FASLG, KLRD1, CD247, KIR2DL4 and KIR2DL3); B cell receptor signaling (9 genes, e.g., BLNK, BCL10, and NFKBIA); type I diabetes (6 genes, e.g., GLCC1); hematopoietic cell lineage (8 genes, e.g., IL4R, CD19 and CD24); and apoptosis (7 genes, e.g., FADD, CASP3, PIK3CG and CASP10). We corroborated the microarray results, using RT-PCR in 6 genes from the natural killer cell mediated cytotoxicity pathway.

**CONCLUSIONS:** Brief exercise alters PBMC gene expression in early and late pubertal girls. The pattern of change involves diverse genetic pathways, consistent with a global danger-type response, perhaps readying PBMCs for a range of physiological responses from inflammation to tissue repair that would be useful following a bout of physical activity.

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**1693 Board #43 May 27 3:30 PM - 5:00 PM**  
**Team Everest: The Immune Response To High Altitude**

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**INTRODUCTION:** The synergistic effect of the various high-altitude related physiological assaults concomitant with a high exposure to ultraviolet radiation and different strains of common pathogens, crowding, sub-optimal personal hygiene, sleep disturbance, and harsh environmental conditions, may impair immune function.

**PURPOSE:** To examine illness severity in association with immune and hormonal responses to high-altitude exposure.

**METHODS:** Fifty one healthy medical students (26 male and 25 female; age range, 20-28 yrs) consented to be monitored for illness severity (upper respiratory tract (URT), constitutional (CS), gastrointestinal (GI) and oral symptoms), mood and sleep disturbance, perceived exertion (Borg scale), muscle soreness (Visual Analogue Scale), acute mountain sickness (AMS, Lake Louise Score), and concentrations of salivary secretory SIgA, IgG & cortisol (EIA) during a 15-d expedition to the Nepalese Himalayas. Fasting, unstimulated, saliva samples were taken and all other measures were completed at the same time of each data collection day. Data was collected at Sea Level (Baseline) and daily during the 15-d expedition.

**RESULTS:** The severity score of URT ( $P<0.001$ ), CS ( $P=0.022$ ), GI (NS), and oral ( $P=0.026$ ) symptoms increased relatively to high-altitude exposure (1300-5200m). At 5200m cf. 1300m, URT, CS, and oral symptoms severity scores increased by 9-fold, 2.9-fold and 4.5-fold, respectively. Salivary cortisol varied significantly among the different levels of altitude ( $P=0.001$ ). It decreased by 40% at 1300m cf. Sea Level, and steadily increased after 3867m. Both, SIgA and IgG concentrations decreased ( $P<0.05$ ) relatively to high-altitude exposure and coincided with severity of illness. Perceived exertion also increased significantly ( $P=0.012$ ).

**CONCLUSIONS:** The concomitant decrease of SIgA, IgG and cortisol concentrations with the increased severity of illness, suggests an association. The decrease in cortisol might be due to impaired P450 activities. Acute cortisol suppression and increased severity of URT symptoms may predispose to the development of Acute Mountain Sickness.

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**1694 Board #44 May 27 3:30 PM - 5:00 PM**  
**Effect Of Acute And Regular Exercise On CD4+ Lymphocyte Activation In Chronic Kidney Disease Patients**

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Chronic kidney disease (CKD) is associated with impaired cellular immunity, leading to a high incidence of infections. In healthy people, it has been shown that acute intensive exercise temporarily depresses many aspects of immune function, whereas moderate exercise exerts little influence on these measures. In addition, it has been suggested that regular moderate exercise participation may enhance immunity. However, it is not clear what effect exercise may have in CKD patients given their compromised immune systems.

**PURPOSE:** To determine the effects of acute and 6 months of regular moderate aerobic exercise on T helper (CD4+) lymphocyte activation in CKD patients.

**METHODS:** Twelve CKD (stage 4 and 5 pre-dialysis) patients (9M and 3F) with a mean age of 59 years (range 50-73 yrs), exercised for 30 min at least 5 times per week for a total period of 6 months. The exercise programme consisted of brisk walking at a Rating of Perceived Exertion (RPE) in the range of 12-14. At baseline and after the 6-month training period patients performed a standard 30 min treadmill exercise test. Venous blood samples were collected before (Pre), immediately after (Post) and 1 h after (1H) the exercise test at baseline and before the exercise test at 6 months (6M). CD4+ lymphocyte activation (CD69 expression) was determined by flow cytometry following 20 h in vitro stimulation by staphylococcal enterotoxin B.

**RESULTS:** Acute exercise induced a transient decrease in the geometric mean of fluorescence intensity (GMFI) of CD69 in CD4+ lymphocytes (mean  $\pm$  SEM, Pre:  $124 \pm 16$  vs. Post:  $110 \pm 14$ ,  $P=0.024$ ), yet values returned to resting levels within 1 h (1H:  $123 \pm 17$ ,  $P=0.914$  vs. Pre). There was no effect of acute exercise on the percentage of CD4+ lymphocytes expressing CD69 (Pre:  $23.7 \pm 3.5\%$ , one-way ANOVA,  $P=0.960$ ). Average RPE response to the exercise test after the training period was lower than at baseline ( $10 \pm 0$  vs.  $13 \pm 0$ ,  $P=0.002$ ). However, the percentage (6M:  $24.2 \pm 2.7\%$ ,  $P=0.775$  vs. Pre) and GMFI (6M:  $122 \pm 14$ ,  $P=0.748$  vs. Pre) of CD4+CD69+ lymphocytes did not change over this period.

**CONCLUSIONS:** These findings suggest that CD4+ lymphocyte function in CKD patients is not compromised by an acute bout of moderate intensity exercise and it is maintained by 6 months of regular moderate aerobic exercise participation.

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**1695 Board #45 May 27 3:30 PM - 5:00 PM**  
**Reliability Study Of The Technique To Assess Upper Respiratory Airway Inflammation In A Polluted Environment**

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Airway inflammation can be detected by an increased influx of inflammatory cells, such as neutrophils, as well as increased expression of inflammatory markers, which include interleukin-6 (IL-6) and Clara cell protein (CC16). When an individual is exercising in a polluted environment, it is useful to be able to assess these variables with a reliable technique. Some of these techniques, such as bronchial biopsies and bronchoalveolar lavage, though frequently used, are relatively invasive procedures. The nasal lavage technique (NL), on the other hand, is a simple and relatively noninvasive



procedure that samples the upper respiratory airway.

**PURPOSE:** To investigate the reliability and sensitivity of the NL when used to assess upper respiratory airway inflammation in a non-polluted environment and compare it to an ozone-polluted environment.

**METHODS:** Six healthy volunteers took part in this study (mean  $\pm$  SD, 27  $\pm$  3 years; 69.6  $\pm$  10.8 kg; 172  $\pm$  7 cm). Once a week, at the same time of day, during a period of 5 weeks, the participants underwent NL. On the 5<sup>th</sup> week, before the NL, they remained seated for 30 min inside a thermoneutral environmental chamber with an ozone concentration of 0.10 ppm. After collection, the nasal lavage was immediately processed in the lab, the supernatant being removed and frozen at -80°C for further analysis of albumin, IL-6 and CC16. The remaining pellet was re-suspended and used for a differential cell count. Data was analysed using Repeated Measures ANOVA with Tukey's post-hoc test.

**RESULTS:** The NL was successful in measuring immune cells, albumin and CC16 from the upper respiratory airway. IL-6, however, was not detectable. During the 4 weeks with no ozone exposure, the inflammatory markers remained unchanged, with a significant inter-subject variability for albumin ( $P = 0.002$ ) and CC16 ( $P = 0.000$ ). The ozone exposure significantly increased the neutrophil counts ( $P = 0.024$ ) in the NL, but did not affect the other inflammatory markers.

**CONCLUSION:** NL is a reliable technique to assess the upper respiratory inflammatory markers. In addition, a short period of exposure to 0.10 ppm of ozone, without exercise, initiates a small inflammatory process in the lungs characterized by increased neutrophil count.

*Supported by Napier University.*

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**1696 Board #46 May 27 3:30 PM - 5:00 PM**  
**Effect Of Power Walking Program On The Immune Response In Human Body**

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*(No relationships reported)*

Whether the effects of power walking program on immune response in human body remains less clear.

**PURPOSE:** The purpose of this study was to investigate the effect of power walking program on the immune response including interleukin-6 (IL-6), tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), c-reactive protein (CRP), white blood cell (WBC) in female adults.

**METHODS:** 31 healthy female adults aged 19 to 22 years were participated in this study and classified as a three groups by light walking group (30-60 HRmax, 3-5d/wk, 30-55min/d), power walking group (40-70 HRmax, 3-5d/wk, 30-55min/d), and control group (non exercise program). They performed power walking program on treadmill for 12 months. IL-6, TNF- $\alpha$ , CRP, WBC were measured before treatment, after 6 months, and 12 months of the program treatment. Cardiorespiratory fitness was indirectly assessed by Harvard 5-minute step test. Repeated Measures Analysis of Variance (ANOVA), Multiple Range Test (Bonferroni), Pearson Product-Moment Correlation, Analysis of Simple Linear Regression, and Dubin Watson Test were used to examine the statistical significance using SPSS 12.0 windows (SPSS Inc., Chicago, IL).

**RESULTS:** There were significant differences on TNF- $\alpha$  for 12 months among three groups and walking period ( $p < .05$ ), but there were no significant differences on IL-6, CRP, and WBC among three groups. Cardiorespiratory fitness was associated with IL-6 ( $r = 0.39$ ,  $p < .05$ ).

**CONCLUSIONS:** In conclusion, power walking program for 12 months may be partly affected on immune response in healthy female adults.

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**1697 Board #47 May 27 3:30 PM - 5:00 PM**  
**Effects Of Tai Chi Chuan On Cytokines Il-4 And Ifn- $\gamma$  Among Middle-aged And Elderly Women**

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*(No relationships reported)*

Immunosenescence refers to the decline in the immune response associated with aging in humans and animals. Factors increasing TH1 by mediated immune response (mainly the production interferon gamma [IFN- $\gamma$ ]) are related to suppression of the development of allergic disease. IFN- $\gamma$  and IL-4 have important contribution in immune defense mechanism. In this study, we analyze the effect of Tai Chi Quan on cytokines IL-4 and IFN- $\gamma$  among middle-aged or elder women who practiced for six months **PURPOSE:** The objective of the present study is to reveal the mechanism that Tai Chi promotes health in levels of cytokine.

**METHODS:** 25 women, 60 $\pm$ 6 years old, were required, who have not participated in any exercise ever. Exclusion criteria included major diseases, use of corticosteroids or other hormones. All subjects participated in 24-Type Tai Chi Quan and 42-Type Tai Chi sword exercise for six months, 60mins every time and four times a week. The intensity was regulated every month. Laboratory examinations consisted of the detection of cytokines IL-4 and IFN- $\gamma$  in peripheral blood by flow cytometry three-color method using the commercial sets of Immunotech Comp. Peripheral venous blood samples were withdrawn in the morning (7 - 9am) with fasting. Withdrawals were carried out prior to the commencement of Tai Chi program, after 4 months and after 6 months.

**RESULTS:** IFN- $\gamma$  has increased from 12.58 $\pm$ 4.40 to 16.96 $\pm$ 5.33 ( $P < 0.01$ ) and 16.15 $\pm$ 5.27 ( $P < 0.05$ ), after 4 and 6 months exercise, respectively. IL-4 has increased from 1.74 $\pm$ 1.10 to 2.55 $\pm$ 1.32 ( $P < 0.05$ ), after 4 and 6 months exercise, respectively.

**CONCLUSIONS:** Based on the literature, relation between exercise and IFN- $\gamma$  could be concerned with factors of exercise mode, exercise intensity, exercise time, exercise intermission. Tai Chi Quan is a type of aerobic training, having the characteristic of regulating physiology and psychology. We conclude that the Tai Chi Quan Exercise may affect some aging related physiological characteristics.

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**1698 Board #48 May 27 3:30 PM - 5:00 PM**  
**The Menstrual Cycle Effect On The Immune System Response To Acute Exercise.**

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The total number of white blood cells (leukocytes) in circulation tends to increase during and immediately following exercise. However, little is known about the influence of menstrual cycle phase on the response of total leukocytes and leukocyte subsets to an acute bout of exercise.

**PURPOSE:** To compare the response of total leukocytes and leukocyte subsets to 45 min of running and 45 min of recovery between the follicular phase and luteal phase of the menstrual cycle.

**METHODS:** Ten moderately active females taking some form of chemical contraceptive ran for 45 min at 70% of  $\dot{V}O_2$  peak in both the follicular phase and luteal phase of the menstrual cycle. Two 2 X 7 repeated measures ANOVAs were computed for measured and corrected total leukocytes, and five 2 X 7 repeated measures ANOVAs were computed for leukocyte subsets.

**RESULTS:** No significant interaction ( $p > .05$ ) was found between menstrual cycle phase and time for total leukocytes and leukocyte subsets. No significant main effect ( $p > .05$ ) was found for menstrual cycle phase for total leukocytes and leukocyte subsets. A significant main effect ( $p < .05$ ) for time was found for measured total leukocytes across



45 min of exercise and 45 min of recovery, but not for corrected total leukocytes. A significant main effect ( $p < .05$ ) for time was found for lymphocytes, monocytes, and eosinophils across 45 min of exercise and 45 min of recovery, but not for neutrophils and basophils.

**CONCLUSION:** Menstrual cycle phase does not appear to influence changes in total leukocytes and leukocyte subsets in response to an acute bout of exercise while the duration of exercise may induce changes in some of the leukocyte subset values.

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## **B-26 Free Communication/Poster - Military Physiology and Medicine**

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### **1699 Board #49 May 27 2:00 PM - 3:30 PM**

#### **Cardiac Interbeat Intervals To Assess Combat Readiness.**

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**PURPOSE:** Chronic fatigue/physical exhaustion (FPE) impacts combat readiness but is difficult to identify. We tested the hypothesis that resting cardiac interbeat intervals, including both time- and frequency-domain assessments of heart rate variability (HRV), would correlate with hydration status and aerobic capacity in military recruit-age men and women with varying fitness levels.

**METHODS:** Cardiac interbeat intervals were recorded using a Polar R-R monitor during 20 minutes of quiet, supine rest with paced breathing (0.25 Hz). HRV metrics included: R-R intervals (RRI); R-R interval standard deviation (RRISD); the percentage of adjacent R-R intervals varying by  $\geq 50$  ms (pNN50); and integrated areas of R-R interval spectral power at the high (0.15 - 0.4 Hz; RRIHF) and low (0.04 - 0.15 Hz; RRI LF) frequencies. Treadmill  $\text{VO}_2$  peak; segmental bioimpedance estimates of total body water (TBW); and urine specific gravity (USG) were also assessed.

**RESULTS:** All dependent variables of interest were within expected ranges, although absolute ranges of individual values were considerable. RRI correlated with  $\text{VO}_2$  peak ( $r = 0.49$ ;  $p < 0.001$ ), TBW ( $r = 0.38$ ;  $p < 0.001$ ) and inversely with USG ( $r = -0.23$ ;  $p = 0.02$ ). RRISD correlated with  $\text{VO}_2$  peak ( $r = 0.21$ ;  $p = 0.03$ ), but not with TBW or USG. pNN50 correlated inversely with urine specific gravity ( $r = -0.21$ ;  $p = 0.03$ ) but not  $\text{VO}_2$  peak or TBW. R-R interval spectral power at the high and low frequencies correlated poorly with  $\text{VO}_2$  peak, TBW, and USG.

**CONCLUSIONS:** These results provide direction as to how fitness level and hydration status may affect cardiac function via changes in autonomic tone, highlighting the potential utility of applying field-based assessment of various interbeat interval metrics to identify FPE and other aspects of combat readiness.

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### **1700 Board #50 May 27 2:00 PM - 3:30 PM**

#### **Evaluation Of Physiological, Endocrinal And Cognitive Responses After 5 Days Of Field Survival Conditions**

Hervé Sanchez<sup>1</sup>, Nathalie Koulmann<sup>1</sup>, Christophe Pons<sup>2</sup>, Nadine Simler<sup>1</sup>, Simon Pla<sup>1</sup>, Didier Caballe<sup>2</sup>, Sébastien Banzet<sup>1</sup>, Corinne Cian<sup>1</sup>, Xavier Bigard<sup>1</sup>. <sup>1</sup>Centre de Recherches du Service de Santé des Armées, La Tronche, France. <sup>2</sup>Centre National Entraînement Commando, Montlouis, France.

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Survival conditions can occur during military operations. These emergencies situations often need intensive physical performances performed with limited feeding and associated with high psychological stress. Little is known about the physiological, endocrinal and cognitive responses to survival, as well as alteration of physical and mental performances.

**PURPOSE:** To determine consequences of field survival conditions on physical and cognitive performances and examine metabolic and endocrinal responses in well trained soldiers.

**METHODS:** 8 French commando soldiers (age  $28.4 \pm 0.8$ , height  $178 \pm 1$ , body weight (BW)  $74.3 \pm 2.9$ ) were monitored before and after the last 5 days of their field survival instruction. Anthropometric parameters (BW, fat mass), blood samples for metabolic (glycerol (GL), glucose (G) and free fatty acid (FFA) levels) and endocrinal responses (growth hormone (GH), insulin growth factor 1 (IGF-1), IGF-Binding Protein 3 (IGF-BP3)), and muscle strength characteristics were collected in resting conditions and after a 5-days field survival period. Both knee extensor and forearm muscles strength during isometric maximal voluntary contraction (MVC) and endurance time at 20% of MVC (ET20) were measured. Cognitive evaluation was done with a questionnaire. Two reconnaissance missions per day at moderate exercise intensity were performed, while subjects had to find their own food during the survival period.

**RESULTS:** As expected, BW and fat mass were decreased (-5.4%, -13.5%  $p < 0.05$ , respectively). Concerning blood parameters, both GL and G concentrations were unchanged while plasma FFA level increased (+147%,  $p < 0.01$ ). Plasma GH concentration increased (+200%  $p < 0.05$ ), associated with a surprisingly decrease of both IGF-1 and IGF-BP3 levels (-43%, -17%,  $p < 0.05$ , respectively). Neither MVC of both knee extensor and forearm nor ET20 were altered after 5 days of caloric restriction. Cognitive function also remained unaffected by survival conditions.

**CONCLUSIONS:** A short field survival period leads to lypolysis and adaptive response of the GH axis, without detectable alteration of both physical performance and cognitive status. These surprising findings could be explained by the high level of physical training and mental resilience of our subjects.

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### **1701 Board #51 May 27 2:00 PM - 3:30 PM**

#### **Ambulatory Monitoring Of Performance And Health In The Military Using Field Labs**

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(No relationships reported)

Operations in Iraq, Afghanistan and Bosnia reveal that soldiers are exposed to extreme, complex and sustained operations, crossing the limits of human capabilities. During these operations the operational readiness or status of the soldier is estimated by the commander based on subjective observations of the physical and mental capabilities of the soldier. This commander evaluation can be biased by personal experiences and commanders own physical and mental status. Wrong judgement can have negative consequences for the soldier, which might lead to dangerous and harmful situations. To predict the operational readiness and to guard the safety and health of soldiers, it is important to objectively recognize symptoms of fatigue and exhaustion. Up till now, no methods were available for the Dutch Army to monitor physiological and cognitive status of soldiers during military operations.

**PURPOSE:** Development of a mobile laboratory setting (field lab) to assess physical and cognitive changes throughout sustained operations. The data obtained will be used to develop a model predicting performance and operational status/readiness.

**METHODS:** A field lab has been developed to assess soldiers physiological and cognitive functioning during military operations (for example during education, training and missions). Equivital Life Monitors (Hidalgo, UK) measure physiological parameters like heart rate, skin and core temperature, respiratory rate, and body movements; laptops

are used to assess cognitive performance and to obtain subjective ratings, and a weather station collects environmental data.

**RESULTS:** The variety of parameters measured in our field labs result in data which will be used to develop a multi-parameter model to predict operational readiness/status. The model will give insight in important parameters to guard soldiers' performance and health and will provide the commander with additional information that might be relevant for the decision making process.

**CONCLUSIONS:** By using well equipped and well defined field labs, it is possible to assess cognitive and physiological functioning of soldiers in operational settings. This results in increased ecological validity of the data that give insight in the effect of military operations on physical and mental performance.

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**1702 Board #52 May 27 2:00 PM - 3:30 PM**  
**Test-retest Reliability Of Selected Measures Of Soldier Performance**

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(No relationships reported)

**PURPOSE:** To determine the test-retest reliability (TRR) of measures of Soldier performance.

**METHODS:** 7 Soldier performance tests (30-m grenade throw for distance [GT-D] and accuracy [GT-A], maximum box lift [IRM], running long jump with 20.5-kg load [LJ], 2-mile march with 33-kg load [LM], 80-kg dummy drag [DD], repetitive lift and carry of a 20.5 kg box [RLC], and 5-30-m rushes with 20.5 kg load [Rush],) were performed 4 times over an 8 week period, with adequate rest between tests. Repeated measures analyses of variance (RMANOVA) were used to examine changes over time. Intraclass correlation coefficients (ICC) and 95% confidence intervals (CI) were calculated using data from all Soldiers with 4 trials for a test. Models and forms for reliability coefficients were ICC (2,1), except for GT (ICC(2,5)) and LJ (ICC(2,3)).

**RESULTS:** RMANOVA revealed no differences over time for GT-D, LJ, LM, DD or Rush. RLC and IRM stabilized by the second trial and GT-A by the third trial. Table 1 lists the ICC, CI and sample size for each test. Three tests (GT, IRM and LJ) had significantly higher overall TRR compared to 3 tests with lower TRR (CD, RLC, and Rush). By virtue of a CI that overlapped both high- and low-TRR groups, the TRR for LM was not different from either group.

Table 1. Test-Retest Reliability results.

	ICC	95% CI	n
GT-A	0.95	0.92-0.97	34
GT-D	0.94	0.90-0.97	34
IRM	0.94	0.90-0.97	35
LJ	0.93	0.88-0.96	36
LM	0.85	0.75-0.92	26
DD	0.78	0.66-0.87	34
RLC	0.71	0.57-0.83	34
Rush	0.67	0.52-0.80	32

**CONCLUSIONS:** The measures of soldier readiness with the greatest TRR were GT, IRM and LJ. Based on CI overlap, the LM was not different from the higher or lower TRR group. These 4 tests could be used to provide a reliable measure of soldier readiness.

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**1703 Board #53 May 27 2:00 PM - 3:30 PM**  
**Army Physical Fitness Test 2-mile Run Correlates With Peak Oxygen Uptake In Infantry Soldiers**

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(No relationships reported)

Active duty Soldiers must be sufficiently physically fit to perform military tasks and maintain physical readiness. The Army Physical Fitness Test (APFT), consisting of a 2 mile run (2MR), sit-ups and push-ups, is used to assess Soldiers' aerobic and muscular fitness. While 2MR times have been correlated to aerobic capacity in a laboratory setting (n=61, r=-.91, Mello et al 1984), the relationship between 2MR time and peak oxygen uptake (peak VO<sub>2</sub>) has not been assessed in a large Infantry population in a field or operational setting. This matter is important due to recent findings of Soldiers entering basic combat training with lower levels of aerobic fitness and increased percent body fat.

**PURPOSE:** To determine whether 2MR time correlates with peak VO<sub>2</sub> in Infantry Soldiers in a field setting. This study will also determine whether 2MR times are influenced by body weight or composition.

**METHODS:** Prior to deploying to Afghanistan, 199 Infantry Soldiers (Mean±SD: 22.9±4.0 yr; 82.1±14.1 kg; 177.1±7.2 cm) were measured for body mass (BM), percent body fat (BF) via dual energy x-ray absorptiometry, and peak VO<sub>2</sub> by indirect spirometry using the Parvo Medics TrueOne<sup>®</sup> 2400 system and an uphill treadmill running protocol. 2MR times from the most recent APFT were obtained. Correlation coefficients were established using Pearson Product Moment correlations (α = 0.05) and prediction equations were determined through a linear regression analysis.

**RESULTS:** Mean±SE values for peak VO<sub>2</sub>(ml/kg/min), 2MR(sec), BM(kg) and BF(%) were 50.9±0.4, 863.4±5.0, 82.1±1.0, and 18.1±0.5, respectively. 2MR time was correlated negatively with peak VO<sub>2</sub> (r=-0.65); and positively with BM (r=0.41) and %BF (r=0.52). The linear regression analysis generated the following equation: Peak VO<sub>2</sub>=95.78 - .052\*2MR time(sec); r=-0.65 r<sup>2</sup>=0.42, p<.001.

**CONCLUSIONS:** Although the correlation is less than determined in the laboratory, in a field setting APFT 2MR times are correlated with and can be used to predict peak VO<sub>2</sub> or aerobic fitness. In addition, greater body weight and percent body fat are associated with slower APFT 2MR times.

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**1704 Board #54 May 27 2:00 PM - 3:30 PM**  
**Oxygen Consumption Output Increases During Steady-State Submaximal Prolonged Heavy Load Carriage**

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(No relationships reported)

**INTRODUCTION:** Research indicates that oxygen consumption ( $\text{VO}_2$ ) increases seen during prolonged walking with a load depend upon the walk duration, velocity, grade, load carried and  $\text{VO}_2$  sampling frequency during the exercise. The timing when  $\text{VO}_2$  starts to increase as a function of loading and walking conditions remains an open question. Predictive models do not accurately capture this  $\text{VO}_2$  increase over time.

**PURPOSE:** We examined the effects on  $\text{VO}_2$  of continuous walking while carrying a heavy load versus walking without a load.

**METHODS:** Eight male volunteers (24 yrs, 81 kg, 180 cm) participated and walked on a level treadmill uninterrupted for 120-min at 1.35 m/sec. At one session volunteers wore

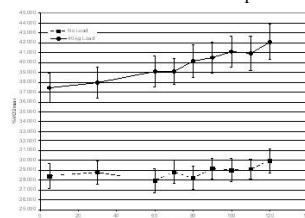


Figure 1: Interaction between time and load condition.

shorts, t-shirt, and footwear. At a second session, volunteers walked wearing that basic outfit plus an armor vest and a loaded backpack, for a total load of 40 kg.  $\text{VO}_2$  was collected for 3 min at minutes 5, 30, 60, 70, 80, 90, 100, 110, and 117 of the walk, and scaled to percentage of  $\text{VO}_{2\text{max}}$ . A two-way repeated measures ANOVA with nine levels of time and two levels of load (40-kg load, no load) was used to assess differences in percentage of  $\text{VO}_{2\text{max}}$  and appropriate statistics were used for follow-up analyses.

**RESULTS:** A significant interaction effect was found. Follow-up tests revealed increases over time for the loaded condition and also as compared to no load. Across time, energy cost as a percentage of  $\text{VO}_{2\text{max}}$  increased at a greater rate for the loaded condition as compared to the unloaded condition and did not appear to taper off to a steady state (Figure 1).

**CONCLUSIONS:** This study demonstrates that results of energy cost increases due to prolonged load carriage are study dependent and cannot accurately be captured by existing model predictions.

## B-27 Free Communication/Poster - Motor Control

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

### 1705 Board #55 May 27 2:00 PM - 3:30 PM

#### The Effects Of Aquatic Exercise On Balance Outcomes In Individuals With Parkinson's Disease

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(No relationships reported)

**INTRODUCTION:** Research has shown that physical activity is beneficial for improving motor performance and the quality of life for people with PD. However, few examined the effects of aquatic exercise on motor outcomes of people with PD.

**PURPOSE:** The purpose of this study was to investigate the effects of aquatic exercise on various balance outcomes of people with PD.

**METHODS:** A total of 24 individuals with PD were recruited initially and randomly assigned to two groups (12 subjects per group). Only 15 of them were able to complete this intervention study. The aquatic group (n=9) participated in a 50-minute therapeutic pool exercise program (90-94° F) 3 times a week for 9 weeks. The control (n=6) was recommended to do similar exercises at home after receiving an on-site orientation initially. Participants were tested on four balance measures: Activities Specific Balance Confidence Scale (ABCS), Berg Balance Score (BBS), static balance (postural sway), and dynamic balance (time of sit-to-stand). The postural sway was measured in two conditions (static standing with eyes closed and eyes open), using a force plate (Quattro Jump 9290, Kistler, 2003). Postural sway was calculated based on the total traveling distance of center of pressure. Time of sit-to-stand (STS) was measured using a force plate in combination with a 2 dimensional motion analysis system (Peak Modus, Vicon, 2007). Both force displacement data and movement trajectory information were used to identify the start and end times of STS.

**RESULTS:** A mixed-model ANOVA showed that there was a significant group interaction in time of STS ( $F=5.671, p < .039$ ). The aquatic group showed a greater decrease in the STS time. However, no significant group differences were noted for other dependent variables: ABC, BBS, static balance with eyes open, static balance with eye closed.

**CONCLUSIONS:** Although no significant differences were found in the ABC, BBS and static balance tests, many participants were able to maintain their balance ability, which still bears clinical significance considering the progressive nature of PD. The result of this study indicated aquatic exercise program can improve dynamic and functional balance of people with PD while it can help them prevent further loss of static balance and balance confidence.

### 1706 Board #56 May 27 2:00 PM - 3:30 PM

#### Motor Unit Conduction Velocity During Sustained Contraction Of The Vastus Medialis Muscle Injured By Eccentric Exercise

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**PURPOSE:** Eccentric contractions induce muscle fiber damage, which is associated with a decreased capacity to generate force. The sarcolemma, which conducts the action potential, is subjected to substantial tears during eccentric contractions. Thus, in this study it is hypothesized that the electrophysiological fiber membrane properties change after muscle damage induced by eccentric exercise. The aim of the study was to investigate the propagation velocity of muscle fiber action potentials in individual motor units following eccentric exercise.

**METHODS:** Multi-channel surface and fine-wire intramuscular EMG signals were concurrently recorded from two locations (proximal and distal) of the right vastus medialis muscle of 10 healthy men during 60-s isometric contractions at 10% and 30% of the maximal force. The measures were performed before (baseline), 24h, and 48h after eccentric exercise.

**RESULTS:** The maximal force decreased by  $26.1 \pm 16.1\%$  ( $P < 0.0001$ ) at 24h and remained reduced by  $23.6 \pm 14.5\%$  ( $P < 0.0001$ ) 48h post exercise with respect to baseline, which was indicative of muscle damage. Muscle fiber conduction velocity (MFCV) was reduced 24h and 48h post exercise with respect to baseline for both contraction forces and both recording locations. The percent reduction in MFCV from day 1 to day 2 and 3 (average for 24h and 48h post exercise) was  $7.7 \pm 2.7\%$  (proximal) and  $7.2 \pm 2.8\%$  (distal).

(distal) ( $P < 0.05$ ) for 10% MVC force, and  $8.6 \pm 3.8\%$  (proximal) and  $6.2 \pm 1.5\%$  (distal) ( $P < 0.05$ ) for 30% MVC force. Moreover, motor unit conduction velocity decreased over time during the sustained contractions at a faster rate when assessed 24h and 48h post exercise with respect to baseline for both levels of force and muscle locations ( $P < 0.05$ ).

**CONCLUSIONS:** These results indicate that the electrophysiological membrane properties of muscle fibers are altered by exercise-induced muscle damage.

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**1707 Board #57 May 27 2:00 PM - 3:30 PM**

**Relationship Between Limb Unloading And Quadriceps Strength Loss After Total Knee Arthroplasty**

Michael J. Bade, Jaclyn E. Balter, Laurel R. Kramer, Wendy M. Kohrt, FACSM, Jennifer E. Stevens-Lapsley. *University of Colorado Denver, Aurora, CO.*

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(No relationships reported)

Deficits in muscle strength that compromise functional performance persist years after total knee arthroplasty (TKA). Unweighting or unloading of the involved limb both before and after TKA is a common adaptation to avoid knee pain and instability, but may exacerbate quadriceps strength loss.

**PURPOSE:** To quantify the relationship between changes in involved limb unloading and the amount of quadriceps strength loss after TKA.

**Subjects:** Twenty-four patients with end-stage osteoarthritis were studied ( $68.3 \pm 8.4$  years; 15 women, 9 men). Patients were excluded if they had uncontrolled hypertension, uncontrolled diabetes, body mass index  $> 35$ , or significant neurologic impairments. All subjects underwent a primary, unilateral TKA.

**METHODS:** Maximal voluntary isometric strength (MVIC) of the quadriceps muscle was assessed preoperatively and again 4 weeks after TKA using an isokinetic dynamometer. Static limb unloading was quantified by having patients place each limb on one of 2 electronic scales. Weight on each scale was recorded continuously and averaged over a total of 90 seconds. Patients were asked questions to distract them and encourage habitual stance patterns. All patients participated in a standardized rehabilitation program for 9 weeks following surgery.

**RESULTS:** Average quadriceps strength loss 1 month following TKA was  $37.9 \pm 27.9\%$  (range: 85.5% loss to 30% gain). The average amount of unloading did not change significantly before and after surgery ( $5.7 \pm 6.1\%$  vs  $7.0 \pm 4.4\%$  respectively) ( $p > 0.05$ ), although the changes in unloading by individual were more variable and ranged from a 35.9% decrease to a 29.9% increase in unloading of the involved limb. The change in quadriceps strength was significantly correlated with the change in limb unloading ( $r = 0.47$ ,  $p < 0.05$ ).

**CONCLUSION:** Quadriceps strength loss following TKA was associated with an increase in involved limb unloading. Additionally, limb unloading did not improve following TKA and one month of standard rehabilitation, suggesting that habitual unloading patterns may persist. Further research is required to determine if targeted quadriceps strengthening after TKA would attenuate limb unloading and if other causal factors exist for limb unloading.

*Funding: Foundation for Physical Therapy, American College of Rheumatology, NIH 1 UL1 RR025780*

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**1708 Board #58 May 27 2:00 PM - 3:30 PM**

**Dynamic Stability During Multi-directional Gait Initiation: Influence Of Age And Disease**

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(No relationships reported)

Gait initiation (GI) and turning while walking have been widely investigated in older adults and more recently in Parkinson's disease (PD) patients. Previously, we have shown that persons with PD have difficulty initiating gait 90° to the side of the stepping leg. However, whether these findings carry over to other perhaps more functional turning angles (open 45° and cross over 45°) is unknown.

**PURPOSE:** To examine the differences in dynamic stability during multi-directional GI among three groups: Healthy Young Adults (HYA), Healthy Older Adults (HOA) and Persons with Parkinson's (PWP).

**METHODS:** Nine HYA (age:  $28.4 \pm 4$ y), nine HOA (age:  $56.6 \pm 9.7$ y) and 11 PWP (age:  $63 \pm 2$ ; Modified Hoehn & Yahr stage of 1 to 3) participated. An 8-camera motion capture system was used to capture the kinematic data at 120 Hz. Center of pressure (COP) data were collected using two force platforms at 1560 Hz. The whole body center of mass (COM) location was computed as the weighted sum of each body segments COM from a 15 segment biomechanical model using the collected kinematics and subject anthropometrics. Participants performed five GI trials in each of four directions: stepping 45° medially (crossing in front of the body, c45), open-stepping 45° laterally (O45), open-stepping 90° (O90) and straight (ST). The magnitude of the COP-COM moment arm was evaluated in three distinct phases (postural, weight shift, and locomotor) of the GI cycle.

**RESULTS:** The MANOVA results indicated a significant interaction effect in all the three phases. *Postural:* PWP produced the smallest resultant and AP COP-COM moment arms across C45, O45 and ST directions ( $P < 0.05$ ). However, for the O90 direction, the PWP produced the greatest resultant and ML COP-COM moment arm ( $P < 0.05$ ). *Weight shift:* PWP had a smaller AP COP-COM moment arm than HYA and HOA groups across all directions ( $P < 0.05$ ). *Locomotor phase:* PWP exhibited lowest resultant moment arm in all the directions except C45 direction ( $P > 0.05$ ). Similarly, the PWP group had lowest AP moment arms in C45, ST and O45 directions ( $P < 0.05$ ), but the greatest moment arm in O90 direction ( $P < 0.05$ ).

**CONCLUSION:** The results indicate that PWP have deficits in multi-directional GI when compared to their aged-matched counterparts and HYA, placing greater emphasis on maintaining stability than momentum generation.

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**1709 Board #59 May 27 2:00 PM - 3:30 PM**

**Ankle Morphometry In The Chinese Population**

Ching-Ya Huang, Kuo-Wei Tseng, Hon-Wen Cheng, Cheng-Hsiu Lai, Kuan-Ting Lee, Jyun-You Lin. *Taipei Physical Education College, Taipei, Taiwan.*

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(No relationships reported)

**INTRODUCTION:** Modern designs are now contributing to a remarkable renewed interest in total ankle arthroplasty (TAA), but TAA is still not as successful as total hip and total knee arthroplasty. Among the remaining issues there is the design of the prosthesis components, which are often claimed to be 'anatomical' or compatible with the bony and ligament structures. However, very little is reported in the literature about the morphology of the distal tibia and proximal talus. Not a single is dedicated to the ankle morphological parameters in the Chinese population, which are expected to be addressed particularly in prosthesis designs dedicated to meeting the requirements of oriental life style.

**PURPOSE:** The purpose of the current study was to bridge the gap.

**METHODS:** Ten ankle/foot cadaver specimens without any trauma or disease (mean foot length: 22cm) were used in the current study. Each specimen was positioned at the neutral position and fixed to the plastic frame before receiving a computerized tomography (CT) scan at a slice thickness of 0.6 mm. The CT data were then used to reconstruct the 3D model of the bones and a MATLAB program was implemented with Geomagic STUDIO to obtain the morphological parameters of the distal tibia and proximal talus.

**RESULTS:** The morphometrical measures obtained are all less than those in a recent study, except for TaW, SRTi and Tiw. The relatively smaller bone mass of the distal tibia in the Chinese population suggests that the tibial bone may not be enough for the tibial component, and the stress fracture of the medial and lateral malleoli may occur.

**CONCLUSIONS:** The success of an ankle prosthesis design depends largely on the morphological data from the ankle joints of its targeted population. The measurements in the current study are expected to contribute to the design of surgical instruments and in particular of the dimensions for the different prosthesis component sizes, which were revealed to be under dimensioned. This is particularly true in post-traumatic ankles, where bones are larger than in normal ankles.

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## **B-28 Free Communication/Poster - Nutritional Interventions**

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### **1710 Board #60 May 27 3:30 PM - 5:00 PM**

#### **Post-exercise Carbohydrates Increase The Magnitude Of The Inflammatory Response**

Chris M. Depner, Sara J. Frederickson, Kitrick Rhodes, Kelly Bond, Rita Barry, Rochelle Kirwan, Mary P. Miles, FACSM. *Montana State University, Bozeman, MT.*

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(No relationships reported)

**PRUPOSE:** To determine the influence of high carbohydrate intake during recovery from eccentric exercise on the inflammatory response.

**METHODS:** The study was a cross-over design. College aged men and women (n=12) completed high carbohydrate and high fat/protein conditions in counterbalanced order. Both conditions consisted of 6 sets of 10 maximal high-force eccentric contractions of the elbow flexors and extensors. The exercise was followed by a controlled diet for the first 8 hours post-exercise based on the condition. Interleukin-6 (IL-6), interleukin-1b (IL-b), and C-reactive protein (CRP) were measured as indicators of inflammation pre-exercise, 1.5, 4, 8, and 24 h post-exercise. Blood glucose and insulin were measured at these same time points to identify differences between diets in the conditions. Creatine kinase (CK), muscle soreness, and isometric strength loss were measured as indicators of muscle damage through 120 h post-exercise.

**RESULTS:** Insulin increased ( $p<0.01$ ) in the high carbohydrate condition compared to the high fat/protein condition at 1.5, 4, and 8 hours post-exercise. Perceived soreness was elevated ( $p<0.001$ ) at all time points post-exercise in both conditions and was higher ( $p<0.05$ ) in the high carbohydrate condition compared to the high fat/protein condition. There was a main effect trend ( $p = 0.064$ ) for IL-6 to be greater in the high carbohydrate condition compared to the high fat/protein condition. IL-1b increased ( $p = 0.05$ ) 24 hours post-exercise in the high carbohydrate condition compared to the high fat/protein condition.

**CONCLUSION:** The inflammatory response following eccentric exercise was higher in the high carbohydrate compared to the high protein/fat condition, as evidenced by augmented IL-1b and IL-6 (trend only) responses. This is consistent with greater perceived muscle soreness post-exercise in the high carbohydrate condition. Additional research is required to investigate whether this response to high carbohydrate intake has the potential to influence recovery from strenuous exercise or the development of chronic diseases related to inflammation.

Supported by Dept. of Health and Human Development, Montana State University, Bozeman, MT, and ADVANCE Women into Science funding from NSF.

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### **1711 Board #61 May 27 3:30 PM - 5:00 PM**

#### **Alpha-lipoic Acid Attenuates Exercise-induced Oxidative Stress And Enhances Heat Shock Protein Responses**

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(No relationships reported)

Uncontrolled oxidative stress, a state where the increased production of ROS overwhelms endogenous antioxidant protection, may result in macromolecular damage and perturbation of redox control of signalling and cellular events. The heat shock proteins (HSPs) respond to a wide variety of stress, including oxidative stress. HSPs function primarily as molecular chaperones, but also control protein synthesis and trafficking, as well as regulate cellular adaptation and survival.

**PURPOSE:** Several antioxidant supplementation strategies have been used to cope with exercise-induced oxidative stress and to facilitate adaptations to exercise. While antioxidant supplementation diminishes exercise-induced oxidative stress, there is also a risk of decreasing the normal response of tissues to exercise and blunting the adaptations. In this study we examined the protective role of natural thiol antioxidant, alpha-lipoic acid (LA) supplementation at rest, after exercise and at different recovery points in skeletal muscle in horses.

**METHODS:** Six standardbred trotters were examined on the treadmill and exercised 75 min at individually defined aerobic level. Blood and muscle biopsy samples were taken before and immediately after treadmill exercise, as well as after 2-, 6-, 24- and 48-hour recovery.

**RESULTS:** LA supplementation ( $25 \text{ mg kg}^{-1} \text{ day}^{-1}$ ) for five weeks increased the resting levels of HSP90 and the recovery levels of inducible HSP70 in gluteus medius muscle. In addition, following LA-supplementation, we observed a significant decrease in exercise-induced protein oxidation in plasma and free radical formation in muscle, measured by EPR signals.

**CONCLUSION:** Our findings suggest that LA enhances HSP levels and decreases exercise-induced oxidative stress in skeletal muscle.

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### **1712 Board #62 May 27 3:30 PM - 5:00 PM**

#### **The Impact Of Pre Exercise Snacks On Exercise Intensity, Stress, And Fatigue In Children**

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( J.M. Sacke, California Raisin Marketing Board, Contracted Research.)

**PURPOSE:** Few studies have examined how the composition of snacks affects athletic performance in children. We investigated whether the macronutrient and flavonoid content of 3 pre-exercise snacks differentially affected exercise intensity, stress, and post-game fatigue in young soccer players.

**METHODS:** At 1 h prior to a 50-min soccer game, 115 children ( $9.1 \pm 0.9 \text{ y}$ ) were randomly assigned to consume 1 of 3 isocaloric snacks: 1) nutrient dense/high flavonoid (HF) raisin/nut bar; 2) low flavonoid (LF) peanut butter graham bar; or 3) low flavonoid/high sugar (LF/HS) rice cereal bar. Blood glucose and salivary cortisol and IgA were measured before consuming the snack and immediately following the game. Game exercise intensity was measured by accelerometry. Self-administered questionnaires were used to assess diet quality and physical and mental fatigue after the game.



**RESULTS:** The children spent approximately 33% of the game in moderate to vigorous activity and 49% of the game in sedentary activity. The snack consumed was not related to exercise intensity. Mean post-exercise blood glucose ( $P<0.001$ ) and cortisol ( $P<0.05$ ) increased and IgA levels decreased ( $P<0.001$ ) from pre-game values. The pre-exercise snack did not predict the post-exercise outcome for any of these parameters after controlling for pre-exercise values of the biomarkers, age, gender, BMI, exercise intensity, game-time water consumption, and diet quality. Children who reported symptoms of fatigue were more likely to have consumed the LF/HS snack ( $P<0.05$ ).

**CONCLUSIONS:** The pre-exercise snacks formulated for this study did not affect blood sugar or salivary biomarkers of stress following a soccer game in young children. The nutrient content of the single snack did not differentially influence these biomarkers or the exercise intensity; however subjective feelings of fatigue may be associated with low flavonoid/high sugar snacks. Future investigations are warranted to further explore the effects of pre-exercise snacks on exercise, performance, stress and fatigue in children.

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**1713 Board #63 May 27 3:30 PM - 5:00 PM**

**The Effects Of Three Pre-exercise Meals On Long And Short-term Submaximal Cycling Endurance Exercise.**

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**PURPOSE:** To determine the effects of pre-exercise meals on blood and cardiorespiratory variables during long-term and short-term submaximal endurance cycling.

**METHODS:** Eighteen endurance trained males, ages of 18 - 35 years, participated in this study examining the effects of 200 iso-caloric meals (300 mL) of glucose, whole milk, and an artificially flavored placebo after an overnight fast and 2-day diet high (>60%) in complex carbohydrates fed 30 minutes prior to separate rides at 55% of  $\dot{V}O_{2max}$  for 120 minutes, followed by a 30 minute rest, and a short high intensity ride to exhaustion at 80% of  $\dot{V}O_{2max}$ . Subjects were healthy and each paid \$100 for their participation. Variables measured were blood glucose, glycerol, free fatty acids, and lactate, respiratory exchange ratio, heart rate, rating of perceived exertion, and time to exhaustion. Data were analyzed using a two-way repeated measures ANOVA. Significant differences ( $p < 0.05$ ) were tested using a Bonferroni post hoc test.

**RESULTS:** Only the means of the free fatty acids were significantly different between the long ride trials ( $p < .007$ ) with milk and glucose significantly blunting the rise in free fatty acids with exercise. Over time in the long ride free fatty acids, glycerol, and heart rate increased significantly and glucose, lactate, and respiratory exchange ratio decreased significantly. On the short rides there were no significant differences between any of the variables ( $p < 0.05$ ). While the differences were not significant, time to exhaustion for the carbohydrate meal was 18% longer than milk and 20% longer than the placebo.

**CONCLUSIONS:** These results demonstrate that, following an overnight fast, a 200 kilocalorie meal prior to endurance exercise will not make a difference in time to exhaustion if it is a carbohydrate or whole milk meal. Additionally, a whole milk meal will blunt the free fatty acid response during endurance exercise similar to that of a carbohydrate only meal.

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**1714 Board #64 May 27 3:30 PM - 5:00 PM**

**Atkins Diet Has Profound Effects On Mood With Minimal Effects On Physiological Responses During Exercise**

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(No relationships reported)

Low carbohydrate diets such as the Atkins diet induce weight loss but the combined effects of decreased mood, increased fatigue, increased perception of effort and reduced capacity to exercise may alter submaximal and high intensity exercise responses.

**PURPOSE:** The purpose was to evaluate the effects of the Atkins dietary intervention on mood state and the physiological responses during submaximal and high intensity exercise.

**METHODS:** Twenty-four healthy males volunteered to participate in the study. All subjects performed a graded exercise test to exhaustion (GXT) on a cycle ergometer or treadmill. Subjects were pair-matched and divided into two groups [control(C) and Atkins (A)]. All subjects kept a daily food record for 9 days and provided 24-hr urine samples on protocol days 3, 6 and 9 for evaluating pH and ketones. On protocol day 3 (baseline), subjects answered the Profile of Mood States (POMS) questionnaire, followed by a 40-minute exercise bout at  $58 \pm 10.2$  % of  $\dot{V}O_{2max}$ . Expired gases and RPE were measured at 10-minute intervals. At 40 minutes, intensity was increased to 90% of  $\dot{V}O_{2max}$  and time-to-exhaustion was recorded. Beginning on protocol day 4, the C group consumed their normal diet and the A group followed the induction phase of the Atkins diet for 6 days. On protocol day 9, POMS questionnaire and baseline exercise tests were repeated.

**RESULTS:** Daily CHO intake in the A group was reduced from 48% to 9% ( $p < .05$ ). pH was reduced 9.8% ( $P < .05$ ) in the A group at protocol day 9. POMS TMD was increased 768.5% in the A group ( $p < .05$ ) at protocol day 9. During exercise, fat oxidation increased. RER was reduced by 12.8 % ( $p < .05$ ) in the A group compared to C.  $\dot{V}O_2$  and RPE in the A group were significantly higher than baseline but were not different than the C group. Time-to-fatigue in the A group was also reduced compared to baseline but not different from C.

**CONCLUSION:** The Atkins diet was successful in significantly reducing CHO intake. This had a profound effect on resting urinary markers of ketogenesis and mood. Despite a large shift in substrate utilization during submaximal exercise, there were minimal effects on  $\dot{V}O_2$ , RPE and time to exhaustion during high intensity exercise. This indicates that a 6-day Atkins dietary intervention has large effects on resting mood with minimal effects during submaximal and high intensity exercise.

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**1715 Board #65 May 27 3:30 PM - 5:00 PM**

**Weight Loss And Liquid Ingestion During Classical Ballet Training**

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(No relationships reported)

Even during moderate exercises, such as classical Ballet, weight loss (WL) due to significant water loss may happen.

**PURPOSE:** To assess WL and liquid ingest during classical ballet training sessions.

**METHODS:** The sample was composed of 21 ballet dancers of a dance school in Porto Alegre, whose average age was  $21.29 \pm 2.53$  years, who participated in three classical ballet training sessions. Initially, WL was evaluated in a 90-minute ballet session with no liquid reposition. Then, in two different training sessions of same duration, dancers received 1L of water or sports drinks, which were consumed *ad libitum*. Dancers body mass was measured in their underwear before and after the three ballet sessions, and different liquid's intake was measured through volume of individual consumption. The room temperature was controlled during the three training sessions, remaining between 20.9 and 22° C. Statistical data analysis was made through the Wilcoxon test, in which liquid ingestion and WL were compared.

**RESULTS:** Data are presented as median, and maximum and minimum values. The dehydration percentage during the session without liquid consumption was  $0.64\% \pm 0.49\%$ . In the session which dancers received water, the liquid intake was 376,19 mL (50-600mL) and the WL was -190g (-500 + 210g). In the session with sports drinks consumption, liquid intake was 226,19 mL (50-500 mL) and WL was -150g(-400g+800g). Significant differences were detected in liquid ingestion, but not in the WL in different sessions (respectively  $p=0.01$  and  $p=0.79$ ).

**CONCLUSION:** Classic ballet exercise induces a low level of dehydration, and dancers voluntarily drink more water than sports drinks during classical ballet training sessions.

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1716 Board #66 May 27 3:30 PM - 5:00 PM

**The Effect Of Acculturation And Socioeconomic Status On Dietary Patterns In Mexican-American Women**

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(No relationships reported)

Obesity has become epidemic among adult Hispanic women in the U.S. Currently over 75% of adult Latinas are either overweight or obese, which is partly attributable to poor dietary patterns. Although dietary patterns may be related to acculturation status, relationships have been inconsistent and are likely confounded by socioeconomic factors.

**PURPOSE:** To examine the effect of acculturation and socioeconomic status on dietary intake patterns in Mexican-American women.

**METHODS:** A community sample of 299 women (mean age = 36.0 ± 9.1 yrs; mean body mass index [BMI] = 31.0 ± 6.4) were recruited from the South Bay region of San Diego County. Participants completed an interviewer-assisted survey regarding education level, family size, household income, a short acculturation scale and a brief dietary questionnaire for Hispanics. To evaluate the combined effects of acculturation and socioeconomic status, indicators were dichotomized, and participants categorized into one of four quadrants (high/high, high/low, low/high, low/low), each reflecting a different combination of acculturation and socioeconomic status. Data were analyzed using MANCOVA to determine the effect of acculturation/socioeconomic groupings on dietary fat intake, fast food intake, and fruit and vegetable intake.

**RESULTS:** No significant differences were observed between the acculturation/socioeconomic groupings and dietary fat intake or fruit and vegetable intake. While the difference between the frequency of fast food intake per week was statistically significant between the high acculturation/above poverty group and the low acculturation/poverty group (1.18 vs. 0.99;  $P < 0.05$ ), it is doubtful this small difference has practical significance.

**CONCLUSION:** Limited evidence was found for an interaction between acculturation, socioeconomic factors and dietary intake. Relationships between acculturation, income, and fast food consumption appear complex and need further study in understanding the dietary habits of underserved populations.

Supported by a SIP 09-04 Cooperative Agreement (U48 DP000036-01S1) between the Centers for Disease Control and Prevention (CDC) and the San Diego Prevention Research Center.

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1717 Board #67 May 27 3:30 PM - 5:00 PM

**Effect Of Dash Diet On Pre- And Stage-1 Hypertensive Individuals In A Free-living Environment**

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(No relationships reported)

**BACKGROUND:** Dietary Approaches to Stop Hypertension (DASH) has been shown to successfully reduce systolic (SBP) and diastolic blood pressure (DBP) when evaluated in clinically controlled environments but little is known about the efficacy of the DASH diet when it is applied in a free-living environment.

**PURPOSE:** To determine if following the DASH diet in a free-living environment for a 4-week duration decreased SBP and DBP.

**METHODS:** Twenty, pre- and stage-1 hypertensive participants were split into 2 groups; DASH (males N = 5, females N = 5, age = 38.1 ± 11.1) and control (males N = 7, females N = 3, age = 38.5 ± 10.5). The DASH group was instructed how to follow the DASH diet on their own for a 4-week duration while the control group continued their normal diet. SBP, DBP, bodyweight, 3-day food diaries and physical activity questionnaire data were collected pre and post intervention.

**RESULTS:** Group (DASH, control) by gender (males, females) by time (pre, post-intervention) ANCOVAs, with weight change as a co-variate, demonstrated a significant group by time interaction for changes in SBP ( $p = 0.003$ ) and no significant effects for DBP. The interaction was due to a significant reduction ( $p = 0.001$ ) in SBP in DASH (pre: 141.3 ± 11.3 mmHg vs. post: 130.7 ± 9.1 mmHg) with no change in SBP in control (pre: 133.5 ± 6.6 mmHg vs. post: 131.9 ± 8.9 mmHg). Bodyweight change was entered as a covariate to ensure significant changes in SBP and DBP were independent of weight loss. Chi-square demonstrated no significant differences in the number of participants per group ( $n = 4$  DASH,  $n = 1$  control) who indicated increasing physical activity during the intervention. Group by time ANOVAs demonstrated significant interactions for K<sup>+</sup>, total and saturated fat ( $p \leq 0.02$ ). These interactions were the result of a significantly greater increase in dietary intake of K<sup>+</sup> and decrease in dietary intake of total and saturated fat ( $p \leq 0.02$ ) in DASH (D 1267.8 ± 1103.2mg K<sup>+</sup>, -68.4 ± 35.9g total fat, -22.1 ± 13.1g saturated fat) relative to control (D -40.0 ± 1103.2mg K<sup>+</sup>, -18.8 ± 19.7g total fat, -3.1 ± 10.0g saturated fat).

**CONCLUSION:** DASH diet followed in a free-living environment significantly reduced SBP independent of weight loss and without significant differences in self-reported physical activity. These changes may be due to differences in K<sup>+</sup>, total and saturated fat intake.

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**B-29 Free Communication/Poster - Obesity**

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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1718 Board #68 May 27 3:30 PM - 5:00 PM

**Contrasting Effects Of Exercise On Total And Intra-abdominal Visceral Fat**

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(No relationships reported)

Obesity is increasingly becoming a world-wide health concern leading to a variety of diseases, disorders and metabolic abnormalities such as coronary artery disease (CAD).

**PURPOSE:** To evaluate the effects of 16 weeks of endurance (ET) and concurrent endurance and resistance training (CT) on anthropometric measures of fatness in inactive males.

**METHODS:** Thirty-seven males were randomly assigned to an ET (N = 12), CT (N = 13) or non-exercising control (NE) group (N = 12). ET subjects utilized a combination of aerobic equipment, while the CT subjects utilized both endurance and whole-body resistance training in equal proportions.

**RESULTS:** While the NE group only found an unfavourable increase in the waist to stature ratio (WSR), ET improved ( $P \leq 0.05$ ) five of the six anthropometric measures of total fatness (i.e. body mass, fat mass, sum of skinfolds, percentage body fat (%BF) and body mass index) and two of the four anthropometric measures of intra-abdominal visceral fat mass (i.e. conicity index (CI) and WSR). CT resulted in an improvement in three of the six measures of total fatness (i.e. fat mass, sum of skinfolds and %BF) and all four measures of intra-abdominal visceral fat mass (i.e. CI, waist circumference, waist to hip ratio and WSR).

**CONCLUSIONS:** This study highlighted the superiority of endurance training over concurrent endurance and resistance training when assessing anthropometric indices of total fatness. However, concurrent endurance and resistance training was found to be more effective than endurance training at improving anthropometric measures of intra-

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**1719 Board #69 May 27 3:30 PM - 5:00 PM**

**Prevalence And Trends In Overweight, Obesity And Fitness In University And Government Employees.**

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( F.J. Diaz, University of Guanajuato, Salary.)

**PURPOSE:** To determine prevalence and trends in overweight, obesity, Metabolic Syndrome (MS) and Maximal Aerobic Capacity (VO2Max.) in Mexican people.

**METHODS:** Data from 761 subjects (431 men and 330 women) studied in 1997-8 were compared with another group of 769 subjects (529 men and 240 women) studied in 2007-8. All subjects were government and university employees. Prevalence of overweight was defined by Body Mass Index (BMI > 24 and < 30), obesity by BMI ≥ 30, MS equal ATP III criteria and VO2Max on a treadmill.

**RESULTS:** There were no significant differences between groups in age and height (37.5±9 vs 39.4±8 years, 164±8 vs 168±8 cms for 1997-8 and 2007-8 respectively). Subjects from 2007-8 were heavier and with higher BMI (78.3±12 vs 67.7±14 Kg. and 28±4 vs 25±4 respectively.) (p<0.05). Prevalence of overweight increased from 55 to 58% and prevalence of Obesity increased from 10 to 29% respectively. These changes were observed in both genders; although women tended to present greater changes. Prevalence of MS did not change significantly (33.6 to 32.7%). There were only two variables of MS that increased significantly; waist circumference increased from 88 to 96 cms (90 to 99 for men and 85 to 90 from women) and blood glucose also increased from 86 to 95 mg/dl. (87 to 98 for men and 82 to 90 mg/dl for women)(p<0.05). In ten years VO2Max in men decreased 5 ml\*kg/min (42.3 to 37.0 ml/kg\*min) meanwhile in women did not change significantly (30 to 32 ml/kg\*min).

**CONCLUSIONS:** These data clearly demonstrate that overweight, obesity, hyperglycemia and low cardiovascular fitness are worse than ten years ago and also are mayor problems for public health in our people. These risk factors are probably deeply related to elevated morbidity and mortality from cardiovascular diseases. We need to establish urgently program of fitness related to health.

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**1720 Board #70 May 27 3:30 PM - 5:00 PM**

**The "Fit But Fat" Concept Revisited: Population-based Estimates Using Nhanes**

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(No relationships reported)

Low cardiovascular fitness is an independent risk factor for developing type 2 diabetes and of all-cause and cardiovascular disease mortality in adults. The so-called "fit but fat" concept suggests that cardiovascular fitness attenuates risk of metabolic and cardiovascular disease independent of body mass index (BMI), even among individuals classified as obese. However, the proportion of the U.S. population that is both fit and obese is unknown.

**PURPOSE:** To estimate the proportion of U.S. adults who are clinically obese yet have a high cardiovascular fitness level, and determine the independent effect of obesity on cardiovascular fitness.

**METHODS:** Analysis of data on 4,675 adults (20-49 years) who had completed a submaximal exercise test, from the National Health and Nutrition Examination Survey (1999-2002), a cross-sectional health survey of a nationally representative sample of the non-institutionalized U.S. population. Cardiovascular fitness and body weight were expressed as continuous (estimated VO<sub>2max</sub> [ml\*kg<sup>-1</sup>\*min<sup>-1</sup>] and BMI [kg/m<sup>2</sup>]) and categorical variables (low, moderate, and high cardiovascular fitness level; and normal weight, overweight, and obese), the latter using sex and age-specific criteria established in the Aerobic Center Longitudinal Study and standard BMI cut-points, respectively.

**RESULTS:** The prevalence of meeting the "fit but fat" definition among U.S. adults aged 20-49 was 8.9% (95% C.I. = 6.9-10.9%). The proportion of low, moderate, and high cardiovascular fitness differed significantly (P < 0.05) by body weight category. Overall, 8.9% were obese and had a high cardiovascular fitness level, 17.4% were overweight and high fit, and 30% were normal weight and high fit. In multiple regression, obesity was associated with a 9.2% lower estimated VO<sub>2max</sub> compared to a normal weight adult, controlling for age, sex, race, and income.

**CONCLUSION:** A small proportion of U.S. adults can be considered "fit but fat", and obesity is significantly and independently associated with reduced cardiovascular fitness. These results suggest that obese adults in the U.S. population may be at increased health risk due to low cardiovascular fitness.

Analyses Supported by U01CA114642.

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**1721 Board #71 May 27 3:30 PM - 5:00 PM**

**The Effect Of Percent Body Fat On Mets During Self-paced Activities Of Daily Living**

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(No relationships reported)

Activities of daily living (ADLs) are examples of lifestyle activities that can be performed at a moderate intensity to achieve physical activity recommendations. However, previous data suggest that obese individuals do not consistently perform ADLs at a moderate intensity. Variability in the self-selected intensity of performing ADLs needs further investigation in order to include them as examples of moderate intensity activities in the physical activity guidelines for the general public.

**PURPOSE:** To determine the effect of percent body fat on oxygen consumption and corresponding metabolic equivalents (METs) during self-paced ADLs in women.

**METHODS:** Forty-three healthy women (normal weight, < 30 % body fat, n=23; overweight/obese, ≥ 30% body fat, n = 20) between the ages of 30-60 completed a series of self-paced ADLs that were seven minutes in duration. ADLs were grouped into intensity categories (moderate = 3-6 METs, vigorous > 6 METs). Oxygen consumption was measured with a portable indirect calorimeter for each activity. To evaluate the relationship between percent body fat group and METs during ADL, a two-way repeated measures analysis of variance (RMANOVA) was performed.

**RESULTS:** The mean +/- SD percent body fat for the normal weight and overweight/obese groups were 23.7 ± 5.25 and 38.9 ± 6.40, respectively. The mean MET levels reported for moderate ADLs were > 3 METs for both normal weight and overweight/obese groups (4.5 METs ± 0.11 vs. 3.7 METs ± 0.15, respectively). However, the overweight/obese group performed moderate and vigorous ADL's at a significantly lower intensity compared to the normal weight group (moderate= 15% lower, p < 0.001; vigorous = 17.8% lower, p = 0.001).

**CONCLUSION:** Both normal weight and overweight/obese women performed self-paced ADLs at a moderate intensity. Although the overweight/obese group performed ADLs at a lower absolute intensity compared to their normal weight counterparts, the mean MET level was above the lower boundary for moderate intensity activities. The promotion of self-paced ADLs may be a successful and achievable strategy for increasing physical activity among overweight/obese women, a population at risk for chronic diseases.

Supported by NIH RO1 CA121005

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**1722 Board #72 May 27 3:30 PM - 5:00 PM**

**Discrepancy Between The IOTF-BMI Criteria And The Body Fat Criteria For Classifying Chinese Childhood Obesity**

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(No relationships reported)

Age and gender specific body mass index (BMI) cut-off criteria for screening overweight and obese children has been introduced by the International Obesity Task Force (IOTF) (Cole, 2000), and has been claimed to be appropriate for Asian children. This children specific BMI criteria was developed from extrapolating the adult BMI of 25 (overweight) and 30 (obesity) to the children's BMI distribution. Its sensitivity to identify %fat-determined overweight and obesity in Chinese children is unknown.

**PURPOSE:** To evaluate the association between BMI and %fat in Chinese children and to examine the sensitivity of the IOTF-BMI criteria for screening overweight and obese children as compared to %fat criteria.

**METHODS:** A heterogeneous sample of Chinese children (N=230; BMI=13.9-37.4; Age=9-19 yrs-old) was recruited to participate in measurement of height and weight, and body fat criterion using Plethysmography (Bod-Pod). The sample was then screened for overweight and obesity using both the IOTF-BMI criteria and the %fat criteria (overweight: 25%fat for boys, 30%fat for girls; obesity: 30%fat for boys, 35%fat for girls). Difference in prevalence of overweight and obesity was compared by chi-square test. Moreover, regression equations were developed to estimate %fat from BMI and age. Using IOTF-BMI cut-off values, estimated %fat was computed using the developed equations and to compare with the measured %fat.

**RESULTS:** Using the IOTF BMI criteria, the prevalence of overweight and obesity in this sample was 20% and 6% respectively; versus the %fat determined overweight and obesity prevalence was 27.8% and 15.7%, respectively. Significant differences existed ( $p<.05$ ). From the regression analysis, mean %fat estimated from IOTF-BMI<sub>(overweight)</sub> was 23.6% for boys and 31.9% for girls; whereas mean %fat estimated from IOTF-BMI<sub>(obese)</sub> was 32.2% for boys and 40.1% for girls, which yielded large discrepancies with the %fat criteria for overweight and obesity ( $p<.05$ ). It is also noted that the predicted %fat decreases linearly as age increases in boys, whereas predicted %fat increases curvilinearly as age increases in girls.

**CONCLUSION:** There is a lack of sensitivity of IOTF-BMI criteria for screening obese Chinese children. The use of IOTF-BMI criteria as a screening tool for obesity of Chinese children is questioned.

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**1723 Board #73 May 27 3:30 PM - 5:00 PM**  
**Self Reported Weight Category Vs. Actual Weight Category Within College-aged Students**

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Determining the most appropriate standard to measure body composition in the young adult population (18-20 yrs) may lead to more accurate classification of weight category and awareness of health status.

**PURPOSE:** To examine weight category (WC) classifications, body mass index (BMI) and percent body fat (%BF), and compare actual to perceived WC in young adults.

**METHODS:** 121 male and 162 female students from a Midwestern university were assessed for BMI and %BF via standard procedures. Subjects in the 95<sup>th</sup> percentile or higher (BMI) for age and sex were classified as obese. A questionnaire elicited self-reported and peer perceptions of WC.

**RESULTS:** Subjects were classified as overweight (OW) or obese (OB) based on BMI or %BF. BMI results for men were 13.2% OW and 18.2% OB; 24.8% OW and 7.4% OB using %BF. For women BMI values were 11.7% OW and 8.0% OB and 43.8% OW and 16.7% OB using %BF method. Men more accurately self reported WC regardless of BMI or %BF classification. 34.7% self categorized as OW/OB similar to BMI (37.3%) and %BF (38%) results. Women were not as accurate, with 39.9% self categorizing as OW/OB, lower than BMI (44.7%) or %BF (62%) findings. Regardless of sex, OB individuals indicated that their peers would view them as obese, but the OW were less likely to think their peers would categorize them OW.

**CONCLUSION:** Current methods of weight categorization appear to misclassify college men and women. Using an appropriate standard to classify this population into weight categories is important when addressing risk factors associated with body composition. The young adult population can modify lifestyle behaviors to maintain health by utilizing appropriate classifications and increasing awareness of suitable body composition values.

*Acknowledgements: Supported by a grant from Indiana University Residential and Programs and Services.*

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**1724 Board #74 May 27 3:30 PM - 5:00 PM**  
**On Campus Living Decreased Body Weight In Hispanic Female During College Freshman Year.**

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It is known that the freshman year of college is a critical period for weight gain and also behavioral patterns such as unhealthy diet and physical inactivity obtained during this period may contribute to overweight and obesity after graduation.

**PURPOSE:** To examine changes in body weight, body composition and diet pattern in Hispanic female during freshman year in the college.

**METHODS:** 43 Hispanic women (19 on campus living and 24 off campus living) in college freshman year participated in this study and completed two test sessions held at the beginning and end of freshmen year. In each session, participants completed three day diet log and health screening test including height, weight, body mass index (BMI), waist-hip ratio, % body fat, blood glucose and cholesterol. Level of physical activity measured using a pedometer was only taken at the end of freshmen year. Diet pattern was analyzed using Diet Power program (Danbury, CT).

**RESULTS:** From students living on campus, we observed decreased level of cholesterol (177mg/dL $\pm$ 6.1(SE) vs. 131 $\pm$ 3.7,  $p<.05$ ), body weight (140 lbs $\pm$ 3.1 vs. 131 $\pm$ 3.2,  $p<.05$ ), and daily caloric intake (1724 $\pm$ 10582 kcal/day vs. 1366 $\pm$ 55,  $p<.05$ ). BMI, waist-hip ratio, and %body fat were also slightly decreased but not significantly. We could not see any significant difference from students living off campus except decreased cholesterol level (161 $\pm$ 5.8 vs. 133 $\pm$ 4.1). Daily caloric intake was increased in this population but not significantly (1384 $\pm$ 108 vs. 1569 $\pm$ 103). Furthermore, level of physical activity was significantly higher in students living on campus as compared to students living off campus (89,600 $\pm$ 18,930 steps/week vs. 41,700 $\pm$ 5720;  $p<.05$ ).

**CONCLUSIONS:** We concluded that Hispanic female students don't gain body weight during freshman year. Results indicate that on campus living induces decrease in daily caloric intake and increase in level of physical activity in Hispanic female students during freshman year. Students living on campus may have difficulty to have food other than during University dining hours. Students who commute may experience lack of physical activity as opposed to students living on campus who walk to campus and have easy access to exercising facilities on campus.

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**1725 Board #75 May 27 3:30 PM - 5:00 PM**  
**Body Composition And Cardiovascular Risk Factors Within College-aged Students**

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Identifying cardiovascular risk factors (CRF) in the young adult population (18 - 20 years) may lead to a delay of adult-onset cardiovascular disease.

**PURPOSE:** To examine the prevalence of CRF within the college-aged population and describe the relationship between CRF and body composition measures.

**METHODS:** 57 male and 81 female students from a Midwestern university were assessed. Body mass index (BMI), percent body fat (%BF), waist circumference (WC), and waist-to-hip ratio (WHR) were determined via standard procedures. Subjects in the 95<sup>th</sup> percentile or higher (BMI) for age and sex were classified as obese. Serum lipid profile (TC, HDL, LDL, TG) and glucose were determined following a 12-hr fast. The number of cardiovascular risk factors was determined utilizing American Heart Association (AHA) standards. An ANOVA was performed to examine sex differences in the variables studied.

**RESULTS:** Men had significantly higher BMI ( $24.0 \pm 3.4$ ;  $22.9 \pm 2.9$ ), WC ( $81.8 \pm 8.3$ cm;  $73.6 \pm 7.5$ cm), WHR ( $0.85 \pm 0.05$ ;  $0.78 \pm 0.06$ ) and lower %BF ( $13.7 \pm 6.2$ ;  $25.3 \pm 6.7$ ) compared to women. Women had significantly higher TC ( $173.8 \pm 33.4$  mg-dl<sup>-1</sup>;  $157.2 \pm 28.8$  mg-dl<sup>-1</sup>) and HDL ( $62.3 \pm 13.7$  mg-dl<sup>-1</sup>;  $54.9 \pm 11.9$  mg-dl<sup>-1</sup>) as compared to men. Low HDL levels were found in 25.4% of the population, followed by high TC (18.1%), TG (13%), and LDL (8%). According to AHA standards, 63% of students had at least 1 CRF, with 26% having 2 CRF, and 13% with  $\geq 3$  CRF. A significant ( $p < 0.01$ ) correlation was noted between WHR and all of the lipid values for men. For women, only HDL demonstrated a significant correlation with body composition measures (BMI, - 0.38; WC, - 0.34; %BF, - 0.23).

**CONCLUSION:** The occurrence of CRF in the young adult population predisposes them to elevated risk of cardiovascular disease (CVD) in adulthood. Efforts to encourage young adults to monitor, achieve and maintain optimal CRF levels might lead to a decreased risk for CVD in mid life. These findings reinforce the importance of lifelong health behaviors which may be established during the transition from adolescence to adulthood.

Supported by a grant from Indiana University Residential and Programs and Services.

1726 Board #76 May 27 3:30 PM - 5:00 PM

### Body Mass Index And Physical Activity As Predictors Of Mortality In Adult Women

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**PURPOSE:** Physical inactivity and obesity may be independently related to all cause and cardiovascular mortality. As these conditions continue to increase in the population it is important to assess the independent effect they have in women and other segments of the population that may be disproportionately affected by them. Therefore, the purpose of this study is to examine the effects of body mass index (BMI) and leisure time physical activity (LTPA) on all cause and cardiovascular mortality using a nationally representative sample of Non-Hispanic White, Non-Hispanic Black, and Mexican American women.

**METHODS:** This study uses data from the NHANES III conducted between 1988 and 1994 and the mortality follow up (2002) in adults 20+ yrs/old. Anthropometric measurements were obtained at a mobile examination center and leisure time physical activity was obtained via a questionnaire. Other covariates analyzed were age, education, smoking, and presence of chronic disease conditions. SAS and SUDAAN software programs were used estimate relative risk of mortality and to take into account the complex sample design.

#### RESULTS:

Relative Risk ratio with 95% confidence interval of all cause mortality among non-Hispanic White, non-Hispanic Black and Mexican American women, 20 yrs and older.

	Non-Hispanic White		Non-Hispanic Black		Mexican American	
	BMI no PA	BMI with PA	BMI no PA	BMI with PA	BMI no PA	BMI with PA
Women						
Normal weight	1.0	1.0	1.0	1.0	1.0	1.0
Overweight	1.05 (0.83-1.31)	1.50 (0.84-1.32)	0.96 (0.67-1.39)	0.94 (0.64-1.37)	1.23 (0.80-1.89)	1.22 (0.80-1.87)
Obese	1.26 (1.00-1.59)	1.20 (0.96-1.49)	0.98 (0.70-1.39)	0.95 (0.68-1.32)	1.20 (0.84-1.70)	1.14 (0.79-1.64)
Physical Activity						
Frequent Active*		1.0		1.0		1.0
Infrequent Active**		1.16 (0.91-1.47)		1.10 (0.69-1.74)		1.16 (0.60-2.22)
Sedentary***		1.92 (1.55-2.39)		2.06 (1.33-3.20)		1.74 (1.10-2.76)

\* 5+ times per week \*\*1-4 times per week \*\*\* < 1 time per week

**CONCLUSION:** Sedentary behavior was an independent predictor of all cause mortality and cardiovascular mortality. Overweight status in women was not a predictor of all-cause mortality or cardiovascular mortality with physical activity or without physical activity in the model. Subsequent statistical analysis, including the combination of BMI and waist-to-hip ratio (WHR) and the division of obesity into categories (Obesity I, II, III) did not alter our findings.

1727 Board #77 May 27 3:30 PM - 5:00 PM

### Traditional And Nontraditional Cardiorespiratory Fitness, Percentage Body Fat And All-cause Mortality In Women

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(No relationships reported)

**PURPOSE:** Low cardiorespiratory fitness (CRF) is inversely associated with mortality. Most previous studies have assessed CRF in ml/kg/min which accounts for body weight, and does not distinguish between fat free mass and fat mass. We investigated the independent and joint associations of two measures of CRF (ml/kg/min vs. ml/kg



FFM/min) and percentage body fat on all-cause mortality in women.

**METHODS:** We followed 10,259 women (age  $43.2 \pm 10.3$  y, % body fat  $26.7 \pm 7.0$  %), who completed a baseline maximal treadmill exercise test and percentage body fat measures during 1974-2003, for an average of  $14.5 \pm 7.6$  y follow-up. Mortality surveillance was completed through December 31, 2003. CRF was reported using traditional (ml/kg/min) and non-traditional methods (ml/kg FFM/min) and both exposures were grouped into tertiles. The lowest third was defined as unfit and the upper two thirds as fit. Percentage body fat was categorized to normal fat ( $<30\%$ ) and overfat ( $\geq 30\%$ ). Cox regression analyses were used to estimate relative risks (RRs) and 95% confidence intervals (CIs).

**RESULTS:** We identified 304 deaths during the 148,322 woman-yr of observation. Middle and high tertiles of traditional CRF (ml/kg/min) showed 21% (95% CI: 0.60-1.03) and 32% lower risk (95% CI, 0.50-0.93) for all-cause mortality after multivariable adjustments (age, examination year, smoking status, alcohol drinks, chronic diseases, and family history of CVD) compared with low CRF, respectively ( $P$  trend=0.03). After adjusting for the same variables, a 24% (95% CI: 0.58-1.00) and 27% (95% CI: 0.54-0.99) all-cause mortality risk reduction was observed using the non-traditional CRF (ml/kg FFM/min) method. Additional adjusting for percentage body fat did not materially change the results. Over-fat women had a 32% higher risk (95% CI, 1.04-1.67) of death when comparing with normal fat individuals. This relationship was no longer significant after further controlling for CRF. Unfit over-fat women were at the highest risk of death compared to fit and normal fat women, regardless of CRF method used.

**CONCLUSIONS:** Fitness was inversely associated with all-cause mortality in women even after adjusting for adiposity. The two CRF methods (ml/kg/min and ml/kg FFM/min) were similar in their association with all-cause mortality.

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**1728 Board #78 May 27 3:30 PM - 5:00 PM**  
**Associations Between Anthropometrics, Adiposity And Mortality In Individuals With A History Of Weight Cycling**

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**Background:** The cycling of body weight is associated with increased weight gain (Van wye et al., 2007) as well as changes in body composition (Manore et al., 1991) and fat distribution (Rodin et al., 1990). Although some studies have found negative metabolic effects (Vergnaud et al., 2008) and increased mortality risk (Folsom et al., 1996) consequent to weight cycling, others do not (Montani et al., 2006). Thus, whether individuals with a history of weight cycling are at increased adiposity or elevated health risk for a given body weight requires further study.

**PURPOSE:** To quantify the impact of weight cycling on body composition and investigate its effects on the relative risk of cardiovascular disease (CVD) and all-cause mortality.

**METHODS:** Data from the Women's Health Initiative (WHI) observational study was obtained from the NHLBI (N=5675; age 50 - 79 y) and used for the analysis. Participants were classified as weight cyclers (WgtC; 37%) if they had reported that their weight had gone up and down by  $\geq 10$ lb. Multiple linear regression was used to quantify the relationship between waist circumference (WC; cm), % body fat (%BF - assessed by dual energy x-ray absorptiometry), and body mass index (BMI;  $\text{kg}\cdot\text{m}^{-2}$ ). To assess subsequent risk of mortality, Cox regressions were used to examine the effect of weight cycling for a given BMI, %BF or WC, adjusting for age, physical activity, and dietary fat consumption.

**RESULTS:** For a given BMI, %BF and WC were higher in WgtC than non-WgtC ( $P<0.001$ ). Similarly, risk for all-cause mortality was significantly higher in WgtC as compared to non-WgtC for a given BMI (HR: 1.21, 95% CI: 1.01-1.46), but not WC (HR: 1.19, 95% CI: 0.99-1.42). Alternatively, CVD mortality risk was not different between WgtC and non-WgtC for a given BMI (HR: 1.31, 95% CI: 0.94-1.83) or WC (HR: 1.31, 95% CI: 0.94-1.83). With respect to %BF, risk for both all-cause and CVD mortality was higher in WgtC versus non-WgtC (HR: 1.32, 95% CI: 1.09-1.58; HR: 1.57, 95% CI: 1.12-2.18, respectively). Implications: For a given BMI, women with a history of weight cycling have a higher %BF and WC. As weight cycling is associated with a higher risk of CVD and all-cause mortality even after adjusting for increased adiposity, these results have implications for the prediction of health risk within current obesity management guidelines.

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**1729 Board #79 May 27 3:30 PM - 5:00 PM**  
**Association Between Adiposity And The Development Of Hypertension In Men**

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**PURPOSE:** General obesity is a major risk factor for the development of hypertension (HTN). It is not well-studied whether central obesity and fat distribution are also related to the future HTN.

**METHODS:** 13,925 healthy normotensive men aged 20-100 years completed a baseline examination during 1976-2004, and were followed for HTN incidence. Incident HTN was identified via follow-up mail-back surveys. Obesity was defined as Body mass index (BMI)  $\geq 30 \text{ kg/m}^2$ , waist circumference (WC)  $\geq 102 \text{ cm}$ , and percent body fat  $\geq 25\%$ .

**RESULTS:** A total 1,697 men reported HTN during a mean 15.5 years of follow-up. We observed a positive gradient ( $p$  trend  $< .0001$ ) of HTN incidence rates across incremental fifths of BMI, WC, and percent body fat groups. After adjusting for potential confounders, higher baseline BMI, WC, and percent body fat was associated with greater risk of developing HTN, respectively ( $p$  trend  $< 0.0001$  for each). Additional adjusting for the other adiposity factors did not alter the relationships significantly ( $p$  trend  $< 0.01$  for each). When adiposity factors were grouped based on the clinical cutpoints, HTN incidence risk was significantly higher in BMI-defined overweight (HR, 1.53; 95% CI, 1.38-1.70) and obese (HR, 2.16; 95% CI, 1.84-2.53) compared with normal weight men; in WC-defined abdominal obese (HR, 1.61; 95% CI, 1.06-2.43) compared with normal WC men; in percent body fat-defined obese (HR, 1.47; 95% CI, 1.32-1.65) compared with normal percent body fat men, respectively. After further adjustment for the other adiposity measures, the direct association between BMI and HTN attenuated, but remained statistically significant ( $p$  trend = 0.004). However, the associations between abdominal obesity and HTN, and between percent body fat-defined obesity and HTN were no longer significant ( $p$  trend  $> 0.05$ , for each).

**CONCLUSION:** We conclude that the risk for HTN may be better identified by obesity defined by higher BMI than higher WC or higher percent body fat.

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**1730 Board #80 May 27 3:30 PM - 5:00 PM**  
**The Association Of Abdominal Obesity With Endothelial Function In Adults With Type 2 Diabetes**

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**PURPOSE:** Obesity is associated with impaired endothelial function, an early marker of cardiovascular disease. Mounting evidence suggests that abdominal obesity is especially harmful to cardiovascular health. We evaluated the relationship between general and abdominal obesity with endothelial function in persons with type 2 diabetes.

**METHODS:** 107 non-smoking, sedentary persons with type 2 diabetes controlled by diet or oral medication, aged 45-65 years old, with mild hypertension, were examined at baseline after being recruited for an exercise trial. Body mass index (BMI) was used as a measure of general obesity. Abdominal subcutaneous and visceral fat were assessed by magnetic resonance imaging. Endothelial function was measured by maximal flow-mediated dilation (FMD) of the brachial artery in response to reactive hyperemia following 5 minutes of upper arm occlusion. Bootstrap linear regression was used to assess the association of measures of obesity with FMD.

**RESULTS:** The mean (SD) age was 60.0 (5.8) years and 64% of participants were men. Mean HbA1c was 6.2% and mean BMI was 32.5 (4.3) kg/m<sup>2</sup>. Mean subcutaneous and visceral fat were 384 (121) cm<sup>2</sup> and 165 (74) cm<sup>2</sup>, respectively. Mean FMD was 5.7% (3.8%). BMI was correlated with subcutaneous ( $r=0.79, p<0.001$ ) and visceral ( $r=0.36, p<0.001$ ) abdominal fat. In a multivariate regression model with adjustment for baseline brachial artery diameter, age, and gender, we found that a -1% difference in FMD was somewhat associated with each additional 9.1 kg/m<sup>2</sup> of BMI ( $p=0.19$ ) and each additional 208 cm<sup>2</sup> of abdominal subcutaneous fat ( $p=0.16$ ). However, a -1% difference in FMD was significantly associated with each additional 91 cm<sup>2</sup> of visceral fat ( $p=0.036$ ).

**CONCLUSIONS:** Among those with type 2 diabetes, greater visceral abdominal obesity, rather than general obesity and subcutaneous fat, was associated with impaired FMD. Because of the prognostic importance of impaired endothelial function on cardiovascular health, these data suggest that strategies designed to reduce abdominal visceral fat loss need to be incorporated into preventive treatments for cardiovascular risk reduction in persons with diabetes.

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1731    **Board #81    May 27    3:30 PM - 5:00 PM**

**Combined Effects Of Cardiorespiratory Fitness, Not Smoking, And Normal Waist Girth On Morbidity And Mortality.**

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(No relationships reported)

Physical inactivity, cigarette smoking, and obesity are key modifiable risk factors for coronary heart disease (CHD). Little is known about the relations between these combined risk factors and incident CHD and mortality.

**PURPOSE:** We investigated the combined effects of cardiorespiratory fitness, not smoking, and normal waist girth on incident CHD and mortalities from cardiovascular disease (CVD), cancer, and all causes in men.

**METHODS:** We followed 40,397 men, ages 20-79 yr, who completed a medical evaluation including a maximal treadmill exercise test and self-reported health habits at baseline examination. We defined a low-risk profile as not smoking, moderate- or high-fitness, and normal waist girth (<94 cm), respectively. The combined low-risk group was defined as satisfying all three above factors. There were 1,147 incident CHD (fatal and nonfatal CHD events) and 2,682 deaths (862 CVD, 985 cancers, and 835 others) during an average of 17.8 yr of follow-up (717,404 man-yr).

**RESULTS:** After adjustment for age, examination year, alcohol intake, and family history of CHD, men who were at low-risk for these 3 factors had 70% lower risk of incident CHD (95% CI: 57%, 79%), 84% lower risk of CVD mortality (95% CI: 77%, 89%), 72% lower risk of cancer mortality (95% CI: 58%, 81%), and 75% lower risk of all-cause mortality (95% CI: 69%, 80%), respectively, as compared with men who had none of these low-risk factors (all  $p$  for trend <0.001). Associations persisted after additional adjustment for hypertension, diabetes, and high cholesterol (all  $p$  for trend <0.001). The CHD events in this population might have been reduced by 20% (95% CI: 11%, 29%) if they had been physically fit, not smoking, and had normal waist girth. Men with all three exposures had 2.2 times the risk of CHD (95% CI: 1.52, 3.09  $p<0.001$ ) compared with men with none of these risk factors. This was equivalent to being 10.4 years older in chronological age.

**CONCLUSIONS:** Moderate and high levels of cardiorespiratory fitness, not smoking, and normal waist girth are associated with a reduced risk of incident CHD and much lower mortality from CVD, cancer, and all causes in men.

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1732    **Board #82    May 27    3:30 PM - 5:00 PM**

**Relation Between Muscular Strength and the Prevalence of Obesity: A Cross Sectional Analysis**

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Recent physical activity recommendations have included resistance training due to positive effects of increased muscular strength (MS), lean body mass and resting metabolic rate, and reduction in percent body fat (PFAT). The research that supports these recommendations tends to be of limited duration with little information on MS relations with health-related body composition parameters.

**PURPOSE:** To determine the relations between MS and the prevalence of indicators of obesity as measured by PFAT and waist girth (WG).

**METHODS:** The participants were men ( $n = 3,258$ , age range = 20 - 79 yrs) from the Aerobics Center Longitudinal Study that completed clinical examinations at The Cooper Clinic in Dallas, TX between 1980 and 1989. During the exam, PFAT, estimated through skinfold or hydrostatic weighing techniques, and WG were measured. Participants were considered to have excessive body fat (EBF) if PFAT was  $\geq 25\%$  and excessive abdominal fat (EAF) if WG > 102cm. The participants completed a treadmill test to estimate cardiorespiratory fitness (CRF) and 1 repetition maximums of the bench press and leg press on rack mounted weight equipment as measures of MS. An index of MS was calculated, which combined the two MS tests after controlling for age and body weight. The MS was then divided into quintiles (Q1 lowest - Q5 highest). Logistic regression was used to model the MS relations with EBF and EAF controlling age, body weight, smoking status, and CRF and produce relevant odds ratios (OR).

**RESULTS:** Prevalence (%) of EBF and EAF, respectively, were Q1 (27, 15.2), Q2 (18, 11), Q3 (15, 9), Q4 (12, 10), and Q5 (8, 9). There was a strong inverse gradient ( $p<.001$ ) between quintiles of MS and EBF with Q1 as the referent, ORs (95% CIs) were 0.55 (0.39-0.78) in Q2, 0.47 (0.32-0.68) in Q3, 0.33 (0.23-0.48) in Q4, and 0.19 (0.12-0.29) in Q5. A significant inverse gradient ( $p<.01$ ) between MS and EAF was present but only the OR (0.32, 95% CI = 0.18-0.59) for Q5 was significantly lower than Q1.

**CONCLUSION:** MS demonstrated a significant inverse gradient with two indicators of obesity, EBF and EAF. This association was present after controlling important confounders including CRF and supports the use of resistance training to increase strength, lean body mass, resting metabolic rate and improve health-related body composition.

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1733    **Board #83    May 27    3:30 PM - 5:00 PM**

**An Inverse Gradient Between Muscular Strength And The Incidence Of Obesity: A Prospective Analysis**

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(No relationships reported)

Resistance training to increase muscular strength (MS), lean body mass, and resting metabolic has been recommended to aid in weight loss and maintenance programs.

**PURPOSE:** To determine the relations between MS and the incidence of two indicators of obesity, excessive body fat (EBF) and abdominal fat (EAF).

**METHODS:** The participants were men ( $n = 2,623$ , age range = 20 - 79 yrs) from the Aerobics Center Longitudinal Study that completed at least two or more (baseline, follow-ups) clinical examinations at The Cooper Clinic in Dallas, TX between 1980 and 2006. At baseline, estimates of percent body fat (PFAT) were gathered from skinfold or hydrostatic weighing methods with PFAT  $\geq 25\%$  indicating EBF. Measured waist girths (WG) >102 cm indicated EAF. Participants completed a treadmill test to estimate cardiorespiratory fitness (CRF) and two tests of muscular strength (MS), 1 repetition maximums of the bench press and leg press on rack mounted weight equipment. An index of MS was calculated, which combined the two MS tests after controlling for age and body weight. The MS was then divided into quintiles (Q1 lowest - Q5 highest). At baseline, all participants had measures of PFAT and WG below the standards for EBF and EAF set for the study. PFAT and WG were again measured in follow-up clinical exams to determine if EBF and EAF were present. Cox proportional hazards regression analysis was used to model the MS relations with EBF and EAF controlling age, body weight, smoking status, and CRF and produce relevant hazard ratios (HR).

**RESULTS:** There was a strong inverse gradient ( $p<.001$ ) between quintiles of MS and EBF with Q1 as the referent, HRs (95% CIs) were 0.57 (0.44-0.73) in Q2, 0.58 (0.45-0.75) in Q3,

0.42 (0.32-0.55) in Q4, and 0.28 (0.20-0.37) in Q5. A significant inverse gradient ( $p<.001$ ) between MS and EAF was present with HRs (95% CIs) of 0.73 (0.48-1.10) in Q2, 0.60 (0.39-0.93) in Q3, 0.55 (0.36-0.85) in Q4, and 0.35 (0.22-0.54) in Q5. Incidence rates per 1,000 man-years adjusted for age and body weight (EBF, EAF) were Q1 (50.1, 17.6), Q2 (28.0, 12.5), Q3 (26.2, 9.7), Q4 (19.5, 9.5), and Q5 (11.5, 5.5).

**CONCLUSIONS:** In adult men, MS demonstrated a strong inverse gradient with the incidence of two indicators of obesity, EBF and EAF. Resistance training to increase MS should be considered for obesity prevention.

**1734 Board #84 May 27 3:30 PM - 5:00 PM**  
**Fitness, Fatness And Cancer Mortality. Prospective Study Of Japanese Men**

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 (No relationships reported)

Limited data are available on the relationship between fitness, fatness and cancer mortality.

**PURPOSE:** To investigate the influences of fitness and fatness on cancer mortality among Japanese men.

**METHODS:** We evaluated fitness (cardiorespiratory fitness: CRF) and fatness (percentage of body fat: %FAT) in relation to cancer mortality in 9,039 healthy Japanese men (Age: 19-59 yr). These men completed a submaximal exercise test, a medical examination, and questionnaires on their health habits between 1982 and 1988. CRF and %FAT were estimated using a cycle ergometer test and skin fold measurements. Men were divided into tertiles based on CRF and %FAT. The mean follow-up period was more than 18 years (165,468 man-years of observation). There were 148 cancer deaths during follow-up.

**RESULTS:** Relative risks (RR) and 95% confidence intervals (95% CI) for cancer mortality were obtained using the Cox proportional hazards model while adjusting for age, systolic blood pressure, cigarette smoking, and alcohol intake. Using the least fit group (first tertile) as reference, the RR and 95% CI for second tertile and third tertile were 0.60 (0.41-0.88) and 0.60 (0.37-0.99) ( $p$  for trend=0.010). Also, using the lean group (first tertile) as reference, the RR and 95% CI for second tertile and third tertile were 0.98 (0.66-1.44) and 1.02 (0.69-1.52) ( $p$  for trend=0.926). Moreover, we calculated RR for cancer mortality according to groups of men cross-tabulated by tertile of %FAT and "Unfit group" (first tertile) and "Fit group" (second and third tertiles) (Table).

**CONCLUSION:** These results suggest that low CRF is a risk factor for cancer mortality in Japanese men which was present in the low fatness and high fatness categories.

	Low-%FAT(7-12%)	Mid-%FAT(13-15%)	High-%FAT(16-40%)
Fit	1 (reference)	1.12 (0.65-1.94)	0.87 (0.44-1.75)
Unfit	2.04 (1.20-3.47)	1.46 (0.86-2.48)	1.64 (0.99-2.71)

**1735 Board #85 May 27 3:30 PM - 5:00 PM**  
**Increased Daily Physical Activity Contributes To Weight Reduction During An Exercise Program In Obese Men**

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**PURPOSE:** To investigate the influence of physical activity (PA) during days when not participating in a supervised exercise class (Ex-CL) on weight reduction.

**METHODS:** Twenty one Japanese obese men (body mass index:  $30.1 \pm 4.8$  kg/m<sup>2</sup>,  $52.9 \pm 9.3$  years) performed 90-min exercise sessions on 3 days per week for 12 weeks. They were also urged to self-initiate increases in PA during daily living. The amount of PA above an intensity of 3 metabolic equivalents (METs) was measured using a triaxial accelerometer which could classify PA to locomotive or lifestyle activity. Participants wore the accelerometer constantly for 2 weeks prior to and during the entire exercise program. PA was expressed as METs and multiplied by activity time (METs-h). A 3-day food record was used to estimate energy intake (EI).

**RESULTS:** EI remained unchanged during the exercise program (from  $2069 \pm 367$  to  $2022 \pm 336$  kcal/day). During non-Ex-CL days, the amount of lifestyle activity remained unchanged (from  $1.0 \pm 0.6$  to  $1.0 \pm 0.6$  METs-h/day) but locomotive activity increased (from  $2.4 \pm 1.8$  to  $3.8 \pm 2.5$  METs-h/day,  $P < 0.05$ ). There was also a relationship between change (D) in PA during non-Ex-CL days and D in weight ( $r = -0.70$ ,  $P < 0.01$ ), although no relationship was observed between D in PA during Ex-CL days and D in weight ( $r = -0.36$ ,  $P = 0.11$ ).

**CONCLUSIONS:** The increase in PA appears to be due to locomotive activity and not lifestyle activity in men. These results suggest that increased PA during non-Ex-CL days strongly contributes to weight reduction during an exercise program.

**1736 Board #86 May 27 3:30 PM - 5:00 PM**  
**High Fatness And Low Fitness Are Associated With Elevated Serum Vaspin Level In Young Korean Adults**

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Visceral adipose tissue-derived serine protease inhibitor (vaspin) is a novel adipocytokine with insulin-sensitizing effects that may have some critical roles in the development of obesity, and insulin resistance, and type 2 diabetes.

**PURPOSE:** To investigate if body fatness and fitness are associated with serum vaspin levels in Korean adults.

**METHODS:** In a cross-sectional study, we examined 396 young Korean men (age,  $23.8 \pm 2.5$  years; BMI,  $23.2 \pm 2.8$  kg/m<sup>2</sup>) who were recruited from our institute. Body fatness and fasting levels of serum insulin, adiponectin, and vaspin were measured. Cardiorespiratory fitness (CRF) was quantified as minute volume of oxygen consumption (VO<sub>2</sub>) measured during a graded treadmill test. In the present analyses, we assigned individuals to either lowest, middle, and top third CRF tertiles based on age-adjusted VO<sub>2</sub>max values or lean weight (LEAN) and obese (OB) groups based the BMI criterion (BMI = 25 kg/m<sup>2</sup>) for Pacific-Asian obesity.

**RESULTS:** In the total study population, serum vaspin was positively associated with BMI ( $R=0.139$ ,  $P=0.003$ ) and waist circumference ( $R=0.116$ ,  $P=0.021$ ) and inversely associated with CRF ( $R=-0.103$ ,  $P=0.040$ ). Further, the OB group had significantly higher serum vaspin ( $P=0.030$ ), insulin ( $P<0.001$ ), and homeostasis model assessment insulin resistance ( $P<0.001$ ) along with a lower adiponectin ( $P=0.043$ ) than the LEAN group in the low CRF tertile only, but not in either middle or top CRF tertile.

**CONCLUSION:** The current findings of the study suggest that both body fatness and fitness may modulate serum vaspin levels in young Korean adults.

**1737 Board #87 May 27 3:30 PM - 5:00 PM**

**Gender And Body Mass Index Related Differences In Predictors Of Physical Activity Among White Collar Workers**

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Understanding the correlates of physical activity (PA) in a worksite setting is crucial for developing interventions tailored to the needs of that group.

**PURPOSE:** To determine PA correlates and its predictors among white-collar workers. **METHOD:** 320 white-collar workers (124 women, 196 men) participated in this study (25-65 years old;  $M$  age=43±8.3). Questionnaires were completed with items including PA (Baecke PA Questionnaire), stress, self-efficacy (SE), and dietary habits. Simultaneous multiple regression analyses were stratified by gender and body mass index (BMI) and adjusted for age. BMI categories included normal weight (BMI 18.5-24.9;  $M$ =22.7±1.7), overweight (BMI 25.0-29.9;  $M$ =27.5±1.4), and obese (BMI ≥ 30;  $M$ =34.7±4.2).

**RESULTS:** Regression analyses for the total sample revealed that BMI, SE for exercise, gender, stress, and dietary habit ( $b$  =-.27\*\*,  $b$  =.26\*\*,  $b$  =-.13\*,  $b$  =-.12\*,  $b$  =.11\* respectively) predicted PA ( $R^2$  =.21\*\*). For women, BMI and SE for exercise ( $b$  =-.42\*\*,  $b$  =.33\*\* respectively) predicted PA ( $R^2$  =.31\*\*). For men, SE for exercise, BMI and stress ( $b$  =.22\*\*,  $b$  =.17\*,  $b$  =-.15\* respectively) predicted PA ( $R^2$  =.12\*\*). For obese participants, gender, stress, SE for exercise and dietary habit ( $b$  =-.25\*\*,  $b$  =-.24\*,  $b$  =.20\*,  $b$  =.19\* respectively) predicted PA ( $R^2$  =.20\*\*). For overweight, SE for exercise and gender ( $b$  =.29\*\*,  $b$  =-.18\* respectively) predicted PA ( $R^2$  =.14\*\*), and SE for exercise ( $b$  =.34\*\*) predicted PA in normal weight participants ( $R^2$  =.19\*\*).

**CONCLUSION:** SE for exercise was the most common predictor of PA across all gender and BMI categories. Men were more physically active than women. People with higher BMI were less active than those that weighed less. Efforts to increase PA among white-collar workers should consider programs that focus on increasing SE for exercise based on gender and weight status. \* $p$ <.05, \*\* $p$ <.01

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**B-30 Free Communication/Poster - Oxygen Kinetics**

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**1738 Board #88 May 27 2:00 PM - 3:30 PM**

**Performance Level Has No Influence On The Oxygen Uptake Kinetics During A 5-km Race**

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It has been suggested that severe-intensity runs conducted at a constant speed until exhaustion (on a treadmill) or during middle-distance competitions are likely to induce a decrease in oxygen uptake ( $\dot{V}O_2$ ) at the end of the exercise. The impairment of the respiratory system due to high ventilatory flow or exercise-induced arterial hypoxemia in highly trained-endurance athletes have been proposed as potential underlying mechanisms. However, the influence of subjects' aerobic fitness level on  $\dot{V}O_2$  response and the amplitude of this  $\dot{V}O_2$  decrease have not been investigated.

**PURPOSE:** To examine  $\dot{V}O_2$  kinetics to a 5-km run test according to the training status of the runner.

**METHODS:** On a 200-m track, six highly- (H) and six well-trained (W) triathletes completed an incremental test to determine their maximal oxygen consumption ( $\dot{V}O_{2max}$ ; 68.8±7.2 vs. 57.1±4.3 ml.min<sup>-1</sup>.kg<sup>-1</sup> in H and W, respectively) and a 5-km self-paced race (mean performance: ~16 min 20 s and 18 min 40 s in H and W, respectively). The  $\dot{V}O_2$  response was measured breath-by-breath (Cosmed K4b2, Italy) and fit subsequently with a model including three exponential functions (primary, slow component and downward linear phases).

**RESULTS:** No significant ( $P>0.05$ ) changes in amplitude (47.4±6.4 vs. 44.7±3.6 ml.min<sup>-1</sup>.kg<sup>-1</sup>), time delay (3.0±1.5 vs. 2.0±0.0 s) or time constant (23.0±3.7 vs. 20.5±2.7 s) of the primary phase were observed when comparing H and W. Similarly, there was no difference between groups ( $P>0.05$ ) in parameters characterizing the slow component (amplitude: 10.8±3.3 vs. 11.2±3.7 ml.min<sup>-1</sup>.kg<sup>-1</sup>; time delay: 117.8±8.3 vs. 136.6±38.8 s; time constant: 189.8±21.0 vs. 153.3±107.7 s in H and W, respectively) and downward linear (amplitude: 11.1±5.3 vs. 9.0±3.5 ml.min<sup>-1</sup>.kg<sup>-1</sup>; time delay: 395.7±51.4 vs. 409.5±55.9 s; time constant: 217.7±123.1 vs. 359.7±172.0 s in H and W, respectively) phases.

**CONCLUSION:** These data support the occurrence of a new phase in oxygen kinetics characterized by a marked decrease in  $\dot{V}O_2$  during severe-intensity running but the observed decrease was not affected by runners' performance level. This  $\dot{V}O_2$  race profile is in good agreement with those observed during supramaximal run tests such as 800-m and 1500-m races. Nevertheless, further studies are needed to understand which mechanisms are responsible for this phenomenon.

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**1739 Board #89 May 27 2:00 PM - 3:30 PM**

**$\dot{V}O_2$  And Leg Blood Flow Kinetics During Moderate-intensity Exercise: Effect Of Hyperventilation With And Without Added  $CO_2$**

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Hyperventilation-induced hypocapnic alkalosis slows the activation of the mitochondrial pyruvate dehydrogenase complex and pulmonary  $O_2$  uptake ( $\dot{V}O_2$ ) kinetics during the transition to moderate-intensity exercise (MOD). However, the effect of hyperventilation without the associated hypocapnic alkalosis during the transition to MOD has not been established.

**PURPOSE:** To examine the effect of hyperventilation with and without hypocapnic alkalosis on  $\dot{V}O_2$  and LBF kinetics at the onset of MOD.

**METHODS:** Seven young male subjects (25 ± 6 yrs; mean ± SD) performed alternate-leg knee-extension exercise during a step increase in work rate from baseline (3W) to MOD (80% of estimated lactate threshold). Subjects completed 4-6 repetitions each of the following 3 conditions: i) Control (CON,  $P_{ET}CO_2$  ~40 mmHg): Normal breathing with regular levels of  $CO_2$  (0.03%); ii) Hypocapnia (HYPO,  $P_{ET}CO_2$  ~20 mmHg): Sustained hyperventilation with regular levels of  $CO_2$  (0.03%); and iii) Normocapnia (NORMO,  $P_{ET}CO_2$  ~40 mmHg): Sustained hyperventilation with elevated levels of  $CO_2$  (5%).  $\dot{V}O_2$  was measured breath-by-breath by mass spectrometry and volume turbine. LBF was calculated using mean blood velocity and femoral artery diameters measured by Doppler ultrasound. The adaptation of  $\dot{V}O_2$  and LBF were modeled using a mono-exponential equation by non-linear regression.



**RESULTS:** The phase 2  $\text{VO}_2$  time constant ( $t\text{VO}_2$ ) was different ( $P < 0.05$ ) amongst all 3 conditions: CON ( $19 \pm 7$  s), HYPO ( $43 \pm 17$  s), NORMO ( $30 \pm 8$  s);  $\text{VO}_2$  amplitude was not different amongst conditions. The adaptation of LBF ( $t\text{LBF}$ ) was slower ( $P < 0.05$ ) during HYPO ( $31 \pm 9$  s) compared to both CON ( $19 \pm 3$  s) and NORMO ( $20 \pm 6$  s), and the LBF amplitude was lower during HYPO ( $1.1 \pm 0.2$  L/min) compared to NORMO ( $1.2 \pm 0.2$  L/min;  $P = 0.049$ ) and CON ( $1.2 \pm 0.2$  L/min;  $P = 0.08$ ).

**CONCLUSION:** While hyperventilation + hypocapnia (HYPO) was associated with slower  $\text{VO}_2$  and LBF kinetics compared to CON, preventing the fall in  $P_{\text{ET}}\text{CO}_2$  (NORMO) restored LBF kinetics but  $\text{VO}_2$  kinetics remained "slowed" relative to CON. These data suggest that some factor associated with the hyperventilation maneuver itself (i.e., independent of the induced hypocapnic alkalosis) may contribute, in part, to slowed  $\text{VO}_2$  kinetics during the transition to MOD.

*Supported by NSERC, Canada*

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**1740 Board #90 May 27 2:00 PM - 3:30 PM**

**$\text{O}_2$  Uptake Kinetics During Knee Extension And Leg Cycling Exercise In The Moderate-intensity Domain**

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(No relationships reported)

During the transition to the same relative intensity of exercise in the moderate-intensity domain the phase II time constant for  $\text{O}_2$  uptake ( $t\text{VO}_2$ ) and the  $\text{VO}_2$  gain ( $\text{DVO}_2/\text{DWR}$ ) tend to be greater with knee-extension (KE) than with leg cycling exercise (CE), however, the response at the same absolute work rate (WR) has not been established.

**PURPOSE:** To examine the adaptation of pulmonary  $\text{VO}_2$  during the transition to the same relative and same absolute WRs in the moderate-intensity domain.

**METHODS:** Four younger subjects completed an incremental exercise test to volitional fatigue during both alternate-leg KE and CE to estimate lactate threshold ( $\theta_L$ ) and peak  $\text{VO}_2$ . Subjects then completed four step transitions in WR from light- to a moderate-intensity exercise corresponding to 90%  $\theta_L$  (KErel, CErel), as well as four step transitions during CE from light-intensity to an absolute WR equal to that used during KErel (CEabs). A cadence of 50 rpm was maintained throughout all testing with KE and CE.  $\text{VO}_2$  was measured breath-by-breath using a volume turbine and mass spectrometer. The phase II  $\text{VO}_2$  response was modeled using a monoexponential function and non-linear regression techniques.

**RESULTS:** The  $t\text{VO}_2$  was greater ( $p < 0.05$ ) in KErel (28 (7) s; mean ( $\pm$  SD)) than in CErel (15 (2) s) and in CEabs (16 (4) s). The  $\text{VO}_2$  gain was greater ( $p < 0.05$ ) in KErel ( $15.3$  ( $2.?$ )  $\text{ml} \cdot \text{min}^{-1} \cdot \text{W}^{-1}$ ) than in CErel ( $8.5$  ( $3.1$ )  $\text{ml} \cdot \text{min}^{-1} \cdot \text{W}^{-1}$ ), but not different from that found in CEabs ( $11.5$  ( $6.6$ )  $\text{ml} \cdot \text{min}^{-1} \cdot \text{W}^{-1}$ ).

**CONCLUSION:** The tendency for a greater  $t\text{VO}_2$  and  $\text{VO}_2$  gain during the transition to the same relative and same absolute intensity of exercise using KE compared to CE may be related to biomechanical differences or to the different muscle fibres or muscle groups recruited during the exercise transition within each modality.

*Supported by NSERC*

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**1741 Board #91 May 27 2:00 PM - 3:30 PM**

**Effect Of Respiratory-alkalosis On  $\text{Vo}_2$ , Femoral Artery Diameter And Leg Blood Flow During Moderate-intensity Exercise**

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(No relationships reported)

Hyperventilation-induced respiratory alkalosis (RALK) may reduce vascular conductance and muscle perfusion (through a  $\text{CO}_2$ -linked process) which may explain, in part, the slower adaptation of pulmonary  $\text{O}_2$  uptake ( $\text{VO}_2$ ) observed during moderate-intensity exercise (MOD).

**PURPOSE:** To study the effect of RALK on  $\text{VO}_2$ , leg blood flow (LBF), mean blood velocity (MBV), femoral artery (FA) diameter and muscle deoxygenation kinetics at the onset of MOD.

**METHODS:** Eight male subjects ( $26 \pm 5$  yrs; mean  $\pm$  SD) completed 4 - 6 repetitions of alternate-leg knee-extension exercise during normal breathing (CON;  $P_{\text{ET}}\text{CO}_2 \sim 40$  mmHg) and sustained hyperventilation (RALK;  $P_{\text{ET}}\text{CO}_2 \sim 20$  mmHg). Instantaneous increases in work rate were made from baseline (3W) to MOD (80% estimated lactate threshold).  $\text{VO}_2$  was measured breath-by-breath by mass spectrometry and volume turbine. MBV and FA diameter were measured simultaneously by Doppler ultrasound and used to calculate LBF. The change in concentration of vastus lateralis muscle deoxyhemoglobin (D[Hb]) was measured continuously by near-infrared spectroscopy (NIRS; Hamamatsu, NIRO 300). The adaptation of  $\text{VO}_2$ , MBV, LBF, FA diameter and D[Hb] were modeled using a mono-exponential equation by non-linear regression.

**RESULTS:** The phase 2  $\text{VO}_2$  time constant ( $t\text{VO}_2$ ) was greater ( $P < 0.05$ ) in RALK ( $49 \pm 26$  s) compared to CON ( $28 \pm 8$  s). FA diameter was reduced ( $P < 0.05$ ) after 20 min resting accommodation in RALK ( $9.8 \pm 1.2$  mm) compared to pre-hyperventilation values ( $10.5 \pm 1.1$  mm) and CON ( $10.5 \pm 1.1$  mm). During the transition to MOD, FA diameter increased ( $P < 0.05$ ) in an exponential manner towards a new steady-state ( $10.3 \pm 1.2$  mm); FA diameter did not change in CON. As a consequence, although MBV kinetics ( $t\text{MBV}$ ) were not different between RALK ( $30 \pm 13$  s) and CON ( $23 \pm 6$  s), LBF kinetics ( $t\text{LBF}$ ) were slower ( $P < 0.05$ ) in RALK ( $46 \pm 16$  s) than CON ( $23 \pm 6$  s). The mean response time for muscle deoxygenation (Time Delay-D[Hb] +  $t\text{D[Hb]}$ ) were similar in RALK ( $23 \pm 5$  s) and CON ( $24 \pm 3$  s).

**CONCLUSION:** Collectively, the slower adaptation of LBF with unchanged D[Hb] kinetics in RALK suggests that slower conduit artery and microvascular blood flow kinetics may contribute, in part, to the slower  $\text{VO}_2$  kinetics in RALK.

*Supported by NSERC, Canada*

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**1742 Board #92 May 27 2:00 PM - 3:30 PM**

**Cocaine Does Not Alter Microvascular  $\text{Po}_2$  On-kinetics In Rat Hindlimb Skeletal Muscle**

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Cocaine abuse in athletes and the associated morbidity and mortality has piqued interest in its mechanisms of action. Acute cocaine intoxication initially enhances muscle performance, but ultimately leads to premature muscle fatigue and may precipitate renal failure, and death. In rats, cocaine administration accelerates muscle glycogen utilization and fatigue during treadmill exercise. Blood flow to rat hindlimb muscles during exercise is not reduced after cocaine administration (Hagen et al., MSSE 29: S218, 1997), suggesting that cocaine may elevate muscle metabolism.

**PURPOSE:** To determine whether acute cocaine administration increases skeletal muscle metabolism and oxygen uptake, thereby accelerating microvascular  $\text{PO}_2$  ( $\text{PO}_{2\text{m}}$ ) on-kinetics.

**METHODS:**  $\text{PO}_{2\text{m}}$  was measured by phosphorescence quenching in the extensor digitorum longus muscle (EDL) of anesthetized female Sprague-Dawley rats at rest and during the rest-to-contraction transition (1 Hz, 6V). In each rat,  $\text{PO}_{2\text{m}}$  was measured during a control stimulation (STIM 1) and after administration of either cocaine (C,  $n=13$ ; 5 mg/kg i.v.) or an equivalent volume of saline (S;  $n=10$ ) (STIM 2). EDL twitch tension was measured during each contraction bout using a muscle tension analyzer.

**RESULTS:** During STIM 1, resting  $\text{PO}_{2\text{m}}$  ( $R\text{-PO}_{2\text{m}}$ ), the time delay (TD) between the onset of contractions and the fall in  $\text{PO}_{2\text{m}}$ , the time constant ( $\text{Tau}$ ) and the magnitude



and of the fall in  $PO_2m$  at the onset of contractions (D- $PO_2m$ ) were the same in the S and C groups. Cocaine administration had no effect on R- $PO_2m$  during prior to STIM 2 (S,  $23 \pm 2$ ; C,  $26 \pm 1$  mmHg). Further, cocaine had no effect on D- $PO_2m$  (S,  $-12 \pm 2$  vs. C,  $-15 \pm 1$  mmHg), TD (S,  $6 \pm 1$ ; C,  $6 \pm 1$  s) or Tau (S,  $8 \pm 2$ ; C,  $9 \pm 2$  s). Neither twitch tension (S,  $31 \pm 7$ ; C,  $28 \pm 7$  N) nor any other indices of muscle contractile function were different during STIM 2.

**CONCLUSION:** The results of this study indicate that acute cocaine administration does not alter resting  $PO_2m$ ,  $PO_2m$  on-kinetics, or contractile function in the rat EDL muscle. Thus, these data do not support the notion that cocaine enhances muscle metabolism in contracting skeletal muscle.

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**1743 Board #93 May 27 2:00 PM - 3:30 PM**  
**The Effects Of Reduced Blood Volumes On Oxygen Uptake Kinetics In Trained Athletes**

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The Effects of reduced blood volumes on Oxygen Uptake Kinetics

**PURPOSE:** The purpose of this study was to test the hypothesis that a reduced total blood volume will influence the ( $VO_2$ ) on-kinetic response during both moderate (MOD) and heavy (HVY) intensity exercise. **METHOD:** Following University Institutional ethics approval twelve subjects volunteered and agreed to participate (age,  $21 \pm 2$  yrs; height,  $175.2 \pm 5.1$  cm; weight,  $66.4 \pm 2.8$  kg;  $VO_{2max}$ ,  $53.0 \pm 4.1$  ml.kg<sup>-1</sup>.min<sup>-1</sup>). The subjects completed two exercise trials, un-bled (UBL) and bled (BLL) which were interspersed by a period of 48h. The trials consisted of an initial phase of 4-min of unloaded cycling followed by 2 bouts of 6-min constant load cycling at D 80% base-line  $VO_2$  -  $VO_2$  at ventilatory threshold (MOD), which were separated by 10-min of recovery unloaded cycling. Following the same recovery phase the subjects completed a third bout of 6-min constant load cycling at D50% ventilatory threshold -  $VO_{2max}$  (HVY). Between the two exercise trials the subjects donated 500ml<sup>3</sup> of blood. For both the UBL and BL trials  $VO_2$  was recorded on a breath-by-breath basis using a pre-calibrated metabolic cart, haemodynamic responses were recorded throughout the trials and haematological variables were recorded pre-exercise. For both UBL and BLL trials the  $VO_2$  on-kinetic response data were fitted with a 3-component exponential model for analysis of the primary time component and mean response times.

**RESULTS:** There were significant differences between UBL and BLL for Hb gdl<sup>-1</sup> ( $p < 0.005$ ), HcT % ( $p < 0.001$ ) and RBC  $\mu l^{-1}$  ( $p < 0.013$ ) with Hb showing a decrease of 9.7% from  $14.5 \pm 5.5$  gdl<sup>-1</sup> to  $13.1 \pm 14.9$  gdl<sup>-1</sup>. There were non-significant differences between UBL and BLL for either the time constant or the amplitude of the phase II/III  $VO_2$  responses in both the MOD and HVY conditions ( $p > 0.05$ ). However there was a significant increase in the D pulse pressure for phase II between UBL and BLL in both MOD ( $10.4 \pm 24.1$ mmHg) ( $p < 0.037$ ) and HVY domains ( $21.2 \pm 4.1$ mmHg) ( $p < 0.042$ ).

**CONCLUSION:** The data highlights the capability of the cardiovascular system in compensating for a reduction in the  $O_2$  carrying capacity of the blood through central alterations of cardiovascular function suggesting that exercise in the MOD and HVY domains does not appear to be limited by  $O_2$  delivery in healthy young individuals.

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**1744 Board #94 May 27 2:00 PM - 3:30 PM**  
**Oxygen Kinetics During Specific Intermittent Work**

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(No relationships reported)

**PURPOSE:** The time (t) discriminates the speed of activation of the oxidations mechanisms, during an intermittent work (IW) 95 - 100% of the  $VO_2$  Max. The deficit of oxygen ( $DO_2$ ) of the fast phase of the  $O_2$  kinetics ( $O_2K$ ) represents the anaerobic work participation.<sup>1</sup>

**PURPOSE:** to analyzer the  $DO_2$  utility during specific intermittent work (SIW)<sup>2,3</sup>.

**METHODS:** Olympic athletes: 4 boxers and 4 judokas. Age (18-24 years); weight (60-75 kg) and height (170-185 cm). SIW on treadmill (slope 2%; heating 2 min; 4 repetitions of 2 min by 1 of rest). Each repetition represents one round and in the rest the subject remains seated; thus the test is considered specific for boxing.  $VO_2$  Max was measured with  $K_4b^2$  and  $DO_2$  by COSMED software. It was applied ANOVA TWO WAY with and without replications.

**RESULTS:** In boxing:  $DO_2 = 1905 \pm 597$  ml F NS between three evaluations. The  $DO_2$  between subjects (BS) and rounds was different  $F = 3.24$   $p < 0.003$  and  $F = 4.83$   $p < 0.003$  respectively; interaction NS. In judo  $DO_2 = 2050 \pm 769$  ml BS  $F = 6.48$   $p < 0.007$ ; between repetitions N.S.

**CONCLUSIONS:** the  $DO_2$  differences BS, demonstrate that the functional answer would be modulated by the characteristics of the box and by the individual variability. The fast phase of the  $O_2$  kinetics ( $O_2K$ ) is considered dependent of the type of muscular fiber with recruitment of fast motor units, we could think that the results, express the functional answer to specific metabolic requirements of box. The SIW designed originally for boxing, demonstrated a relative utility in judo, possibly due to that competition times are different.

1 Barstow, Thomas J., Andrew M. Jones, Paul H. Nguyen, and Richard Casaburi. Influence of muscle fiber type and pedal frequency on oxygen uptake kinetics of heavy exercise. *J. Appl. Physiol.* 81(4): 1642-1650, 1996.

2 Narváez Pérez G.E. et al.  $O_2$  participation during the 40-s work. *Medicine and Science in Sports and exercise*, Vol., 27:5, Supplement. 1995

3 Narváez P.G.E. and H. Rodríguez P. Improper weight loss in amateur boxers and disorders of the C.N.S. Proceedings of International Medical Symposium "The Safety of the Athlete in Olympic Sports" (Ed) A. Francone. Assisi. Oct.1990, pp.55-56.

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**1745 Board #95 May 27 2:00 PM - 3:30 PM**  
**Change In Intracellular  $PO_2$  During Muscle Contraction Under Hb-free Medium Perfusion**

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(No relationships reported)

**PURPOSE:** Regulation of  $O_2$  transport to the mitochondria is a fundamental issue, particularly in exercising muscle, where  $O_2$  consumption can vary over a wide range.

Although the  $O_2$  gradient from the capillary to the mitochondria is one of the key factors regulating  $O_2$  transport to the mitochondria, intracellular  $O_2$  dynamics during muscle contraction remain unclear. We recently developed an experimental perfusion model in order to investigate intracellular  $O_2$  utilization during muscle contraction using near infrared spectroscopy (NIRS). The purpose of the present study is, therefore, to examine the kinetics of myoglobin (Mb) saturation ( $S_{mb}O_2$ ) and intracellular  $PO_2$  ( $P_{mb}O_2$ ) during muscle contraction.

**METHODS:** The hindlimbs of male Wistar rats (9 weeks old,  $n = 6$ ) were perfused from the abdominal aorta with the Hb-free Krebs-Henseleit buffer equilibrated with 95%  $O_2$  + 5%  $CO_2$  gas. During perfusion, muscle contraction was evoked by electrostimulation via the sciatic nerve. The kinetics of D[deoxy-Mb] during muscle contraction were monitored using NIRS. After the exercise protocol, buffer equilibrated with 95%  $N_2$  + 5%  $CO_2$  gas was perfused in order to determine the maximal deoxygenation state.  $S_{mb}O_2$  was also converted into  $P_{mb}O_2$  using the  $O_2$  dissociation curve of Mb. Estimated kinetics of  $S_{mb}O_2$  and  $P_{mb}O_2$  were evaluated by fitting the data to the exponential function.

**RESULTS:** The kinetics of  $P_{mb}O_2$  (RT (response time) =  $25.64 \pm 3.25$  sec) were more rapid than those of  $S_{mb}O_2$  (RT =  $42.26 \pm 8.55$  sec). In addition,  $DS_{mb}O_2$  during muscle

contraction increased and  $P_{mb}O_2$  at the steady state decreased progressively as oxygen demand increased ( $S_{mb}O_2$ :  $r = -0.47$ ,  $p = 0.05$ ,  $P_{mb}O_2$ :  $r = -0.54$ ,  $p < 0.05$ ), while  $S_{mb}O_2$  and  $P_{mb}O_2$  at the maximal twitch under buffer-perfused condition were 48% and 2.7 mmHg, respectively. Moreover, the decremental ratio of  $S_{mb}O_2$  kinetics was accelerated with oxygen demand ( $r = -0.82$ ,  $p < 0.01$ ).

**CONCLUSIONS:** These results suggest that Mb desaturated immediately at the onset of the muscle contraction, reflecting a fall in intracellular  $PO_2$ , and that this intracellular response was accelerated along with oxygen demand to increase muscle oxygen consumption.

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**1746 Board #96 May 27 2:00 PM - 3:30 PM**  
**Estimation of Oxygen Uptake Dynamics During Walking By Using A Triaxial Accelerometer**

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(No relationships reported)

The use of accelerometry to assess physical activity has become more common in recent years. However, accelerometer devices are unable to determine dynamics of energy expenditure (EE) due to the lack of precision and temporal resolution in estimating EE. This may be attributed to that the assessment of EE is based on the activity counts per time without using raw acceleration signals.

**PURPOSE:** In this study, we developed a novel method to predict dynamics of oxygen uptake ( $VO_2$ ) during walking from triaxial accelerometer signals by using transfer function estimate between breath-by-breath  $VO_2$  and the instantaneous amplitude or envelope (Ae) of a 3D vector of accelerometer signals.

**METHODS:** Seven healthy subjects (3 male and 4 female) were participated. From the oscillatory signal of a 3D vector of accelerometer signals, Ae was calculated in the complex unit circle based on the Hilbert-transform. The transfer function between the Ae and the  $VO_2$  was estimated by applying autoregressive exogenous model to the simultaneously obtained accelerometer signals and  $VO_2$  during treadmill walking, in which treadmill speed was varied between 2.5km/h and 5.5km/h in a pseudo-random binary sequence manner for 20 min. The best-fit model parameters were selected by searching for the minimum AIC value. Then, cross-validation was performed by identifying  $VO_2$  response to stepwise change in work rate from 2.5km/h to 5.5km/h by convolving corresponding Ae with the impulse response.

**RESULTS:** By using an individual transfer function estimate,  $VO_2$  dynamics was successfully estimated from the changes in Ae. The predicted  $VO_2$  response was in close agreement with the observed response in each subject (residual sum of squares was 7.6% on average).

**CONCLUSIONS:** Proposed method should be useful for estimating EE dynamics of walking. Further validation is needed whether the method could be applied in the field-based walking activity.

Supported, in part, by JSPS as the Grant-in-Aid for Exploratory Research #20650110.

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**1747 Board #97 May 27 2:00 PM - 3:30 PM**  
**Oxygen Uptake Kinetics During Arm Cranking Within The Moderate Intensity Domain**

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(No relationships reported)

Recent studies have demonstrated that on-transient oxygen uptake ( $VO_2$ ) kinetics are slowed when constant-load exercise is initiated from the upper compared to lower region of the moderate intensity domain (below the lactate threshold, LT). These studies, focusing exclusively on lower limb exercise, attributed this intensity-dependent slowing of  $VO_2$  kinetics during moderate-intensity exercise to different muscle fiber recruitment patterns or altered oxygen transport dynamics.

**PURPOSE:** To determine if pulmonary  $VO_2$  and heart rate (HR) kinetics are slowed during constant-load arm exercise (arm-cranking) performed in the upper (90%LT) compared to lower (45%LT) regions of the moderate intensity domain.

**METHODS:** Seven healthy male subjects ( $26 \pm 3$  yr) performed 4-8 repetitions of arm-cranking exercise involving: 1) a single, 6-min step transition from 9 W to 90% of the estimated LT ( $AC_{90\%}$ ); two continuous, equal, 6-min step transitions from 9 W to 45% LT ( $AC_{45\%}$ ), and then to 90% LT ( $AC_{45-90\%}$ ); and 3) the  $AC_{90\%}$  protocol superimposed upon low-intensity leg-cycling ( $AC_{90\%+LC}$ ), where baseline HR >100 beats·min<sup>-1</sup> (range: 100-120 beats·min<sup>-1</sup>).

**RESULTS:** The time constants (t) of the  $VO_2$  and HR responses were longer ( $P < 0.05$ ) during  $AC_{45-90\%}$  ( $tVO_2$ :  $70 \pm 5$  s;  $tHR$ :  $59 \pm 4$  s) compared to  $AC_{45\%}$  ( $tVO_2$ :  $54 \pm 6$  s;  $tHR$ :  $47 \pm 5$  s) and  $AC_{90\%}$  ( $tVO_2$ :  $53 \pm 4$  s;  $tHR$ :  $46 \pm 3$  s). The gain ( $DVO_2/DW$ ) and blood lactate concentration were also significantly greater ( $P < 0.05$ ) for  $AC_{45-90\%}$  than  $AC_{45\%}$ . During arm-cranking superimposed upon leg-cycling ( $AC_{90\%+LC}$ ), HR kinetics were significantly slowed when compared to  $AC_{90\%}$  (mean difference for  $tHR$ :  $9 \pm 4$  s,  $P < 0.05$ ) and  $AC_{45\%}$  (mean difference for  $tHR$ :  $9 \pm 5$  s,  $P < 0.05$ ). Similar comparisons between conditions for  $tVO_2$  yielded no significant differences.

**CONCLUSION:** During arm exercise performed within the moderate intensity domain,  $VO_2$  and HR kinetics do not conform to a dynamically linear model. Since HR, but not  $VO_2$  kinetics were slowed during  $AC_{90\%+LC}$ , factors other than convective oxygen delivery (e.g. those intrinsic to the exercising muscle) may explain the slower  $VO_2$  response in the upper reaches of the moderate intensity domain for arm exercise.

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**1748 Board #98 May 27 2:00 PM - 3:30 PM**  
**The Significance of the Bohr Effect for Muscle Oxygen Extraction: Evidence from Exercise in McArdle Disease**

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(No relationships reported)

In McArdle disease (MD), complete absence of myophosphorylase (MP) blocks glycogen breakdown, thus restricting anaerobic metabolism. We have shown that impaired glycogenolysis also limits substrate availability for oxidative metabolism. Since patients lack the ability to increase lactate during exercise, an additional factor in impaired  $O_2$  utilization may be an absent Bohr effect -the rightward shift in the oxyhemoglobin dissociation curve caused by the increase in lactic acid and  $H^+$ , that facilitates  $O_2$  extraction during intensive exercise.

**PURPOSE:** To assess the importance of the Bohr effect on muscle  $O_2$  extraction employing patients with typical McArdle disease (glycogenolysis completely blocked) and an unusual patient with a small amount of residual MP who we have shown to have a 2-fold higher peak  $VO_2$  than typical patients.

**METHODS:** Three MD patients with complete MP deficiency, 1 variant MD patient with 3% of normal MP activity, and 13 healthy control subjects performed an aerobic forearm exercise test, consisting of 5 sec isometric grip force alternating with 5 sec of rest for 6 min. We measured lactate, pH, partial pressure of  $O_2$  ( $pO_2$ ) and  $CO_2$  ( $pCO_2$ ) in effluent venous blood at rest, and at the end of exercise with a target grip force of 50% of maximal voluntary contraction.

**RESULTS:** Plasma lactate decreased during exercise in typical MD patients ( $0.6 \pm 0.1$  to  $0.5 \pm 0.1$  mmol/L), but increased slightly in the variant MD patient ( $1.03$  to  $1.14$  mmol/L) and substantially in controls ( $0.9 \pm 0.2$  to  $2.9 \pm 1.1$  mmol/L). Correspondingly, pH decreased in controls ( $7.37 \pm 0.02$  to  $7.28 \pm 0.04$ ) and to a lesser degree in the variant MD patient ( $7.35$  to  $7.32$ ), but increased in typical MD patients ( $7.38 \pm 0.04$  to  $7.40 \pm 0.03$ ). During exercise, venous  $pO_2$  was increased in typical MD patients compared with controls ( $37.3 \pm 3.1$  vs.  $26.8 \pm 2.6$  mmHg). The  $pO_2$  level in the variant MD patient was comparable to controls ( $26.0$  mmHg).  $pCO_2$  was increased at the end of exercise in both controls ( $68.2 \pm 9.0$  mmHg) and variant MD patient ( $55$  mmHg), compared with typical MD patients ( $39.3 \pm 9.3$  mmHg).

**CONCLUSIONS:** This study suggests that absence of the Bohr effect in typical MD patients may contribute to impaired  $O_2$  extraction. Minimal residual MP activity in the

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**1749 Board #99 May 27 2:00 PM - 3:30 PM**

**Validation Of A Continuous-wave, Single-distance Nirs Oxymeter For The Determination Of Muscle Oxygenation During Cycling**

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(No relationships reported)

An Italian company recently developed a relatively inexpensive continuous-wave (CW), single-distance near-infrared spectroscopy (NIRS) oxymeter that allows the calculation of absolute values of deoxygenated haemoglobin (*deoxyHb*). This absolute quantification is made possible by an in-vivo estimate of the scattering coefficient (based on direct measures of the scattering at the water absorption peak and on its linear extrapolation to the near-infrared range). The calculated scattering coefficient is assumed not to change over the time of the experiment.

**PURPOSE:** We tested the possible correspondence between non-invasive measures of muscle *deoxyHb* obtained using this CW device and a frequency-domain (FD) multi-distance NIRS system, used as a reference method.

**METHODS:** 11 healthy sedentary males (27±5 years, 176±1 cm, 73±8 kg, 54±4 ml·kg<sup>-1</sup>·min<sup>-1</sup> VO<sub>2max</sub>) performed an incremental cycling test. Following a 3-min rest, subjects pedaled at 50 watt for 3 min. Thereafter, the workload was increased stepwise, 20 watt per minute, up to voluntary exhaustion. During the tests, muscle *deoxyHb* was monitored continuously on the vastus lateralis of the right leg, using the reference FD device (FD*deoxyHb*), and on the right leg, using the CW instrument (CW*deoxyHb*). The average values of the last 30s of rest and warm-up cycling, and the last 10 s of each stage were used for statistical analysis. Agreement between the two instruments was tested by Bland Altman analysis (significance ≤0.05).

**RESULTS:** Resting CW*deoxyHb* and FD*deoxyHb* were 27±6 and 29±5 mmol·l<sup>-1</sup> respectively (not different). As expected, *deoxyHb* increased as a function of exercise intensity reaching 43±9 (CW*deoxyHb*) and 44±10 mmol·l<sup>-1</sup> (FD*deoxyHb*) upon exhaustion (not different). At all exercise intensities, CW*deoxyHb* was not significantly different from FD*deoxyHb* (bias 0.93, not different from 0; precision 7.6 mmol·l<sup>-1</sup>).

**CONCLUSIONS:** The main finding of this study is that there is a very good agreement between muscle *deoxyHb* values measured by the evaluated CW device and the reference FD oxymeter. Compared to the reference device, the new, relatively inexpensive oxymeter yields unbiased and precise *deoxyHb* values during incremental cycling exercises in healthy sedentary males.

The study was Supported by Nirox srl, Italy

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**1750 Board #100 May 27 2:00 PM - 3:30 PM**

**Prior Exercise And Ischemia Affect Blood Flow And Oxygen Uptake During Subsequent Heavy Forearm Exercise**

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(No relationships reported)

Enhanced blood flow (BF) by prior exercise is associated with acceleration of muscle oxygen uptake (VO<sub>2muscle</sub>) kinetics during subsequent heavy exercise.

**PURPOSE:** We tested the influence of enhanced forearm BF by exercise and circulatory occlusion on VO<sub>2muscle</sub> onset kinetics.

**METHODS:** Seven varsity ice hockey players completed three heavy forearm exercise bouts (5-min at 30 % MVC 14.1 ± 1.2 kg) in two different sessions: [1] control, heavy exercise followed immediately by 2 minutes of circulatory occlusion; [2] heavy bout 8-min after control; [3] heavy bout 3-min after release of 5-min forearm occlusion that included 1-min moderate hand-grip exercise. BF was measured continuously using Doppler ultrasound and venous blood was sampled every 15 seconds from a deep forearm vein to determine O<sub>2</sub> extraction.

**RESULTS:** BF was elevated prior to bout [2] and [3] compared to the control at baseline ([2], 318.2 ± 51.7; [3], 282.1 ± 30.9 vs. control, 69.0 ± 13.4 mL/min, *P* < 0.01), however baseline VO<sub>2muscle</sub> was significantly higher only prior to bout [2] (10.1 ± 2.6 vs. 4.0 ± 1.0 mL O<sub>2</sub>/min, *P* < 0.01). Neither BF nor VO<sub>2muscle</sub> were different at end exercise among the three heavy bouts. BF and VO<sub>2muscle</sub> were significantly higher during the first 2-min of bout [2] compared to both bout [3] and control. Prior occlusion slightly enhanced the onset BF and VO<sub>2muscle</sub> kinetics during bout [3] with a significant increase at 45 sec compared to control (BF: 375.8 ± 75.4 vs. 312.9 ± 79.9 mL/min; VO<sub>2muscle</sub>: 51.2 ± 15.9 vs. 41.9 ± 16.1 mL O<sub>2</sub>/min, *P* < 0.05). The calculated VO<sub>2muscle</sub> area during the first two minutes of exercise was significantly greater in bout [2] than the areas of both bout [3] and control ([2], 113.9 ± 39.1 vs. [3], 93.7 ± 28.7; control, 84.3 ± 30.2 mL O<sub>2</sub>, *P* < 0.01). These results indicate a greater contribution from oxidative phosphorylation at the onset of a heavy bout that followed heavy exercise and occlusion compared to that which followed occlusion with moderate exercise.

**CONCLUSION:** We employed two protocols which enhanced BF prior to a subsequent heavy exercise bout (heavy exercise followed by occlusion and moderate exercise during occlusion); however the major impact on oxidative metabolism was seen only following heavy exercise.

Supported by Egyptian Culture and Educational Bureau in Canada and NSERC

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**1751 Board #101 May 27 2:00 PM - 3:30 PM**

**Muscle And Pulmonary Oxygen Uptake Kinetics During Moderate And High-intensity Knee-extensor Exercise In Humans**

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(No relationships reported)

**PURPOSE:** To determine the contribution of muscle O<sub>2</sub> uptake (mVO<sub>2</sub>) to pulmonary O<sub>2</sub> uptake (pVO<sub>2</sub>) during both low-intensity (LI) and high-intensity (HI) knee extension exercise, and during subsequent recovery, in humans.

**METHODS:** Seven healthy male subjects (age 20-25 years) completed a series of LI and HI square-wave exercise tests in which mVO<sub>2</sub> (direct Fick technique) and pVO<sub>2</sub> (indirect calorimetry) were measured simultaneously. The mean blood transit time (MTT) from the muscle capillaries to the lung was also estimated (based on measured blood transit times from femoral artery to vein and vein to artery). The kinetics of mVO<sub>2</sub> and pVO<sub>2</sub> were modeled using non-linear regression.

**RESULTS:** The time constant (t) describing the phase II pVO<sub>2</sub> kinetics following the onset of exercise was not significantly different from the mean response time (initial time delay + t) for mVO<sub>2</sub> kinetics for LI (30 ± 3 vs. 30 ± 3 s) but was slightly higher (*P* < 0.05) for HI (32 ± 3 s vs. 29 ± 4); the responses were closely correlated (*r* = 0.95 and *r* = 0.95; *P* < 0.01) for both intensities. In recovery, limited agreement between the responses was observed with pVO<sub>2</sub> kinetics tending to be slower than mVO<sub>2</sub> kinetics both for LI (36 ± 4 vs. 18 ± 4 s, *P* < 0.05; *r* = -0.01) and HI (33 ± 3 vs. 27 ± 3, *P* > 0.05; *r* = -0.04). MTT was approximately 17 s just before exercise and decreased to 10 s and 12 s after 10 s of exercise for LI and HI, respectively. The increase in mVO<sub>2</sub> above baseline accounted for 100% and 95% of the increase in pVO<sub>2</sub> during LI and HI, respectively.

**CONCLUSIONS:** These data indicate that the phase II pVO<sub>2</sub> kinetics reflect mVO<sub>2</sub> kinetics during exercise but not during recovery where caution in data interpretation is advised.

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**1752 Board #102 May 27 2:00 PM - 3:30 PM**

## Pulmonary Oxygen Uptake Kinetics In Trained And Untrained Male Adolescents

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(No relationships reported)

Exercise training results in a speeding of pulmonary oxygen uptake (VO<sub>2</sub>) kinetics at the onset of exercise in adults, however only limited research has been conducted with physiologically immature subjects.

**PURPOSE:** The aim of the present study was to examine VO<sub>2</sub> and muscle deoxygenation kinetics in trained and untrained male adolescents. **METHOD:** 16 trained (14.5 ± 0.2 yrs, VO<sub>2peak</sub>: 54.7 ± 1.6 ml.kg<sup>-1</sup>.min<sup>-1</sup>, Self-assessed Tanner stage range 2 - 4) and 9 untrained (15.4 ± 0.2 yrs, VO<sub>2peak</sub>: 43.1 ± 1.7 ml.kg<sup>-1</sup>.min<sup>-1</sup>, Tanner stage range 2 - 4) male adolescents performed two 6-min exercise transitions from a 3-min baseline of 10W to a workload equivalent to 80% lactate threshold separated by a minimum of 1 hour passive rest. Oxygen uptake (breath-by-breath) and muscle deoxygenation (deoxyhaemoglobin signal from near infrared spectroscopy) were measured continuously throughout baseline and exercise transition.

**RESULTS:** The time constant of the fundamental phase of VO<sub>2</sub> kinetics was significantly faster in trained versus untrained subjects (Trained: 22.3 ± 1.8 s vs Untrained: 29.8 ± 2.8 s, p=0.03). In contrast, neither the time constant (Trained: 9.7 ± 0.7 s vs Untrained: 10.1 ± 1.1 s, p=0.78) or mean response time (Trained: 17.4 ± 0.6 s vs Untrained: 18.3 ± 0.8 s, p=0.39) of muscle deoxygenation kinetics was altered according to training status.

**CONCLUSION:** The present data suggest that exercise training results in faster VO<sub>2</sub> kinetics in male adolescents, though inherent capabilities cannot be ruled out. Since muscle deoxygenation kinetics were unchanged, it is likely that faster VO<sub>2</sub> kinetics were due to adaptations to both the cardiovascular system and the peripheral musculature.

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## B-31 Free Communication/Poster - Physical Activity Interventions - Adults

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### 1753 Board #103 May 27 3:30 PM - 5:00 PM

#### Effects Of A Promotora Mediated Physical Activity Intervention For Immigrant Latinas

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(No relationships reported)

Physical activity is widely recognized as an important health promoting behavior for women. Levels of physical activity among immigrant Hispanic women (Latinas) decrease following arrival in the US and Latinas born in the US are more likely than other groups to report no leisure time physical activity. Latinas are often socialized to place family needs above their own needs throughout their lives. This construct, referred to as *marianismo*, may contribute to feelings of low self-efficacy for physical activity and depression among Latinas.

**PURPOSE:** To test the effects of a 12-week physical activity intervention for immigrant Latinas using *promotoras* (Latina community health workers). PAIL (Physical Activity Intervention for Latinas) is based upon Paulo Freire's Community Based Participation Research (CBPR) model and is designed to empower women to embrace physical activity as a health promoting behavior by: 1) Enhancing physical and exercise self-efficacy and collective self-efficacy (empowerment) and 2) Decreasing depressive symptoms.

**METHODS:** Sixty-eight immigrant Hispanic women, 18-55 years of age, were recruited to participate in the intervention which utilized an experimental pretest-posttest lag-group design. The intervention consisted of twice weekly, low impact aerobics/Latin dance classes taught by *promotoras*. Dependent variables were physical and exercise self-efficacy, depression and fitness (aerobic capacity, muscle strength, flexibility, percentage of body fat and body mass index). All dependent variables were measured pre-intervention and at 4, 8 and 12 weeks during the intervention.

**RESULTS:** Baseline data (n = 27, mean age= 30.5 yrs, mean length of stay in US= 8 yrs) confirm concerns about obesity and sedentarism. Mean BMI= 30.50 kg/m<sup>2</sup>, mean percentage of body fat = 36.8%. Results of IPAQ and PA-R indicate that walking is only form of physical activity. Mean non-exercise estimate of VO<sub>2 max</sub> was 25.01 ml/kg/min.

**CONCLUSIONS:** Preliminary results indicate that *promotoras* can be highly effective in encouraging adherence to a culturally attuned physical activity intervention and in assisting immigrant Latinas to achieve a balance between responsibilities toward others (*marianismo*) and healthy self-care activities, particularly physical activity.

Supported by NIH grant K01 NR009381.

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### 1754 Board #104 May 27 3:30 PM - 5:00 PM

#### Resistance And Family-support Program To Improve Functional Fitness And QoLs For Japanese Community-dwelling Elderly

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(No relationships reported)

**PURPOSE:** The purpose of this study was to examine the effect of a combined health promotion program composed of resistance training and a family support program to improve functional fitness and QOLs for frail community-dwelling elderly.

**METHODS: PARTICIPANTS:** Subjects were 44 elderly females (69.4±6.0 yrs) The intervention group(IG) were 14(69.4±6.2 yrs, BMI:25.1±3.1) and the control group(CG) were 30 females(69.4±6.0yrs, BMI: 23.1±2.9). **Intervention:**The program was constituted of a home-based exercise program and group learning of resistance training. The intervention program consisted of an exercise program and family support program. The exercise program was composed of resistance training to improve upper, lower and trunk stability. The family support program was composed of learning support skills using behavioral science for the exercise program by the family. The classes were held twice a week over a period of 3 months. **Measurements:** height, body weight, %Fat, one leg standing with eyes open, functional reach, leg extension strength, geriatric depression scale (GDS),QOL score(SF36) and VAS scale of life satisfaction were obtained using standardized tests and questionnaire before and after the intervention period.

**RESULTS:** After the intervention period, measurements of leg extension strength(IG: 19.2±7.8kg to 25.2±7.2kg,P<0.05, CG: 21.4±4.9kg to 22.2±5.5kg,NS, deltaP<0.05), functional reach(IG: 17.9±4.5cm to 23.0±2.5cm,P<0.05, CG: 22.2±3.0cm to 26.3±2.8cm,P<0.05, deltaP<0.05) were improved significantly. QOL scores( Physical Function, Vitality), and VAS scales of life satisfaction in IG were also improved significantly compared to CG( deltaP<0.05).

**CONCLUSIONS:** These results suggest that a combined health promotion program composed of resistance training and a family support program was effective for improving physical function and QOLs in community-dwelling elderly women.

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### 1755 Board #105 May 27 3:30 PM - 5:00 PM



## A Physical Activity And Lifestyle Education Intervention In Irish Adolescent Females

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It has been widely reported that adolescents are not meeting physical activity (PA) guidelines with females often being highlighted as most 'at risk'. The Irish Obesity Taskforce Report 2005 recommended the development of "opportunities for physical activity...that concentrate on increasing physical activity among teenage girls".

**PURPOSE:** To engage a group of 'at risk' adolescent females (age 16yr 3mo±8mo) in a PA and lifestyle education (LE) intervention which would increase their Moderate to Vigorous Physical Activity (MVPA) during and also outside the intervention.

**METHODS:** Participants were randomly allocated to an intervention (n=17) and a control (n=16) group. The intervention group undertook a 32 week PA and LE intervention for 40 minutes 3 times a week. The PA component consisted of activities chosen by the participants (aerobics, kick boxing etc) and the LE component consisted of standard psychological tools such as goal setting and barrier identification. Pre and post tests included two body composition measures, 20 meter shuttle run to estimate  $\text{VO}_{2\text{max}}$  and a 3-5 day measure of PA using recording accelerometry. Accelerometry counts were recorded, and data was processed to identify continuous blocks of MVPA over 10 minutes duration.

**RESULTS:** The intervention did not alter either body composition measures. Estimated  $\text{VO}_{2\text{max}}$  of the intervention group increased significantly ( $p<0.001$ , t-test) from 27.6 ( $\pm 3.6$ ) to 33.6 ( $\pm 4.7$ )  $\text{ml.kg}^{-1}.\text{min}^{-1}$  whilst the control group showed no significant change. PA levels were determined to be below the acceptable level in both groups at pre test (which is as expected since they were chosen due to their sedentary patterns). PA levels increased significantly at the end of the intervention ( $p<0.01$ , t-test) in the intervention group with average minutes of PA per day increasing from 11 ( $\pm 7$ ) to 20 ( $\pm 15$ ) minutes. The control group showed no significant change in MVPA levels. PA patterns were also analysed.

**CONCLUSION:** The PA intervention significantly increased participants PA levels but not enough to reach adult (ACSM, 2007) or child (NASPE, 2005) recommendations. The increase is noteworthy since the group started from a sedentary base and this is combined with an increase in cardiovascular fitness. Data suggests that this type of targeted school based intervention may be successful.

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### 1756 Board #106 May 27 3:30 PM - 5:00 PM

#### Responses Of Postmenopausal Women To Focus Group Inquiries Of Desired Characteristics Of Physical Activity Intervention

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**PURPOSE:** Little participant-centered data exists on appealing characteristics of desirable physical activity (PA) programs for postmenopausal women. Such data may assist in planning PA programs to increase adherence.

**METHODS:** We conducted focus groups (FG) and telephone interviews (TI) for overweight, inactive postmenopausal women aged 45-65. Participants were asked "If you were to create the perfect [PA] program, what would it look like?" FG employed Nominal Group Technique (NGT); women individually listed ideas and voted to elicit the most desired characteristics. Information from FG and TI was reviewed by a research team member using grounded theory approach. Characteristics were reviewed and sorted into categories using open coding.

**RESULTS:** 32 women (average age=57.5 years) participated in FG (n=25) and TI (n=7). Four major themes emerged during review of FG and TI data: 1) Motivating features: "one on one sessions with a pro...I never know what to do or how to do exercises that are good for me," "group activity - with a facilitator who also motivates" and "the program was one in which results were easy to see." 2) Accountability: "requirements for activities to be done at home between sessions," and "a chart or log for keeping track of activities eventually a chart or log to track weight loss and other physical measurements." 3) Variety of PA options: "Varied things (gets bored doing same thing)," "Bikram yoga," "dancing" and "interval training including jogging/walking, calisthenics, weight training." 4) Convenience: "Convenience with regard to work schedule (i.e., noon, after work)" and "Easy parking: can't be so hard to get there that it's not worth it." Motivational factors, both intrinsic and extrinsic, seemed to be the most important factor for the women in our study based on both the frequency of responses and the ranking of these responses by the women in the focus groups.

**CONCLUSIONS:** Physical activity programs for postmenopausal women should include motivational support and a variety of activities in order to attract and retain participation. These characteristics, deemed important to the success of activity intervention participation in postmenopausal women, should be considered when developing an activity intervention program.

Funded by the National Heart, Lung and Blood Institute (HL 085405-02)

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### 1757 Board #107 May 27 3:30 PM - 5:00 PM

#### Effect Long Term Of Physical Exercise On The Nitrate\_nitrite Levels In Hypertensive Obese Postmenopausal

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Shear stress induced by physical exercise is a powerful stimulus to increase NO production in vascular beds either in human or laboratory animals. Cardiovascular disease in women increases after postmenopausal years, mainly arterial hypertension. Furthermore, more women than men die each year of coronary heart disease. Thus, preventive actions to avoid high incidence of cardiovascular disease are extremely necessary for postmenopausal women.

**PURPOSE:** The aim of this study was to investigate the effects of 24 weeks of dynamic exercise training on plasma nitrate/nitrite concentration in hypertensive obese women.

**METHODS:** Eleven volunteers were included in this study with mean age were 50  $\pm$  4 years, BMI 33  $\pm$  6  $\text{Kg/m}^2$ . Participants were submitted to an aerobic exercise program on a cycle ergometer for 3 days a week, each session consisting of 60 minutes during 24 weeks at intensity of 50% of heart rate reserve. Lipid profile and nitrite/nitrate levels were evaluated at baseline and after 24 weeks of exercise training.

**RESULTS:** Neither BMI (33  $\pm$  6 vs 32  $\pm$  6  $\text{Kg m}^{-2}$ ) nor WHR (0.88 $\pm$ 0.06 vs 0.87  $\pm$  0.05 cm) were altered by exercise training. On the other hand, a significant reduction in both systolic (basal: 141 $\pm$ 10, after: 123 $\pm$ 8 mmHg, approximately 13%) and diastolic (basal: 90 $\pm$ 5, after: 80 $\pm$ 5 mmHg, approximately 12%) blood pressure values was seen after aerobic exercise training in hypertensive postmenopausal women. Similarly, heart rate was reduced, approximately 9% (basal: 83 $\pm$ 5, after: 76 $\pm$ 6 beats/min). Total cholesterol was reduced as well, approximately 20%. Physical training did not modify triglycerides levels as well as plasma nitrate/nitrite concentration (basal: 22 $\pm$ 6 after 25  $\pm$  4  $\mu\text{M}$ ).

**CONCLUSION:** Our findings show that exercise training promotes a beneficial effect on the arterial blood pressure which was not associated with plasma nitrate/nitrite levels in hypertensive obese women.

Financial Support: FUNDUNESP/CAPES

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### 1758 Board #108 May 27 3:30 PM - 5:00 PM

#### Effects Of Exercise Training Intensity On Metabolic Syndrome Components: A Preliminary Study Of Japanese Men



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Many studies have reported that regular exercise could improve various components of the metabolic syndrome (MetS). However, it is unclear whether intensity of exercise training affects MetS-component improvements in Japanese obese men.

**PURPOSE:** To examine the effects of exercise training intensity on the components of MetS in obese men.

**METHODS:** Thirty-eight obese men aged 32 to 60 years participated in this study. They were divided into two groups (non-random design): moderate exercise (ME) group ( $n = 31$ , age:  $45.4 \pm 8.4$  yr, body mass index [BMI]:  $30.4 \pm 4.0$  kg/m<sup>2</sup>) and vigorous exercise (VE) group ( $n = 7$ , age:  $47.6 \pm 10.9$  yr, BMI:  $29.2 \pm 1.3$  kg/m<sup>2</sup>). All participants engaged in a 3-month exercise training program consisting mainly of aerobic exercise. The program was 90 minutes per session on 3 days per week. Main exercise modes were brisk walking for ME group and jogging for VE group. Measures of visceral fat area (VFA) by computed tomography, systolic and diastolic blood pressure (SBP, DBP), triglycerides (TG), high-density lipoprotein cholesterol, and fasting blood glucose were performed before and after the program. Relative exercise intensity (percentage of heart rate reserve) was also assessed during exercise sessions by a wireless heart rate monitor.

**RESULTS:** Exercise training reduced body weight by approximately 3 kg in both ME and VE groups. VFA significantly decreased from  $206.4 \pm 53.1$  cm<sup>2</sup> to  $172.1 \pm 44.4$  cm<sup>2</sup> for ME group and from  $167.1 \pm 46.1$  cm<sup>2</sup> to  $135.9 \pm 40.4$  cm<sup>2</sup> for VE group in response to exercise training. Significant reductions in SBP, DBP and TG were detected after the program in the ME group, but not in the VE group. Two-way (time by group) repeated ANOVA revealed no significant interactions ( $P = 0.11$  to  $0.92$ ) for all components of MetS. The results remained unchanged after controlling for weight change and each baseline value. In the pooled samples ( $n = 33$ ), relative exercise intensity did not correlate to improvements in the components of MetS ( $P = 0.13$  to  $0.98$ ). Similar results were also obtained after adjustments for each baseline value ( $P = 0.28$  to  $0.95$ ).

**CONCLUSION:** In this preliminary study, the intensity of exercise training might not influence MetS-component improvements in Japanese obese men.

*This work was supported in part by The Japan Health Foundation (2008-2009).*

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**1759 Board #109 May 27 3:30 PM - 5:00 PM**  
**Effectiveness Of A Lifestyle-modification Program In Overweight Adults**

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Brazil ranks 6<sup>th</sup> with 10% of obese (Ob) and 40% of overweight (Ow) individuals. There are no official data about the expenditure on body weight (BW)-reducing drugs, but it is estimated that chronic diseases associated with fattness cost US\$ 45.45 per person/yr to the health care system. Alternative to drugs, lifestyle intervention can prevent or control the disease.

**PURPOSE:** To evaluate the cost-benefit relationship of a feasible low-cost lifestyle-change program (LISC) for adults.

**METHODS:** The study included retrospective data on 116 adults ( $53.2 \pm 7.8$  yrs, 53.4% males that fulfilled the criteria of not taking medicines or not being on energy-restricted diets, accomplishing 3-5 sessions/wk of supervised exercises (60%-70% VO<sub>2</sub>max, 75 min), dietary-counseling sessions (monthly) and anthropometric assessments (every two months). LISC was conducted during two 6-month periods (P<sub>1</sub> and P<sub>3</sub>), intermediated by a counseling exercise period of 2 mo. (P<sub>2</sub>). The two physical-exercise and nutrition professionals with two students earned US\$ 636/mo. Body Mass Index (BMI) was classified as eutrophic (Eu), Ow and Ob (WHO, 1998), and body fatness (%BF) and the waist/hip ratio (W/H) by NHANES III (1996). The statistics included ANOVA, with  $p=0.05$ .

**RESULTS:** At baseline, Ow was more frequent (45.7%) than Ob (37.9%), and Eu (16.4%) with abdominal fat (W/H) predominated (81%) over body fatness (59.5%), with the latter being more frequent in Ob (58%) and the former in Ow (44.7%). Males were predominantly Ow (48.4%) with abdominal fatness (93.5%) whereas females were equally Ob and Ow (42.6%) with high body fat (77.8%). Ow males responded to LISC better in P<sub>1</sub> by losing BW ( $P_{95}=-4.5\%$ ), %BF (-12.9%) and W/H (-3.2%) whereas Ow females responded better in P<sub>3</sub> by losing %BF (-18.5%) and W/H (-5.5%). The loss of benefits in P<sub>2</sub> led the females to increase Ob (1.9%), %BF (2.4%) and W/H (5.6%). The overall program (P<sub>1</sub>+P<sub>2</sub>+P<sub>3</sub>) reduced 20% of Ob, but increased Eu only over Ow (13.8%). Fatness normalization reached 9.7% and 6.7% for %BF and W/H, respectively.

**CONCLUSION:** If applied nationwide for the 70mi. adult-Ow Brazilians, the present LISC (costing US\$ 7632/yr) with an efficiency of 13.8% would save US\$ 439mi/yr, which would be enough to replicate such LISC program 10 times in all the 5.564 Brazilian cities.

*Supported by Fapesp and CNPq*

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**1760 Board #110 May 27 3:30 PM - 5:00 PM**  
**Tailored Messaging And Its Effect On Health And Lifestyle Improvement**

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(No relationships reported)

The rising cost of healthcare has driven employers to develop effective health education and communication strategies designed to improve health outcomes. There is growing evidence for the use of computer-tailored, online behavioral health interventions.

**PURPOSE:** To determine the effectiveness of a computer-tailored, online behavioral health intervention promoting healthy lifestyle changes.

**METHODS:** Participants were recruited staff from a large mid-western college campus to participate in the computer-tailored wellness program. Information collected was based on epidemiological need, stage of change, motivation, self-confidence, barriers and demographics, the automated system recruits participants into follow-up behavior change interventions. Self-reported baseline and follow-up biometric, health risk behaviors, lifestyle scores, quality of health and life, motivation, and self efficacy data were analyzed using either CHI squared ( $\chi^2$ ) for categorical variables or t tests for continuous variables.

**RESULTS:** Of the 432 employees enrolled, 23.8% ( $n = 129$ ) completed the one-year follow up health risk assessment. The participants in this study were predominately women (78%), middle-aged, white/non-Hispanic and college graduates. At 1yr follow up, body mass index (BMI) data showed proportionally fewer men in extremely obese (-5.6%), and overweight categories (-5.5%) and more men in the obese category (5.6%). Women showed little proportional change in the BMI risk category except for the significant increase in the extremely obese category (4.6%,  $p<0.05$ ). Physical activity, nutrition, weight management, skin protection and mental health were the 5 behaviors with the highest risk at enrollment and there were strong trends toward improving health in these areas at year end. The lifestyle scores indicated a significant shift towards a healthier lifestyle. However, perceived quality of health and life did not significantly change with participation. Overall motivation and self-efficacy to change risk behaviors showed a strong positive trend.

**CONCLUSION:** Participation in the computer-tailored wellness program resulted in a moderate shift towards a healthier lifestyle. The low program retention contributed to the suboptimal program performance on risk modification.

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**1761 Board #111 May 27 3:30 PM - 5:00 PM**  
**Effect Of Lifestyle Health Coaching On Risk Factors In Normal Weight, Overweight And Obese Participants**

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Lifestyle health coaching (LHC) has gained increased popularity as a strategy to facilitate behavior change. Scarce comprehensive data are available on the effect of LHC on multiple cardiovascular disease (CVD) risk factors in normal weight, overweight and obese adults.

**PURPOSE:** In this study, we evaluated the effect of LHC on multiple CVD risk factors in 7,281 adults, of whom 3,784 were obese (Group I, baseline body mass index [BMI] >30 kg/m<sup>2</sup>), 2,134 were overweight (Group II, baseline BMI = 25-29.9 kg/m<sup>2</sup>) and 1,363 were normal weight (Group III, baseline BMI <25 kg/m<sup>2</sup>).

**METHODS:** Outcome measures were assessed at baseline and after approximately 1 year of LHC. LHC included individualized coaching on exercise, nutrition, weight management, stress management and smoking cessation.

**RESULTS:** Weight (Group I, -6.9 lbs; Group II, -2.3 lbs; Group III, 0.1 lbs) and BMI (Group I, -1.1 kg/m<sup>2</sup>; Group II, -0.4 kg/m<sup>2</sup>; Group III, 0 kg/m<sup>2</sup>) decreased significantly (p <0.05) in the overweight and obese participants (p <0.05 for Group I versus Groups II and III; p <0.05 for Group II versus Group III). For participants with abnormal baseline risk factors, significant improvements (p <0.05) were observed for multiple additional variables in all 3 groups, as follows: blood pressure (Group I, -8/7 mmHg; Group II, -8/7 mmHg; Group III, -11/8 mmHg); LDL cholesterol (Group I, -19 mg/dl; Group II, -21 mg/dl; Group III, -21 mg/dl); HDL cholesterol (Group I, 4 mg/dl; Group II, 4 mg/dl; Group III, 6 mg/dl); triglycerides (Group I, -39 mg/dl; Group II, -46 mg/dl; Group III, -58 mg/dl); and fasting glucose (Group I, -9 mg/dl; Group II, -6 mg/dl; Group III, -14 mg/dl). In participants with a baseline Framingham 10-year coronary heart disease risk score >10%, the score decreased significantly (p <0.05) in participants in all 3 groups (Group I, -20.8%; Group II, -21.3%; Group III, -17.2%; p=NS for the differences among groups).

**CONCLUSIONS:** These data serve to document the magnitude of improvement in multiple CVD risk factors in normal weight, overweight and obese individuals in response to participation in 1 year of LHC. Although weight loss is greatest for obese participants, the magnitude of improvement in the Framingham 10-year coronary heart disease risk score is similar for all participants.

## 1762 Board #112 May 27 3:30 PM - 5:00 PM

### Effect Of Gender On Responsiveness Of Multiple Cardiovascular Disease Risk Factors To Lifestyle Health Coaching In Adults With Prediabetes

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( N.F. Gordon, PrevCan, Ownership Interest.)

Prediabetes affects ~33.5% of men and ~22.6% of women in the U.S. Scarce data are available on the effect of gender on the responsiveness of cardiovascular disease (CVD) risk factors to lifestyle health coaching (LHC) in adults with prediabetes.

**PURPOSE:** In this study of 967 men (n = 399; age = 57 years) and women (n = 568; age = 55 years) with prediabetes, we evaluated the effect of gender on the responsiveness of multiple CVD risk factors to LHC.

**METHODS:** At baseline, all participants met the American Diabetes Association's (ADA) criteria for prediabetes. Participants were evaluated at baseline and after an average of ~4 months of LHC. LHC included individualized coaching on exercise, nutrition, weight management, and smoking cessation.

**RESULTS:** In men, baseline fasting glucose (108 mg/dl) decreased by 5 mg/dl (p <0.05) with LHC. Similarly, baseline fasting glucose (107 mg/dl) decreased by 5 mg/dl (p <0.05) with LHC in women. Based on ADA criteria, 172 (43.1%) men and 250 (44.0%) women normalized their fasting glucose (i.e., fasting glucose below 100 mg/dl). For participants with abnormal baseline risk factors, significant (p <0.05) improvements were observed for multiple additional variables, as follows: blood pressure (Men, -9/7 mmHg; Women, -9/7 mmHg); LDL cholesterol (Men, -25 mg/dl; Women, -15 mg/dl; p <0.05 for Men versus Women); HDL cholesterol (Men, 2 mg/dl; Women, 3 mg/dl); triglycerides (Men, -56 mg/dl; Women, -35 mg/dl; p <0.05 for Men versus Women); and weight (Men, -8 lbs; Women, -7 lbs). Of the participants who smoked cigarettes at baseline, 19.6% of men and 0% of women quit smoking. In participants with a baseline Framingham 10-year coronary heart disease risk score >10%, the score decreased significantly (p <0.05) in men and women (Men, -22.8%; Women, -18.1%; p <0.05 for Men versus Women). Thus, while the magnitude of reduction in fasting glucose was similar in men and women, men derived a slightly greater benefit in terms of overall CVD risk reduction.

**CONCLUSIONS:** The present study adds to previous research by reporting on the effectiveness (rather than the efficacy) of LHC in adults with prediabetes. The data show that many adults with prediabetes can normalize their fasting glucose with LHC but suggest that there may be gender-related differences in the therapeutic responsiveness of certain risk factors.

## 1763 Board #113 May 27 3:30 PM - 5:00 PM

### Evidence-based Practice Improves Health Outcomes In A Community-based Fitness Program

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Evidence-based practice (EBP) refers to the integration of current best clinical evidence, clinical expertise, and client choice in making decisions about the care of individuals. It has been noted that EBP exercise interventions have not been widely applied in non-research settings (Glasgow et al., 2003).

**PURPOSE:** The purpose of this study was to implement an EBP exercise intervention into a local community fitness program following the specific exercise dose (14-23 kcal/kg/wk) and intensity (40-60% heart rate reserve - HRR) guidelines reported in a recent randomized, controlled study (Kraus et al., 2002) to elicit positive health outcomes.

**METHODS:** Participants (N = 238; men = 101 and women = 137) with a mean age of 62.4 yr (range = 29-86 yr) completed a 14-wk community fitness program. Baseline (BL) and post-program measures included energy expenditure, systolic and diastolic blood pressure, cardiorespiratory fitness, body mass, waist circumference, and fasting lipid/blood glucose profile.

Outcome variable	Baseline	Post-Program	14 kcal/kg/wk % change	23 kcal/kg/wk % change
Absolute EE (kcal/d)	461 ± 244	1010 ± 409	Not reported	Not reported
Relative EE (kcal/kg/d)	5.0 ± 1.1	17.8 ± 8.7	Not reported	Not reported
Waist Circumference (cm)	103.2 ± 18.2	101.2 ± 18.3	-1.5%	-1.9%
Body mass (kg)	82.3 ± 21.3	81.6 ± 21.1	-0.7%	-0.1%
Cardiorespiratory Fitness (mL/kg/min)	28.7 ± 9.9	32.4 ± 11.2	+11.0%	+12.9%
Cardiorespiratory Fitness (L/min)	2.63 ± 0.91	2.97 ± 0.95	+11.3%	+12.1%
Systolic BP (mmHg)	123.2 ± 13.4	120.1 ± 12.3	Not reported	Not reported
Diastolic BP (mmHg)	76.4 ± 10.9	74.9 ± 8.7	Not reported	Not reported
Total cholesterol (mg/dL)	180.6 ± 40.6	183.7 ± 41.8	+2.3%	+5.5%
HDL (mg/dL)	45.6 ± 18.4	48.3 ± 17.8	+6.6%	+8.8%
LDL (mg/dL)	121.2 ± 36.7	121.4 ± 32.1	+0.3%	-1.4%
Triglycerides (mg/dL)	140.6 ± 77.8	118.1 ± 71.9	-16.1%	-17.0%
Fasting Glucose (mg/dL)	106.8 ± 36.4	89.3 ± 34.9	+2.8%	-7.0%

**RESULTS:** BL and post-program health outcome data (mean ± SD) pooled from six separate semesters between fall 2005 and spring 2008 are presented in the table. Percent (%) change from BL to post-program for our community fitness program and the two exercise volume groups (14 and 23 kcal/kg/wk) from the literature used to guide our intervention are also reported in the table. Mean relative energy expenditure and exercise intensity were 17.8 kcal/kg/wk and 42.3% HRR, respectively.

**CONCLUSION:** Our data indicates that participants in an EBP community fitness program have comparable health outcomes to participants in a research setting. Overall, these findings suggest that EBP exercise guidelines can successfully be translated into a community setting.

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**1764 Board #114 May 27 3:30 PM - 5:00 PM**  
**Self-efficacy Moderates The Effect Of Moderate Intensity Exercise On Smoking Cessation Outcomes Among Women**

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(No relationships reported)

There has been mixed support for exercise as a treatment adjunct for smoking cessation programs, suggesting that certain moderators may help to identify participants for whom such programs are more likely to be effective.

**PURPOSE:** To examine smoking cessation self-efficacy as a potential moderator of smoking cessation outcomes among women enrolled in a randomized clinical pilot study testing moderate intensity exercise as an adjunct to nicotine replacement therapy.

**METHODS:** Sixty previously sedentary, healthy, adult female smokers (70% non-Hispanic White, mean (SD) age = 42.4 (11.5)) were randomly assigned to an 8-week program consisting of brief baseline counseling and the nicotine patch plus either 150 min/week of moderate intensity exercise or a wellness contact control. A previously validated questionnaire was used to assess smoking cessation self-efficacy immediately prior to randomization. Smoking cessation outcomes included carbon-monoxide confirmed 7-day point prevalence abstinence at post-treatment and at one-month follow-up.

**RESULTS:** Smoking cessation self-efficacy moderated treatment outcomes at post-treatment ( $p = .039$ ) and one-month follow-up ( $p = .051$ ). Specifically, participants with higher smoking cessation self-efficacy at baseline had a 122% increase in odds of being quit at post-treatment ( $OR = 2.23$ ,  $p = .076$ ), and a 288% increase in odds of being quit at one-month follow-up ( $OR = 3.88$ ,  $p = .029$ ) if they were in the exercise treatment condition; however, higher baseline self-efficacy did not result in increased odds of being quit at post-treatment ( $OR = 0.545$ ,  $p = .235$ ) or one-month follow-up ( $OR = 0.731$ ,  $p = .594$ ) among participants in the wellness condition.

**CONCLUSION:** Moderate intensity exercise may be a more effective adjunct to nicotine replacement therapy among previously sedentary women with initially high smoking cessation self-efficacy.

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**B-32 Free Communication/Poster - Physical Activity Interventions - Primary Care**

MAY 27, 2009 1:00 PM - 6:00 PM  
ROOM: Hall 4F

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**1765 Board #115 May 27 2:00 PM - 3:30 PM**  
**Improving Physical Activity And Nutrition Assessment And Counseling In Community Health Centers**

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Community Health Centers (CHC) provide comprehensive care for medically underserved patients. Methods to provide quick and culturally relevant physical activity (PA) and nutrition assessment along with counseling to CHC patients are lacking.

**PURPOSE:** Using the PACE (Physician Assisted Counseling for Exercise) Program, we aimed to gain the insight of CHC providers and medical assistants (MAs) to improve PACE for clinic use with a target population of lower-income and primarily Spanish-speaking women.

**METHODS:** Site licenses for PACE were purchased. Four providers (3 MD, 1 PA-C) and eight MAs participated in two focus groups after providing written, informed consent. All participants were bilingual in English and Spanish. Focus groups were conducted at two clinics in urban Utah and each consisted of two providers and four MAs. The Spanish language PACE materials were provided to participants in advance of focus groups. Questions regarding perceived patient understanding of PACE materials, cultural meaningfulness of PACE and practical implementation of PACE in the clinic were asked. Each focus group lasted 60 minutes.

**RESULTS:** Three themes emerged from the focus groups. 1. Participants felt that PA and nutrition are important aspects of health that should be addressed in the context of primary care offered by their respective clinics. Participants noted that patients often request information on PA and nutrition, particularly with regard to weight loss. 2. The researchers felt that a successful PA and/or nutrition program should relate to the cultural background and consider financial constraints of the patient population. Participants suggested changes to the Spanish PACE text for greater patient appeal. 3. The PACE Program must be shortened and use more basic language for practical implementation in clinics. Providers have ~15-minute patient visits and patients are not accustomed to completing complex forms. Therefore, participating clinics cannot implement PACE in its current structure.

**CONCLUSION:** There is support for PA and nutrition assessment and counseling using PACE in urban Utah CHC clinics, yet changes must be applied to improve feasibility and cultural relevance to the patient population.

Supported by OWH Grant 5 ASTWH070006-02-00 & Herbert I. & Elsa B. Michael Foundation.

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**1766 Board #116 May 27 2:00 PM - 3:30 PM**  
**Misunderstanding Of SPF Sunscreen Rating Among Varying Sport And Physical Activity Participants**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to evaluate knowledge of the skin protection factor (SPF) rating among various physical activity groups. The SPF factor is commonly used in labeling for sunscreens and, now, for clothing.

**METHODS:** A total of 1208 submitted answers to a demographic and 10 question T/F survey. Each participant listed activities in which they participate. Surveys were distributed during regional health fairs, skin cancer screenings, medical school classes, and dermatology and surgical oncology patient visits. Knowledge of SPF was measured by the true/false survey statement: "SPF (sun protection factor) represents the number of minutes a person can be out in the sun with sunscreen on and be getting the same amount of UV rays as if they were out in the sun with no sunscreen on for one minute."

**RESULTS:** In the groups listed, the above true statement was the most or 2<sup>nd</sup> to most incorrectly answered. In this survey, all ten statements are true for the purpose of being an educational tool. Participants may have been able to discern the answer pattern. Because of this, the percentage of correct answers to the SPF question is probably skewed high. In a future study, we plan to administer a revised survey instrument with a mix of true and false statements to specific sports teams.

SPF Knowledge by Activity
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ACTIVITY	NUMBER	% CORRECT
Running, jogging	338	68
Swimming	320	63
Hiking	272	69
Bicycling	181	71
Tennis	120	68
Baseball	105	66
Soccer	99	65
Softball	94	64
Walking	78	67
Track/cross country	60	63

**CONCLUSION:** Even though “SPF” is a commonly used acronym indicating the level of sun protection offered in sunscreen and clothing, many people do not understand what SPF actually means. With ACSM and AHA guidelines and their support of the US Dept of Health and Human Services (DHHS) physical activity guidelines, we recommend that the ACSM address skin cancer prevention education, and, in particular, the promotion of accurate understanding of SPF nomenclature.

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**1767 Board #117 May 27 2:00 PM - 3:30 PM**  
**Development And Feasibility Study Of A Chair-based Bladder Health Program For Senior Women**

Ihm Jeni, Sheila Ann Dugan, FACSM, Missy Lavender, Jennifer Hebert-Beirne, Jacqueline de la Cruz, Cody McSellers-McCray, Carol McPherson, Christine Cornell, Mary Susan Chen. *Rush University Medical Center, Chicago, IL.*  
*(No relationships reported)*

**PURPOSE:** To successfully adapt an evidenced-based pelvic fitness and educational program for women to a female senior population reporting bladder symptoms.

**METHODS:** Feasibility study with convenience sampling of women in independent living at The Altenheim, a senior community in Forest Park, Illinois who engaged in a six week fitness and educational class modeled after WHF’s medically-based Total Control™ pelvic exercise program designed for women in the general population. The class met once (1) a week for six (6) weeks for 60 minute pelvic fitness (45 min) and educational program (15 min). Excel and SPSS for demographics; SF-12; UDI-6; TUG; IIQ-7; symptom severity and bothersomeness of symptoms; perception of feasibility of fitness class; and overall health change at B/L & F/U.

**RESULTS:** Participants were eight white women, average age of 81. One subject did not attend the final class and with no follow up. SF 12: 7/8 with symptoms moderate to as bad as they can be at B/L. 3/7 nonexistent to moderate symptoms at F/U. 5/8 rated their health as “good” or “fair” at B/L 6/7 “excellent” or “very good” at F/U. 5/8 at B/L and 2/7 at F/U reported that because of their physical health, they accomplished less than they would like and were limited in the kind of activities in which they engaged. Timed Up and Go (TUG): 12.5 sec (SD 3.38) B/L, 10.8 sec (SD 2.19) F/U.

Urinary Distress Inventory (UDI): 6/8 moderately or greatly bothered by frequent urination at B/L. 3/7 with reduction in bothersomeness with one participant reporting none at F/U. 3/7 moderately or greatly bothered by urine leakage at B/L. 7/7 only slightly bothered or bothered not at all by urine leakage at F/U. Incontinence Impact Questionnaire (IIQ-7): 3/7 with ↓ extent to which urine leakage affected household chores. 2/7 with ↓ in how urine leakage affected social activities Satisfaction: 100% satisfied with the program. 75% definitely understood exercises; 25% somewhat. 5 definitely noticed changes in your bladder control/pelvic floor function at F/U; 2 somewhat

**CONCLUSIONS:** Senior women in independent living were able to engage in a pelvic floor fitness program in sitting. They were able to perform pre- and post-tests. The majority felt they understood the exercises and had positive changes in bladder symptoms. We are ready to use the program and assessments for a multi-site trial.

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**1768 Board #118 May 27 2:00 PM - 3:30 PM**  
**Activity, Diet, And Compliance Trends In A University-based Exercise Prescription Study**

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Some of the challenges that primary care providers (PCPs) face in developing effective clinic-initiated exercise intervention programs include management of PCP time commitment, design of appropriately flexible yet specific exercise prescriptions, and streamlined patient referral to exercise professionals. In an increasingly challenging financial climate for providers and patients alike, there remains a need for model intervention programs that address these challenges at minimal expense.

**PURPOSE:** To design and validate components of an exercise prescription program suitable for adoption by primary care clinics, and to assess the value of specific exercise prescription relative to either (a) no advice or (b) standard advice as recommended by the American Association of Family Physicians (AAFP).

**METHODS:** 78 subjects (BMI 25≤x≤40) were recruited (by clinical or self referral), screened, and enrolled into the UNEPS exercise study at the University of Nevada, Reno. Subjects were randomized to one of three treatments (no advice, standard advice, and specific prescription) in order to assess the effect of fitness testing and prescription specificity on intervention compliance, resting metabolic rate (RMR) progression, VO<sub>2</sub>max progression, and activity levels during the 6-month exercise intervention.

**RESULTS:** Subjects receiving specific exercise prescription demonstrated significantly enhanced RMR and moderate activity levels (by accelerometry) relative to subjects receiving either no advice or standard advice.

**CONCLUSION:** Specificity in primary care-based exercise intervention programs contributes to beneficial increases in general activity.

*Supported by Nevada State Health Division Trust Fund for Public Health.*

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**1769 Board #119 May 27 2:00 PM - 3:30 PM**  
**Healthcare Provider Counseling For Physical Activity, Diet, And Weight Management**

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*(No relationships reported)*

Healthcare provider (HCP) counseling for improving physical activity, diet, and weight management has proven efficacious yet the majority of HCPs do not counsel their patients for these behaviors.

**PURPOSE:** To understand HCP counseling rates and attitudes toward counseling for physical activity, diet, and weight management.

**METHODS:** A survey was mailed to randomly selected physicians (N = 1000), nurses (N = 1000), and all 697 physician assistants. HCPs indicated the percent of their patients

they counsel for physical activity, diet, and weight management. For each of these health behaviors, seven attitudes toward counseling were assessed using a 5-point Likert scale. Multiple regressions were conducted separately for physical activity, diet, and weight management counseling rates. Independent variables were HCP type (physician, nurse, physician assistant), HCP sex, HCP body mass index and health behaviors and HCP attitudes toward counseling.

**RESULTS:** Mean counseling rates for physical activity, diet, and weight management were 52.4%, 51.2%, and 41.1%, respectively (response rate = 16.4%;  $n = 443$ ). For physical activity, two factors explained 17.6% of variance in counseling rate. Nurses were significantly less likely to counsel for physical activity than physicians and physician assistants ( $p = 0.05$ ) and perception that patients are interested in receiving counseling was positively related to counseling rate ( $p < 0.001$ ). For diet, two factors explained 16.3% of variance in counseling rate. Perception that patients are interested in receiving counseling ( $p < 0.001$ ) and perception their patients would benefit from a healthier diet were positively related to counseling rate ( $p = 0.003$ ). For weight management, three factors explained 26.0% of variance in counseling rate. Nurses reported lower rates of counseling than physician assistants and physicians ( $p = 0.002$ ). Additionally, perception that patients are interested in receiving counseling ( $p < 0.001$ ) and perception their patients were overweight ( $p = 0.03$ ) were positively associated with counseling rate.

**CONCLUSION:** These data indicate all HCPs, especially nurses, should increase counseling. Furthermore, increasing HCP perception of patient interest in receiving counseling may increase counseling rates and, ultimately, reduce chronic disease.

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**1770 Board #120 May 27 2:00 PM - 3:30 PM**  
**Healthcare Provider Physical Activity Prescription Intervention Pilot**

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**PURPOSE:** To examine the feasibility and short-term impact of healthcare providers' recommendations of physical activity on the physical activity levels of patients on preventive care visits.

**METHODS:** Consenting adult patients completed questionnaires on their general health and physical activity (Short Form 36, Aerobic Center Longitudinal Study (ACLS) habitual physical activity, Patient-centered Assessment and Counseling for Exercise (PACE) readiness for physical activity, and Cancer Prevention Research Center exercise self-efficacy), and were assigned to 1 of 3 experimental groups, based on chronological order of entry into the study. At the office visit, the healthcare provider prescribed physical activity using a written prescription only (WP), a WP plus a toolkit containing an elastic band and instructions (WPT), or a WP plus a guide to local physical activity resources (WPG). 1 month post, participants completed the PACE survey, with possible scores from 1 to 8 (higher scores indicate more physical activity). 3 months post, baseline questionnaires were repeated.

**RESULTS:** 24 patients completed data-collection at baseline and 3 months; 22 completed baseline, 1 and 3 months. There were no baseline differences among the groups or between those who completed or did not complete the study. Within the overall group of 24 patients (mean age 57 years  $\pm$  10.01; mean BMI 33.4  $\pm$  7.6; 14 women/10 men; 9 WP, 6 WPT, 9 WPG) who returned questionnaires at baseline and 3 months, physical activity level, assessed by the PACE survey, increased ( $p=0.04$ ) from baseline (3.5  $\pm$  2.0) to 3 months (4.3  $\pm$  1.7). Within group analyses revealed that WPT improved ( $p=0.01$ ) from baseline (3.0  $\pm$  1.1) to 3 months (4.8  $\pm$  0.4), whereas WP and WPG did not. Among the 22 participants (all groups combined) who returned questionnaires at baseline, 1 and 3 months, physical activity level increased ( $p=0.01$ ) from 1 month (3.7  $\pm$  1.3) to 3 months (4.4  $\pm$  1.6) and approached a significant increase ( $p=0.06$ ) between baseline and 3 months.

**CONCLUSION:** Preliminary support is provided for the feasibility, and positive impact of, a healthcare provider's written prescription, in conjunction with a physical activity resource, e.g. an exercise toolkit, to enhance patients' physical activity levels over 3 months. Toolkits donated by the Hygenic Corporation.

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**B-33 Free Communication/Poster - Psychological Determinants of Physical Activity**

MAY 27, 2009 1:00 PM - 6:00 PM  
ROOM: Hall 4F

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**1771 Board #121 May 27 2:00 PM - 3:30 PM**  
**I'm Stressed! I Must/can't Exercise Today! Effects Of Stage On Physical Activity And Stress.**

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While only a handful of prospective studies have been conducted in this area, there is evidence that people engage in less physical activity upon encountering higher levels of psychological stress. Despite this, physical activity is often reported to be an effective coping mechanism to relieve stress. In addition, motivational differences exist between frequent and infrequent exercisers. As a result, it might be that the impact of stress on freely chosen physical activity would differ based on exercise stage of change.

**PURPOSE:** Using a prospective design, we examined the relationship between stress and physical activity, while testing for a moderating effect of stages of change derived from the Transtheoretical Model.

**METHODS:** 95 college-aged females (19.34  $\pm$  2.08 yrs; 64.23  $\pm$  2.03 in; 138.27  $\pm$  29.92 lbs; 23.64  $\pm$  4.91 BMI) were recruited from undergraduate classes and the local community. Participants completed a battery of questionnaires before a 6-week evaluation period. During this period, participants were asked to return a leisure-time physical activity log daily and to return a stress events scale weekly (Weekly Stress Inventory; Brantley, et al., 1997).

**RESULTS:** Results of HLM analyses demonstrated that there was no effect of stress events frequency or intensity on physical activity. However, it was found that this effect was suppressed by exercise stage of change as stages of change interacted with stress (both event frequency and intensity) to effect the amount of total physical activity minutes reported per week (stress frequency,  $G = -2.61$ ,  $SE = 0.95$ ,  $t\text{-ratio} = -2.75$ ,  $df = 76$ ,  $p = 0.008$ ; stress intensity,  $G = -0.69$ ,  $SE = 0.25$ ,  $t\text{-ratio} = -2.74$ ,  $df = 76$ ,  $p = 0.008$ ). The stress - physical activity relationship was negative for those in the contemplation stage, positive for those in the maintenance stage, and non-existent for those in preparation and action phases.

**CONCLUSION:** Results are indicative of stress - physical activity relationships that vary by exercise stage of change. Physical activity participation for those at an early stage of change (i.e., contemplation) appears to be negatively influenced by stressful experience, whereas those at the highest stage of change (i.e., maintenance) may exercise more under stress.

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**1772 Board #122 May 27 2:00 PM - 3:30 PM**  
**The Relationship Between Health Knowledge And Measures Of Health-related Physical Fitness**

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Research suggests that individuals who have increased fitness knowledge via health education are more likely to be physically active and fit. However, literature delineating the relationship between health knowledge base and the components of health-related physical fitness is scarce and inconsistent.

**PURPOSE:** To determine the relationship between health-related physical fitness knowledge (HRPFK) and objective measures of health-related physical fitness in adulthood.

**METHODS:** Health knowledge was assessed in 18 F and 16 M adults (19-49 yr) via the FitSmart, a 50 question standardized multiple choice examination of HRPFK, which incorporates: concepts of fitness, scientific principles of exercise, components of physical fitness, effects of exercise on chronic disease risk factors, exercise prescription, as well as nutrition, injury prevention, and consumer issues. Health-related physical fitness was assessed using the Canadian Physical Activity Fitness and Lifestyle Approach (CPAFLA), which objectively measures: physical activity participation (PAP), body composition (BMI, Waist Circumference (WC), Sum Of 5 Skinfolds), aerobic fitness (mCAFT), composite musculoskeletal fitness (grip strength, push-ups, flexibility, partial curl-ups, vertical jump, leg power, back extension (BE)), and composite back fitness (PAP, WC, flexibility, curl-ups, BE ). All measures were completed by a Canadian Society for Exercise Physiology-Certified Exercise Physiologist (CSEP-CEP).

**RESULTS:** HRPFK was significantly correlated to composite musculoskeletal fitness ( $r=0.40$ ). When controlling for socio-demographic variables (age, gender, income, & education), regression analyses showed that HRPFK was the strongest unique contributor to musculoskeletal fitness (standardized  $B=0.59$ ,  $p<0.05$ ). Within composite musculoskeletal fitness, there was a positive and significant correlation between HRPFK and push-ups ( $r=0.37$ ), as well as HRPFK and partial curl-ups ( $r=0.41$ ).

**CONCLUSION:** HRPFK is a significant contributor to and correlate of health-related physical fitness in adulthood. Clearly, the concept of HRPFK warrants further investigation as it holds important implications for the development of future health promotion initiatives.

**1773 Board #123 May 27 2:00 PM - 3:30 PM**

### Differences In Psychosocial Factors According To Physical Activity Levels In Males And Females

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(No relationships reported)

**PURPOSE:** To examine differences in psychosocial factors according to physical activity (PA) levels in males and females.

**METHODS:** Subjects were 552 young adults (mean age  $29.4 \pm 1.1$  yrs). The sample was approximately 82% Caucasian, 15% African-American, with females comprising 57% of the sample. A Mann-Whitney U-test of independent samples was used to determine differences in 8 psychosocial variables (perceived barriers to PA, perceived benefits of PA, self efficacy, social support, perceived stress, decisional balance, depression, and PA enjoyment) between groups differing in total weekly PA. Participants were grouped based on weekly reported PA, with the cut-point set at 150 min/week of reported PA. Separate analyses were done for male and female PA groups.

**RESULTS:** The results showed that both male and female higher PA groups reported less perceived stress, lower depression, greater PA enjoyment, greater PA benefits, and greater self-efficacy than the lower PA groups ( $p<0.05$  for all variables). The results further showed that social support differed significantly ( $p = 0.04$ ) between PA groups for males but not for females, and that decisional balance ( $p = 0.011$ ) and perceived barriers ( $p < 0.001$ ) differed significantly between PA groups for females but not for males. See table for median scores  $\pm$  SD and  $p$ -value for the differences between PA groups, for males and females separately.

	Males				Females			
	Lower PA group Score	Higher PA group Score	p-value	U-score	Lower PA group Score	Higher PA group Score	p-value	U-score
Social Support	35.0 $\pm$ 9.5	40.0 $\pm$ 11.1	0.014	1454.0	37.0 $\pm$ 10.6	40.5 $\pm$ 11.6	0.197	8515.5
Perceived Barriers	31.0 $\pm$ 11.2	28.0 $\pm$ 9.2	0.072	2086.0	37.0 $\pm$ 10.3	30.0 $\pm$ 10.8	0.001	6528.5
Decisional Balance	1.1 $\pm$ 0.7	1.3 $\pm$ 1.2	0.313	1682.5	1.1 $\pm$ 1.0	1.5 $\pm$ 1.1	0.011	7602.5

**CONCLUSION:** Males and females differed by PA group for social support, perceived barriers and decisional balance. These results suggest that PA interventions should consider gender-specific strategies to increase compliance with PA programs.

Supported by NICHD (HD35607) and NCI (R01CA109895)

**1774 Board #124 May 27 2:00 PM - 3:30 PM**

### Psychosocial Variables Influencing Long-term Physical Activity Levels In Overweight Men And Women

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(No relationships reported)

Physical activity (PA) is a primary predictor of weight maintenance. However, rates of long-term exercise adherence are less than optimal.

**PURPOSE:** To identify characteristics of individuals who have sustained high levels of PA at the end of an 18-month intervention.

**METHODS:** 173 overweight (BMI =  $27.0 \pm 1.7$  kg/m<sup>2</sup>; age =  $45.4 \pm 8.4$  years) subjects participated in an 18-month PA intervention and were instructed to exercise between 150-300 minutes/week. Questionnaires were administered at baseline, 6 and 18 months to assess PA, barriers, expected outcomes, and behavioral processes. Subjects were grouped according to PA energy expenditure at 6 and 18 months (MAINTAIN: expending  $\geq 1500$  kcal/wk at 6 & 18 months, NON-MAINTAIN:  $\geq 1500$  kcal/wk at 6 months &  $<1500$  kcal/wk at 18 months, NON-ADOPT:  $<1500$  kcal/wk at 6 & 18 months, LATE ADOPT:  $<1500$  kcal/wk at 6 months and  $\geq 1500$  kcal/wk at 18 months).

**RESULTS:** Weight loss at 18-months was  $-0.95 \pm 4.2$  kg and was significantly greater in the MAINTAIN group ( $-2.04 \pm 4.2$  kg) compared to the NON-ADOPT group ( $0.13 \pm 3.7$  kg) ( $p<0.05$ ). Physical activity levels at 18 months were significantly higher in the MAINTAIN ( $2493 \pm 1024$  kcals) and LATE ADOPT ( $2326 \pm 648$  kcals) groups compared to the NON-MAINTAIN ( $963 \pm 359$  kcals) and NON-ADOPT ( $802 \pm 442$  kcals) groups ( $p<0.05$ ). At 18 months, the MAINTAIN group perceived there to be greater health and overall benefits of PA and reported effort as being less of a barrier to PA compared to the NON-ADOPT group ( $p<0.05$ ). Several PA behavioral processes (reminding oneself, substituting alternatives, rewarding oneself) were greater in the MAINTAIN group compared to the NON-ADOPT group at 18 months ( $p<0.05$ ). The LATE ADOPT scored higher on the subscale, caring about the consequences of others, compared to the MAINTAIN group ( $p<0.05$ ).

**CONCLUSIONS:** Individuals adopting and sustaining high levels of PA perceive greater health benefits and report fewer barriers compared to individuals with low levels of PA. Moreover, individuals sustaining higher levels of PA report the use of more behavioral strategies than individuals with lower levels of PA long-term. Thus these differences should be considered when tailoring PA interventions to meet individual needs.

Supported by the National Institutes of Health (HL070257)

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**1775 Board #125 May 27 2:00 PM - 3:30 PM**  
**A Role Of Social Cognitive Motivational Cues In Psychosocial And Muscular Endurance Training Responses**

Michael Nordvall, Susanne Goodwin, Janet Hinson. *Marymount University, Arlington, VA.*  
(No relationships reported)

Barriers to maintaining an exercise program have been well established; however many studies have stressed self-efficacy in social cognitive models rather than outcome expectancy to prolonged exercise participation. Social cognitive motivational cues have been established as a viable method to improve attendance, self-efficacy, and outcome expectations. The extent to which motivational cues influence psychosocial outcomes as well as regular exercise participation, particularly in an adult female population, remains unclear.

**PURPOSE:** To determine whether social cognitive motivational cues improve psychosocial and muscular endurance responses during a nine-week strength training program.

**METHODS:** Healthy adult female participants (42.1±6.9 yrs) were randomly assigned to an experimental group (N=6; those receiving social cognitive motivational cues) and control group (N=6). Self-efficacy, confidence to overcome barriers to physical activity, exercise outcome expectations, attendance, and muscular endurance were assessed in all subjects at baseline, 3, 6, and 9 weeks into the study. Supervised muscular endurance training and assessments consisted of modified push-ups according to ACSM guidelines. Within and between group comparisons were made using a 2 (group) x 4 (week) ANOVA with repeated measures.

**RESULTS:** Within group comparisons revealed improvements over time for several measures; however between group comparisons revealed that those subjects receiving motivational cues had higher mean (±SD) self-efficacy scores at 9 weeks, more confidence to overcome perceived barriers to physical activity at 3, 6, and 9 weeks, higher expected physical and psychological outcomes for the exercise program at 6 and 9 weeks compared to the control group ( $p \leq 0.05$ ). No differences between groups were noted for muscular endurance or attendance.

**CONCLUSIONS:** While there were no differences in muscular endurance training response and attendance between groups, social cognitive motivational cues had a greater impact on improving self-efficacy, confidence, and expected outcomes as well as reducing perceived barriers associated with maintaining an exercise program.

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**1776 Board #126 May 27 2:00 PM - 3:30 PM**  
**Path Analysis Of Feelings Of Energy, Exercise-related Self-efficacy, And Voluntary Exercise Participation**

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**PURPOSE:** This study utilized a path analysis approach to examine the relationship between feelings of physical and mental energy, task and scheduling self-efficacy beliefs, and exercise participation among college students. Additionally, the mediating effect of task and scheduling self-efficacy beliefs on the relationship between the feeling of energy and exercise participation was also examined.

**METHODS:** A cross-sectional mailing survey design was used to measure feelings of physical and mental energy, task and scheduling self-efficacy beliefs, and voluntary exercise participation in 1,000 healthy undergraduate students (21+2yrs). A total of 399 participants completed the self-report survey questionnaire.

**RESULTS:** The result indicated that univariate relationships between feelings of physical and mental energy, task and scheduling self-efficacy beliefs, and exercise behaviors were significant ( $p < 0.05$ ). The path analysis revealed that the hypothesized path model had a strong fit to the study data (Chi-square=3.36,  $df=4$ ,  $p=0.496$ ; GFI=0.998, AGFI=0.979; RMSEA=0.00; NFI=0.998; CFI=0.90). The path model showed that feelings of physical energy had significant direct effects on task and scheduling self-efficacy beliefs as well as exercise behaviors. In addition, scheduling self-efficacy beliefs had direct effects on moderate and vigorous exercise behaviors. However, there was no significant direct relationship between task self-efficacy beliefs and exercise behaviors. The path model also revealed that scheduling self-efficacy beliefs partially mediated the relationship between feelings of physical energy and exercise behaviors.

**CONCLUSIONS:** Participants who have more positive feeling of physical energy tend to be more efficacious in exercise involvement. Participants who have high feelings of energy also seem to engage in more exercise behaviors, and their relationship would become stronger when they are efficacious in coping barriers for effectively scheduling regular exercises. This result is an important consideration in future intervention studies.

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**1777 Board #127 May 27 2:00 PM - 3:30 PM**  
**Psychosocial Factors Influencing Physical Activity In Older Adults**

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**PURPOSE:** The purpose of this study was to examine the theoretical model relating social support (SS), self-efficacy (SE), decisional balance (DB), and stages of change (SOC) to objectively measured physical activity (PA) level.

**METHODS:** One-hundred and thirty-eight older adults (107 females and 31 males; 63.7 ± 6.4 y; 30.7 ± 5.9 kg/m<sup>2</sup>), completed this cross-sectional study. Demographic information was collected. Anthropometrics, including height and mass, were measured using a stadiometer and balance beam scale, respectively. Surveys focusing on PA relating to SOC, SE, DB, and SS both from family and friends were completed. Finally, participants wore a New Lifestyles NL-800 pedometer during all waking hours for seven consecutive days and recorded the total number of steps accumulated each day. Average steps/d were calculated. Structural equation modeling was used to test the theoretical model relating measures of SOC, SE, DB, and SS to PA level as determined by steps/d.

**RESULTS:** Participants accumulated an average of 5,429 ± 2,022 steps/d. The majority of participants were of white race (91.2%), 53.7% were married, 61.6% lived alone, 53% were currently employed, and 68.2% had an annual income of less than or equal to \$50,000. Results showed a good fit between the model and the data ( $\chi^2(8) = 13.18$ ,  $p = 0.11$ , GFI = 0.97, RMSEA = 0.07). DB ( $b = 0.3$ ,  $p = 0.016$ ) and SS ( $b = 0.4$ ,  $p < 0.001$ ) were found to be significant predictors of pedometer-determined PA level in this older adult population while SE ( $b = 0.004$ ) and SOC ( $b = 0.006$ ) were not.

**CONCLUSION:** In agreement with current literature consensus, among the sociological factors measured in this study, older adults whose perceived benefits of physical activity more significantly outweighed barriers and who had more support from family and friends were more likely to be physically active. Contrary to published literature, the confidence this group of older adults had in their ability to be physically active and their motivational readiness for change were not important predictors of PA.

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**1778 Board #128 May 27 2:00 PM - 3:30 PM**  
**Examination Of Preference For And Tolerance Of The Intensity Of Exercise Questionnaire In Older Adults**

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The preference for and tolerance of the intensity of exercise questionnaire (PRETIE-Q; Ekkekakis et al., 2005) has been proposed as an individual difference measure of the intensity of exercise that one can tolerate and the intensity at which one prefers to exercise. Research suggests that the PRETIE-Q is able to determine who will persist beyond ventilatory threshold and who engages in more strenuous activity on a regular basis. Thus, this measure may be useful in prescribing exercise intensity based on an individual's preference for, and ability to tolerate, exercise intensity. The majority of research on this measure has been done in college-aged subjects.

**PURPOSE:** To examine the factor structure of the PRETIE-Q in an older adult population.

**METHODS:** 74 males (age = 78.5 +/- 7.1) and 110 females (age = 77.7 +/- 6.6) completed the PRETIE-Q and returned it in a self-addressed and stamped envelope. All participants were living independently in a senior community.

**RESULTS:** An initial confirmatory factor analysis on the 2-factor structure of the PRETIE-Q revealed poor fit (Chi square = 656.7 (105), CFI = .76, RMSEA = .09 (.07 - .10), SRMR = .07). An exploratory factor analysis was then conducted to identify a more parsimonious structure; however, no theoretically viable structures were generated. Finally, an alternative 2-factor model was specified omitting items that cross-loaded on the 2 factors, resulting in a 6-item measure. This model provided a better fit to the data (Chi square = 74.5 (15), CFI = .93, RMSEA = .05 (.00 - .11), SRMR = .04).

**CONCLUSION:** While the PRETIE-Q has been shown to have a stable 2 factor structure in college-aged subjects, this structure does not appear viable in an elderly adult population. This is perhaps, not surprising. The PRETIE-Q was developed in a much younger population than that used here and thus, the items in the PRETIE-Q may have little to no relevance to elderly adults. An attempt was made to determine if a different structure would be better suited to an elderly population and while a good statistical fit was found for one of these alternative structures, there exists numerous methodological issues which make the results difficult to interpret. Considerations for future research are discussed.

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**1779 Board #129 May 27 2:00 PM - 3:30 PM**

**Mediating Effect Of Perceived Sports Competence On Achievement Goals In Physical Education And Exercise Intentions**

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The major goal of physical education (PE) is to facilitate students to develop physically active lifestyles. An important research area is to identify motivational strategies to maximize student motivation and engagement in PE and examine its trans-contextual effect on leisure-time physical activity. One important strategy synthesized from achievement goals research is the creation of a task-involved motivational climate in PE. Under this climate, students' goal orientations can be reinforced or altered to focus on mastery learning and self-improvements, rather than social comparisons. A task-involved goal is linked to adaptive motivational and behavioral patterns regardless of PSC. However, PSC mediates the relation between an ego-involved goal and motivational and behavioral responses. It is expected that such motivational effect in PE may affect leisure time physical activity via perceived sports competence (PSC). Evidence shows that PSC is distinguished from perceived behavioral control and strongly related to intentions. Little is known of the mediating relations among achievement goals, PSC, and exercise intentions.

**PURPOSE:** To examine the mediating relation among the perceived motivational climate and goal orientations in PE, PSC, and exercise intentions.

**METHODS:** 248 middle school students completed the questionnaires assessing the perceived motivational climate, goal orientations, PSC, and exercise intentions.

**RESULTS:** The SEM analysis with manifest variables indicated that PSC completely mediated the effect of ego goal orientations on intentions to exercise, and partially mediated the effects of task goal orientations. PSC and task goal orientations accounted for 11% of the variance in exercise intentions, and task and ego goal orientations accounted for 11% of the variance in PSC. The perceived motivational climate significantly predicted goal orientations in physical education.

**CONCLUSION:** A task-involved motivational climate not only can motivate students to learn in physical education, but also may go beyond the boundary of school physical education to facilitate them to develop physically active lifestyles. An important teaching implication is that physical education teachers should create task-involved and competence-focused motivational climates.

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**1780 Board #130 May 27 2:00 PM - 3:30 PM**

**Exercise Motivation In Older Adults**

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Exercise is beneficial both physiologically and psychologically, and individuals are motivated to exercise for a number of different reasons. General recommendations suggest that internal motivation will likely improve exercise adherence and prolong the behavior change.

**PURPOSE:** To determine whether the motivation for exercise differs in a physically active elderly population compared to a younger, college-aged population.

**METHODS:** Participants were either physically active, healthy college-aged females (age 20.5 years) or physically active, healthy older (age 65.5 years) adults. Each participant completed the Exercise Motivation Scale as part of a larger study on exercise and mood. The Exercise Motivation Scale is a valid measure based on Deci & Ryan's self-determination theory and is comprised of 8 motivation subscales (amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, internal motivation to learn, internal motivation to accomplish, and internal motivation to experience).

**RESULTS:** Overall, there was no difference between groups for any of the subscales for motivation for exercise. In addition, the highest subscale for both groups was identified regulation, a form of external motivation.

**CONCLUSION:** While it was hypothesized that individuals who had been successful at maintaining a physically active lifestyle for much of their lives would have a more internally motivated profile, that was not the case in this sample. It is possible that there is benefit for motivation of any kind in maintaining a health promoting behavior like exercise. This sample was comprised of individuals who had been consistently active, but it would be interesting to investigate whether the motivation profile of a new exerciser was different. Thus, future studies should look at the motivational differences for those older adults who became physically active later in adulthood.

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**B-34 Free Communication/Poster - Resistance Training**

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**1781 Board #131 May 27 3:30 PM - 5:00 PM**

**Effect Of Palm Cooling On Muscle Fatigue During High Intensity Bench Press Exercise**

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Local cooling, or cryotherapy, can induce an ergogenic effect during short term intense exercise. Cryotherapy can be accomplished using either limb or whole body cold water submersion, cold water baths, or localized icing. However, these alternatives are not practical when concerned with weight training. One proposed method of personal cooling involves heat extraction from the palm using a device called the Rapid Thermal Exchange (RTX).

**PURPOSE:** The present study investigated the effect of local palm cooling during rest intervals between 4 sets of 85% 1RM bench press on total repetitions and exercise volume in highly resistance trained subjects in a thermo-neutral environment.

**METHODS:** Sixteen male subjects (mean±SD, age = 26.3±5.8 yr, height = 178.4±7.1 cm, body mass = 81.5±11.3kg, 1RM = 123.5± 12.6kg, %body fat = 10.3±5.4%, weight training experience = 10.2±5.8yr) performed 4 sets of bench press exercise to failure, with 3 min rest intervals. Exercise trials were performed in counterbalanced order on three days, separated by at least 3 days; No Cooling (NC), Palm Heating (PH), and Palm Cooling (PC). Heating and cooling occurred using the RTX set to 45 °C and 10 °C, respectively. Data was analyzed using 2-way repeated measures ANOVA and the Tukey's post hoc test.

**RESULTS:**

Table 1. Results for repetitions completed by set.				
	1	2	3	4
NC	6.69±1.89	5.13±1.75	3.56±1.79	3.38±1.41
PH	6.69±1.89	6±2*	4.19±1.72	3.69±1.3
PC	6.69±1.89	7.5±2.07*	5.06±1.39*	4.38±1.31*

\* $p < 0.05$

PC, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> set repetitions were significantly higher than NC and PH. Total exercise volume for PC (2480±636) was significantly higher than NC (1972±632) and PH (2156±668) ( $p < 0.001$ ).

**CONCLUSIONS:** Palm cooling with RTX during rest periods between high intensity bench press sets is associated with increased exercise repetitions and exercise volumes. These results suggest that palm cooling provides enhancement of progressive resistive exercise.

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**1782 Board #132 May 27 3:30 PM - 5:00 PM**  
**Rate Of Force Development Is Not Dependent On The Load During Concentric Bench Press**

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(No relationships reported)

The bench press (BP) is a widely used movement to develop strength and power in the upper-body. Although BP has been extensively used, data about kinematics factors in light free weights is limited.

**PURPOSE:** The aim of this study was to examine if any differences exist in rate of force development (RFDmax), peak force (PF) and simultaneously common parameters for both variables in each force-time curve against three different light free weights.

**METHODS:** 14 subjects were measured during a concentric only bench press test with 25, 35, and 45kg. (40, 55%, and 70% of the group mean 1RM). A linear transducer attached to the barbell was used to sample displacement-time during the attempts.

**RESULTS:** The results of this study clearly indicated significant differences (Table 1) between different loads. The \* represents significant difference between 25 kg and other loads ( $p < .05$ ), † represents significant difference between all loads ( $p < .05$ ), and ‡ represents significant difference between 45 kg and the other loads ( $p < .05$ ).

Table 1. Mean and standard deviation of the different parameters at different loads.			
Parameters	25 kg	35 kg	45 kg
RFDmax (n/s)	15197(8194)	13908(4579)	15166(4668)
Time at RFDmax (msec)	13.29(1.07)*	14.79(.89)	15.14(.95)
Force at RFDmax (N)	356(55) †	445(39)	563(36)
Power at RFDmax (W)	39(20)	39(15)	44(18)
Velocity at RFDmax (m/s)	0.15(.17)	0.08(.03)	0.14(.17)
Peak Force (N)	536(112) †	624(67)	722(88)
Time peak force (msec)	41(12)	49(24)	35(6)
Power at peak force (W)	209(101)	206(115)	141(69) ‡
Velocity at peak force (m/s)	0.37(.14)	0.36(.18)	0.18(.06) ‡

**CONCLUSIONS:** The RFDmax is not dependent on the load during concentric bench press indicating that this parameter does not influence performance with light free weights. However, kinematics at PF only changes significantly when using the highest load (45kg) indicating that increasing load will enhance the differences in bench press performance.

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**1783 Board #133 May 27 3:30 PM - 5:00 PM**  
**Effect Of Single Vs Multiple Sets Of Resistance Exercise On Muscle Strength**

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(No relationships reported)

Most studies reported that performing resistance training with multiple sets per training session is more effective for increasing strength as training with a single set. However, only few studies compared the effects of single vs. multiple sets on strength between small vs. large muscle groups, and upper-body vs. lower-body muscle groups.

**PURPOSE:** The purpose of this study was to determine the effect of single sets vs. multiple sets, during the early phase of adaptation, on different muscle group strength in untrained subjects.

**METHODS:** Twenty six apparently healthy, untrained male participated in the study protocol. The volunteers were randomly assigned into one of two groups: 1) elbow flexion single set and knee extension three sets (E1-K3; n=13; 22.5 yrs), or 2) elbow flexion three sets and knee extension single set (E3-K1; n=13; 23.4 yrs). Subjects trained 2 days per week for 6 weeks and each workout consisted of 1 close chain knee extension exercise and 1 elbow flexion exercise. Training intensity varied between 8 repetition maximum (RM) and 12RM. Unilateral knee extension and elbow flexion strength were tested for both groups at 60°/s on a Biodex System 3 isokinetic dynamometer. Strength was expressed as peak torque (PT). Statistical evaluation of the data was measured using a 2 x 2 analysis of variance [group (E1-K3 and E3-K1) x time (pre and post)]. The probability level of statistical significance was set at  $p < 0.05$  in all comparisons.

**RESULTS:** The increase in PT of the knee extensors muscles from week 0 to 6 was significantly higher in the E1-K3 group (10.29%) than in the E3-K1 (3.78%) group, while no difference existed in PT gains between E1-K3 (7.75%) and E3-K1 (7.44%) of the elbow flexors muscles.

**CONCLUSIONS:** It was concluded that performing three sets of strength training is superior to one set for increasing strength of the knee extensors muscles. It was also concluded that single-set training protocols for the elbow flexors muscles might be sufficient for untrained individuals in the early phases of a strength-training program.

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**1784 Board #134 May 27 3:30 PM - 5:00 PM**  
**Cardiovascular Responses To Unstable Surface Training In Healthy Adults**

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(No relationships reported)

Unstable surface training has been shown to improve neuromuscular functioning and develop muscle strength in stabilizing muscles, but its effect on cardiovascular responses is unclear. Many practitioners state that unstable surface training demands a greater amount of energy which reduces or eliminates the need for additional exercise aimed at improving body composition or cardiovascular fitness. These benefits have not been scientifically studied, so these claims are untested.

**PURPOSE:** To investigate the impact of unstable surface training on cardiovascular responses in healthy adults.

**METHODS:** Twenty-one, college-aged students with previous weight training experience completed two, 30-min resistance workouts following a group exercise format. One workout was performed on a stable surface (STA) and the other on unstable surfaces (UNST). Order was randomly determined and workouts were identical outside of training surface. Workouts included four, 1-minute sets of crunches, squats, pushups, and lunges. During STA, exercises were completed on the floor; during UNST exercises were performed on a stability ball, ½ foam roller, inverted BOSU dome, and dynadisk, respectively. Heart rate was measured every five seconds using Polar Vantage XL heart rate monitors. Comparisons of mean heart rate were made between STA and UNST during the third and fourth sets of exercise using a dependent t-test.

**RESULTS:** Overall, UNST was shown to elicit a significantly greater cardiovascular response compared to STA (UNST=147 ± 18.1; STA=140 ± 16.7 bpm,  $p=.021$ ). A significant difference in cardiovascular response between training surfaces was found for crunches and pushups (UNST=137 ± 21.3; STA=124 ± 19.1 bpm,  $p<.001$ ; UNST=156 ± 17.8; STA=149 ± 16.7 bpm,  $p=.037$  respectively). No significant difference was found for squats or lunges (UNST=139 ± 18.9; STA=135 ± 18.4 bpm,  $p=.205$ ; UNST=157 ± 15.4; STA=154 ± 14.9 bpm,  $p=.175$  respectively).

**CONCLUSIONS:** UNST results in a greater cardiovascular response during a total body bout of exercise. Lower body exercises performed on unstable surfaces do not elicit a greater cardiovascular response individually. This may be due to the increased distance of an individual's center of gravity to the unstable surface during lower body exercises, causing greater instability.

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**1785 Board #135 May 27 3:30 PM - 5:00 PM**  
**Influence Of The Ipsilateral Eccentric Contraction Training On Force Fluctuation In The Untrained Contralateral Limb**

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(No relationships reported)

Unilateral muscle training has effects on the untrained contralateral homologous muscle ("cross-education"). Greater "cross-education" has been evaluated by the change of maximal strength in untrained limb following eccentric contraction training than concentric contraction training. Possible causes of "cross-education" are neural adaptations. If so, it is expectable that not only the increase of maximal strength but also the improvement of submaximal muscle performance enhance, but the latter has not been evaluated following eccentric contraction training than concentric contraction training.

**PURPOSE:** To examine the effect of eccentric contraction training (ECCT) and concentric contraction training (CONT) on the force fluctuations (FF) during submaximal isometric contraction in elbow flexors.

**METHODS:** Ten participants were randomly assigned to ECCT (n = 5) and CONT (n = 5) group. Forces were recorded by using the load cell (LUR-A-2kNSA1, KYOWA) during maximal voluntary isometric contraction (MVC) and submaximal isometric contractions at 10, 30, 50 and 80 %MVC force level of before and after training in right and left elbow flexors. ECCT and CONT were performed to extend/flex the right cubital joint from maximal flexion/extension to extension/flexion using the dumbbell where the weight corresponding about 45-60 %MVC force of pre-training. Trainings were consisted of 6 sets of 10 repetitions in a day, 3 times per wk for 3wk. FF was calculated as follows; SD/mean force × 100. Comparisons of FF between pre- and post-training at each contraction level in both arms were made using paired-t test. Statistical significance level was set at  $p < 0.05$ .

**RESULTS:** MVC force of left arm was increased in CONT group, but not significantly. Left arm MVC force was significantly increased in ECCT group (109.2 ± 4.8% pre-training,  $p < 0.05$ ). FF of left arm at 50 %MVC force level in ECCT group was significantly decreased (pre-training; 1.9 ± 0.2%, post-training; 1.5 ± 0.1%,  $p < 0.05$ ). FF at the other force levels in left arm and all force levels in right arm did not change significantly.

**CONCLUSION:** ECCT induced significant increase of MVC force and decrease of FF during submaximal isometric contraction in left arm. Decrease of FF in the untrained arm may occur selectively depending on the load used in the trained arm.

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**1786 Board #136 May 27 3:30 PM - 5:00 PM**  
**Effect Of Rest-interval On Muscle Fatigue In Young Men And Women.**

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The Rest-Interval (RI) between sets is an important variable to be considered when prescribing effective resistance training. The adequate RI should prevent excessive muscle fatigue and allow complete muscle recovery between sets. Despite this positive effect on muscle fatigue and recovery, RI has not been well documented in young women. Also, studies reported that healthy young males have been shown to exhibit a faster rate of knee extensor torque fatigue than females, which is highly correlated to their peak voluntary work.

**PURPOSE:** To compare the effect of two different RI's between sets of isokinetic knee extension exercise on Peak Torque (PT), and Total Work (TW) between young men and women.

**METHODS:** 18 men (24.22 ± 2.58 yrs) and 11 women (27.0 ± 4.16 yrs) performed 3 sets of 10 unilateral isokinetic knee extension repetitions at 60°/s. The rest intervals between sets were 1 and 2 minutes and were counterbalanced across 2 testing days, separated by a minimum of 72 hours. The work-to-rest ratio was 1:3 and 1:6. Subjects were not involved in exercise programs that included resistance exercise within the last 6 months.



**RESULTS:** The results were as follows:

		men (n = 18)			women (n = 11)		
	SET	1st	2nd	3rd	1st	2nd	3rd
PT (N.m)	1min	263.32	230.98 *	200.38 * <sup>‡</sup>	162.13	149.55 *	136.74* <sup>‡</sup>
	2min	260.44	241.59 * <sup>†</sup>	222.72 * <sup>‡†</sup>	165.41	154.21* <sup>†</sup>	144.85* <sup>‡†</sup>
TW (J)	1min	2,698.24	2,273.91 *	1,865.97 * <sup>‡</sup>	1,492.92	1,327.81*	1,205.83* <sup>‡</sup>
	2min	2,610.51	2,384.96 * <sup>†</sup>	2,124.75 * <sup>‡†</sup>	1,532.45	1,425.93* <sup>†</sup>	1,306.64* <sup>‡†</sup>
* p < 0.05 less than 1st set.							
<sup>‡</sup> p < 0.05 less than 2nd set.							
† p < 0.05 greater than 1min.							

**CONCLUSION:** These results suggest that during maximal-effort muscle isokinetic contractions at 60°/s, males and females exhibit a similar susceptibility to muscle fatigue during isokinetic knee extension exercise. Also, it appears that a 1:6 work-to-rest ratio is not sufficient to promote full muscle strength recovery, for this specific fatiguing protocol, in non-resistance trained young men and women.

**1787 Board #137 May 27 3:30 PM - 5:00 PM**

**The Impact Of An Integrated Functional Resistance Training Program On Chronic Low-back Pain Patients**

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Therapies involving physical exercise have a prominent role from different approaches for the treatment of low back pain. Furthermore, at the moment, new trends are being incorporated into the prescription of physical activity and exercise to improve health and quality of life in chronic low-back patients, but there are a lot of unknown effects.

**PURPOSE:** To evaluate the effects of functional resistance training, integrated in a general physical activity program, in functional disabilities and intensity of pain on a group of women with chronic low-back pain.

**METHODS:** Patients with chronic low back pain for more than 8 weeks but less than 6 months were included in the sample. A total of 19 (35,63±8,44 years old) women were randomized to either exercise group (n = 11) or control group (n = 8). 36 exercise sessions were developed in 3 months of intervention (1<sup>st</sup> month: postural and motor control; 2<sup>nd</sup> month: analytic resistance training exercises; 3<sup>rd</sup> month: analytic and functional resistance training exercises). Pain intensity (Visual Analogue Scale 0-10), and functional disability (Oswestry Disability Index) were recorded before and immediately after the treatment period.

**RESULTS:** The exercise group showed significantly higher improvements than control group in all outcome variables throughout the entire intervention period. Immediately after 3-months of exercise treatment 61,1% and 61,25% of the exercise group and 3,4% and 2,6% in the control group had reduced their functional disability and intensity of pain respectively (p<0,001). Clinically important differences between-group on function and pain were identified.

**CONCLUSIONS:** Functional progressive resistance training program, personalized and integrated after a stage of motor learning and analytic resistance training exercises has produced significant reductions in functional disability and pain intensity in women with chronic low-back pain.

**1788 Board #138 May 27 3:30 PM - 5:00 PM**

**Physical Activity Levels After Functional Resistance Training Program In Subjects With Low-back Pain**

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People with chronic low-back pain usually have functional disability due to pain. This conditions and facts could negatively affect the levels of physical activity and energy expenditure from daily life.

**PURPOSE:** To identify changes in levels of physical activity and energy expenditure in daily life produced by a physical activity therapy which integrates functional resistance training.

**METHODS:** Patients with chronic low back pain for more than 8 weeks but less than 6 months were included in the sample. A total of 19 (35,63±8,44 years old) women were randomized to either exercise group (n = 11) or control group (n = 8). 36 exercise sessions were developed in 3 months of intervention. Pain intensity (visual analogue scale 0-10), level of physical activity and energy expenditure (International Physical Activity Questionnaire (IPAQ)) were recorded before and immediately after the treatment period.

**RESULTS:** The control group showed no significant changes after the exercise intervention. In the experimental group the pain intensity had been reduced significantly (p<0,001), increased (p<0,05) 1,36 d·wk<sup>-1</sup> the frequency, 149,1 min·wk<sup>-1</sup> the duration and 2218,18 METs·min·wk<sup>-1</sup> energy expenditure from vigorous physical activities (8 METs). In moderate activities (4 METs) increased (p<0,05) the duration in 59,09 min·wk<sup>-1</sup> and weekly reduced the time that remained seated 166,36 min (p<0,05). The total weekly energy expenditure increased 2218,85 METs·min·wk<sup>-1</sup> (p<0,05).

**CONCLUSIONS:** Physical activity therapy, including functional resistance training, has produced significant increases in the frequency, duration and energy expenditure from daily life activities and has reduced the daily time that these patients remained seated.

**1789 Board #139 May 27 3:30 PM - 5:00 PM**

**Improved Muscle Activation In Performing A Functional Lunge Versus A Traditional Squat**

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The back squat is a common exercise for performance strength training and rehabilitation. Contrary to common clinical practice, variation in stance width during the squat has not shown to affect the isolation of quadriceps musculature. In addition to the stance width, squat depth has also been a focus of debate in muscle activation. Today, many practitioners are focusing on more functional activities and it is often questioned if the squat, especially to greater depths is truly a functional exercise.

**PURPOSE:** The purpose was to examine the muscle activation at three different squat depths and the body weight walking lunge.

**METHODS:** Eight healthy, female intercollegiate athletes (mean age 20.8 ± 3.9 y; mean height, 177.8 ± 10.9 cm; mean mass, 67.3 ± 9.9 kg) participated. Electromyographic (EMG) data were collected on the following muscles: medial hamstring (semimembranosus and semitendinosus), biceps femoris, gluteus medius, and gluteus maximus while participants performed the three different squat depths and a body weight walking lunge.

**RESULTS:** Kruskal-Wallis test revealed a significant main effect for exercise type on the rectus femoris ( $\chi^2=15.706$ ,  $p=0.001$ ); vastus medialis oblique ( $\chi^2=8.767$ ,  $p=0.03$ ); vastus lateralis ( $\chi^2=15.169$ ,  $p=0.002$ ); medial hamstrings ( $\chi^2=8.775$ ,  $p=0.03$ ); biceps femoris ( $\chi^2=14.258$ ,  $p=0.003$ ); and gluteus medius ( $\chi^2=10.387$ ,  $p=0.02$ ). Exercise type did not have a main effect on gluteus maximus muscle activity ( $p=0.05$ ). The results demonstrated that the total muscle activation of the squat depths were not greater than that of the walking lunge. It was revealed that the walking lunge did indeed produce more activation in the majority of all muscles analyzed, except rectus femoris, when compared to the three squat depths.

**CONCLUSIONS:** By training athletes in the walking lunge they can obtain the same results of that of squat to 90 training. Furthermore, the lunge allows athlete to be in a more functional position. From the basic lunge position of the knees flexed to 90 degrees we can begin to train explosive recovery moves which would transfer over to competition. Ideally, athletes should be training their kinetic chain fluidly and dynamically, the more dynamic the activity the more fluid the athlete's movement and posture will be in competition.

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**1790 Board #140 May 27 3:30 PM - 5:00 PM**

**Short-term Adaptations In Strength, Power And Body Mass Following Three Different Modes Of Resistance Training**

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(No relationships reported)

Recently there has been an increase in focus looking at integrating differing modes of training such as resistance and plyometric training into periodized strength and conditioning programs. More specifically, optimal training techniques designed to maximize dynamic power and rates of force production (RFD) are receiving considerable interest because of the desire to produce high performance training environments. One area receiving increased attention is complex training which alternates between heavy and lighter load resistance exercises with similar movement patterns in a single exercise session. Such "complex pairings" may bring about a state of Post Activation Potentiation (PAP) resulting in increased dynamic power and RFD during the lighter load exercise. This may be a more effective strategy for developing sport specific power than resistance or plyometric training alone.

**PURPOSE:** The purpose of this research was to determine if complex training is more effective than resistance training or plyometric training at improving measures of power and strength in the lower limbs of college aged males after 3 weeks of training.

**METHODS:** Thirty four recreationally trained males trained in 1 of 3 methods; resistance (RT) ( $n = 13$ ; height: 180.14 ± 4.75 cm; body mass: 83.85 ± 20.54 kg), plyometric (PT) ( $n = 11$ ; 181.41 ± 7.97 cm; 81.25 ± 10.43 kg), or complex (CT) ( $n = 10$ ; 185.17 ± 5.56 cm; 87.54 ± 9.04 kg) twice a week for 3 weeks. Participants were tested pre and post training to assess body mass (kg), vertical jump height (cm), squat strength (kg), power (watts) and power per kg of body mass.

**RESULTS:** Repeated measures ANOVA (Group (3) x Time (2)) revealed no significant changes for body mass, vertical jump, power, or power/body mass ( $p > .05$ ). A significant increase was found for squat strength for all groups ( $F_{2, 31} = 53.22$ ,  $p < 0.00$ ) from pre to post with no significant differences between groups.

**CONCLUSIONS:** The incorporation of different modes of resistance training, over a 3 week microcycle, resulted in increases in squat strength for all 3 groups. This can be attributed to a learning effect of the training and/or testing exercise or to the neural adaptations that would be expected after this training cycle. The reported research is a mid point of a 6 week training study.

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**1791 Board #141 May 27 3:30 PM - 5:00 PM**

**Hormonal Responses Of Untrained Males And Females After An Acute Bout Of Resistance Training**

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(No relationships reported)

Males and females have an increase in muscular strength and hypertrophy following a resistance training program. The increase in strength and hypertrophy are heavily dependent upon the hormonal response that occurs acutely after exercise. The difference between untrained males and females in response to an acute bout of resistance training has not been established.

**PURPOSE:** To examine the effects of an acute resistance training protocol on the hormonal profile of untrained males and females.

**METHODS:** The males ( $n = 3$ ) and females ( $n = 3$ ) voluntarily participated in the study. Each subject performed a predicted 1 RM approximately 1 week before the second testing session. During the second testing session, each subject completed four sets of bench presses and leg presses at 60-70% of his or her predicted 1 RM. Testosterone, IGF-I, hGH, and cortisol were measured pre-exercise, immediately post-exercise, and 30 min post-exercise.

**RESULTS:** There was a significant interaction ( $p < .05$ ) for testosterone and IGF-I. Testosterone levels for males were higher compared to females. IGF-I levels were elevated immediately post-exercise compared to baseline values for males. No significant differences occurred for hGH or cortisol between males and females.

**CONCLUSIONS:** The hormonal responses that occur due to an acute bout of resistance training are gender specific. The elevations in testosterone and IGF-I for males may have occurred due to mechanical stress placed on the exercising muscles. The untrained status of the subjects may account for the lack of change of hGH and cortisol for males and females

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**1792 Board #142 May 27 3:30 PM - 5:00 PM**

**Reliability Of Maximal Strength Testing In Novice Weightlifters**

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The one repetition maximum (1RM) is a criterion measure of muscle strength. However, the reliability of 1RM testing in novice subjects has received little attention. Understanding this information is crucial to accurately interpret changes in muscle strength.

**PURPOSE:** To evaluate the test-retest reliability of a squat (SQ), heel raise (HR), and deadlift (DL) 1RM in novice subjects.

**METHODS:** Twenty healthy males (31.5 ± 5 y, 179.1 ± 6.1 cm, 81.4 ± 10.6 kg) with no weight training experience in the previous six months participated in four 1RM testing sessions, with each session separated by 5-7 days. SQ and HR 1RM were conducted using a smith machine; DL 1RM was assessed using free weights. Session 1 was considered a familiarization and was not included in the statistical analyses. Repeated measures analysis of variance with Tukey's *post-hoc* tests were used to detect between-session differences in 1RM ( $p \leq 0.05$ ). Test-retest reliability was evaluated by intraclass correlation coefficients (ICC).

**RESULTS:** During Session 2, the SQ and DL 1RM (SQ: 90.2 ± 4.3, DL: 75.9 ± 3.3 kg) were less than Session 3 (SQ: 95.3 ± 4.1, DL: 81.5 ± 3.5 kg) and Session 4 (SQ: 96.6 ± 4.0, DL: 82.4 ± 3.9 kg), but there were no differences between Session 3 and Session 4. HR 1RM measured during Session 2 (150.1 ± 3.7 kg) and Session 3 (152.5 ± 3.9 kg) were not

different from one another, but both were less than Session 4 (157.5±3.8 kg). The reliability (ICC) of 1RM measures for Sessions 2-4 were 0.88, 0.83, and 0.87, for SQ, HR, and DL, respectively. When considering only Sessions 3 and 4, the reliability was 0.93, 0.91, and 0.86 for SQ, HR, and DL, respectively.

**CONCLUSIONS:** One familiarization session and 2 test sessions (for SQ and DL) were required to obtain excellent reliability ( $ICC \geq 0.90$ ) in 1RM values with novice subjects. We were unable to attain this level of reliability following 3 HR testing sessions; additional sessions are required to obtain an ICC of  $\geq 0.90$ . Resistive exercise training studies should consider the reliability of specific measures to ensure that reported strength changes are attributable to training and not to learning effects associated with 1RM testing.

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**1793 Board #143 May 27 3:30 PM - 5:00 PM**  
**Development Of Muscular Strength Using Open And Closed Kinetic Chain Exercises**

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(No relationships reported)

**PURPOSE:** To compare the effects of open versus closed kinetic chain training on the development of muscular (quadriceps) strength in adults, and to determine if muscular strength development associated with open kinetic chain training translates to improved performance of closed kinetic chain movements, and vice versa.

**METHODS:** A total of 25 sedentary and apparently healthy male and female subjects ranging from 25-55 years of age were divided into open (7 males, 6 females) or closed (7 males, 5 females) kinetic chain training groups. All subjects participated in either an open or closed kinetic chain strength training program for 12 weeks, and completed pre and post-training one repetition maximum (1RM) leg press and leg extension strength tests.

**RESULTS:** Mean Percent Change (MPC) in muscular strength following the training period was not significantly different ( $p > .05$ ) between open ( $32.0 \pm 14.2\%$ ) and closed ( $30.1 \pm 11.3\%$ ) kinetic chain training when assessed using an open kinetic chain strength test (1 RM leg extension). Absolute strength improvement ( $15.2 \pm 6.7$  kg) assessed by closed kinetic chain strength testing (1RM leg press) increased significantly ( $p < .05$ ) following open kinetic chain training. MPC in muscular strength was significantly greater ( $p < .05$ ) following closed ( $28.5 \pm 11.2\%$ ) compared to open ( $14.7 \pm 9.3\%$ ) kinetic chain training when assessed using a closed kinetic chain strength test (1RM leg press).

**CONCLUSION:** These data suggest that strength gains resulting from open and closed kinetic chain training enhance performance of an open kinetic chain movement to the same extent. Open kinetic chain training, however, did not enhance performance of a closed kinetic chain movement to the same extent as the closed kinetic chain training. The discrepancy between the two types of training with regard to performance of a closed kinetic chain movement may have resulted from development of muscle groups engaged during closed but not open kinetic chain training.

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**1794 Board #144 May 27 3:30 PM - 5:00 PM**  
**The Current State Of Resistance Training Among Endurance Athletes**

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(No relationships reported)

Although numerous publications tout the value of resistance training for all populations, including endurance athletes, there is a paucity of information concerning the actual resistance training habits (RTH) of endurance athletes. For the purpose of this study, an endurance athlete is defined as one who performs a minimum of 30 minutes, three days each week of continuous high level aerobic activity.

**PURPOSE:** To ascertain the current resistance training habits of endurance athletes.

**METHODS:** A 37 question internet survey was cross validated and distributed in the Spring of 2008 by email to over 50,000 targeted email addresses (obtained from running and triathlon associations).

**RESULTS:** 1314 internet responses (2.6%) were obtained, which represented 85.8% runners and 9.5% triathletes, with the majority (57%) of responses from males. RTH differed slightly from in-season (I) to out-of-season (O). 63% report RTH  $> 1$  hr/wk during O, while  $< 55\%$  during I. Intensity was similar for O and I, with 64% terminating at a predetermined number of repetitions, thus intensity can not be quantified, but 15% achieve MMF.  $\sim 50\%$  perform  $\leq 2$  exercises, 3 sets,  $\leq 6$  min and 8-12 reps per muscle group for all muscle groups, except the abdominal muscles, in which 42% perform  $> 3$  exercises, 21% perform  $> 4$  sets, 32% spend  $> 10$  min and 38% perform  $> 20$  reps.

**CONCLUSION:** 88% of endurance athletes recognize the benefit of RT as either moderately or very important, and most perform some type of resistance training, with less than 9 % abstaining completely during either I or O.

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**1795 Board #145 May 27 3:30 PM - 5:00 PM**  
**Effects Of Variable Velocity Eccentric Muscle Actions On Caloric Expenditure And Delayed Onset Muscle Soreness**

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(No relationships reported)

Eccentric training protocols require a decrease in metabolic demand and elicit greater muscle strain resulting in delayed onset muscle soreness (DOMS) when compared with concentric training program, using a similar load. However, it is not understood how altering the velocity of an eccentric training protocol will affect metabolic demand and muscle strain.

**PURPOSE:** To determine if velocity during eccentric exercise alters the amount of metabolic demand during exercise and muscle soreness after exercise.

**METHODS:** Thirty college-aged subjects who were enrolled in a beginning weight training class, were recruited for the study, with 15 subjects randomly assigned to either the high (40 cycles per minute) or low (18 cycles per minute) velocity groups. The testing session consisted of a five minute unilateral eccentric hip and knee extensor exercise at a constant workload of 65% of peak eccentric torque. To assess the effects of metabolic demand, energy expenditure and RER were taken for one minute after steady state was attained. To assess the effects of muscle soreness, the subjects completed an electronic muscle soreness questionnaire 12, 24, 36, 48, 60 and 72 hours post exercise. The statistical significance was determined by a t-test for caloric expenditure and RER values, while a repeated measure ANOVA was used to evaluate the effect of velocity on muscle soreness. The alpha level was set at 0.05.

**RESULTS:** Caloric expenditure and RER were statistically higher in the fast group when compare to the slow group. The fast and slow group had a mean caloric expenditure of  $10.79 \pm 2.00$  Kcal/min and  $6.40 \pm 1.75$  Kcal/min, respectively. The fast and slow group had a mean respiratory exchange ratio of  $1.08 \pm 0.19$  and  $0.91 \pm 0.12$ , respectively. No statistical difference in the degree and timeline of muscle soreness was seen between groups.

**CONCLUSION:** Altering the velocity of an eccentric muscle action increases the metabolic demand without increasing muscle soreness in college-aged subjects involved in a beginning weight training class. While the mechanism for eccentric muscle actions is still unclear, an increase in metabolic demand does not affect the amount of muscle strain associated with this type of muscle action.

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**1796 Board #146 May 27 3:30 PM - 5:00 PM**  
**Effects Of Warm-up On Peak Torque, Rate Of Torque Development, And Electromyographic And Mechanomyographic Signals**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to determine if an active warm-up affects peak torque (PT), rate of torque development (RTD), and the electromyographic (EMG) and mechanomyographic (MMG) signals.

**METHODS:** Twenty-one men (mean age  $\pm$  SD = 23.9  $\pm$  2.6 y) visited the exercise physiology lab on two occasions. During the first visit they either performed an active warm-up (10 minutes of stationary cycling at 70% of predicted max heart rate) or sat quietly (no warm-up). Participants were then tested for isometric and isokinetic PT (60, 180, and 300 deg/s), and RTD (measured as S-gradient) on an isokinetic dynamometer. EMG and MMG sensors were placed over the vastus lateralis muscle of the right limb to monitor the electrical and mechanical aspects of muscle contractions, respectively. The testing protocol used for the first visit was repeated for the second visit, but the pre-exercise treatment (warm-up, no warm-up) not given during the first visit was administered.

**RESULTS:** The results indicated that an active warm-up did not affect PT, RTD, EMG amplitude, EMG frequency, or MMG frequency ( $p > 0.05$ ). However, MMG amplitude at 180 deg/s was significantly greater ( $p < 0.05$ ) in the warm-up condition compared to the no warm-up condition.

**CONCLUSIONS:** The results indicated that warm-up did not affect PT, RTD, EMG amplitude, EMG frequency, or MMG frequency. The increase in MMG amplitude, however, suggests that warm-up may have affected the mechanical properties of muscle by reducing muscular stiffness and/or decreasing intramuscular fluid pressure.

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**1797 Board #147 May 27 3:30 PM - 5:00 PM**  
**The Effects Of Exercise Order On Power Output And Mechanical Work During Power Cleans**

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(No relationships reported)

**PURPOSE:** This study aimed to investigate the effects of exercise order on mechanical work and power output during a series of power cleans (PC).

**METHODS:** Nine subjects performed five repetitions of PC with a load equivalent to 80% one repetition maximum for four sets during two separate sessions: 1) PC performed at the end of a series of resistance exercises designed to develop power, 2) only PC performed. The order of the two sessions was counterbalanced and both were separated by one week. The vertical position of the center of the bar was recorded during each PC repetition by a motion analysis system. Net power output during each repetition was then calculated using the work-energy relationship. The greatest value achieved during each set was recorded as peak power output (PP). Mechanical work (W) performed on the bar during each set of PC was calculated by integrating net power output. W was also totaled across the sets of each session to provide total work (TW). Fatigue values were calculated for PP (PP<sub>FATIGUE</sub>) during each set and TW (TW<sub>FATIGUE</sub>) during each session. Differences in PP, W and PP<sub>FATIGUE</sub> were analyzed using an ANOVA model with repeated measures on two factors (session [2 levels]; set [4 levels]), with t-tests used to analyze differences in TW and TW<sub>FATIGUE</sub>.

**RESULTS:** There were no significant main effects or interactions reported for PP, PP<sub>FATIGUE</sub>, or W ( $p > 0.05$ ). Similarly, there were no significant differences in TW or TW<sub>FATIGUE</sub> between the testing sessions ( $p > 0.05$ ). Despite the lack of significant group findings there were some notable individual responses, particularly for the fatigue scores.

**CONCLUSIONS:** When group responses are assessed the order in which resistance training exercises are performed does not affect work done or power output during PC. However, some individuals appear to produce more consistent PP values between sets when PC are performed after other resistance exercises, although the magnitude of PP may be reduced.

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**1798 Board #148 May 27 3:30 PM - 5:00 PM**  
**Acute Effects Of Manipulating Volume And Load Of Back Squats On Countermovement Vertical Jump Performance**

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(No relationships reported)

**PURPOSE:** The acute effects of manipulating the volume and load of back squats on subsequent countermovement vertical jump performance were investigated in the present study.

**METHODS:** Eleven NCAA Division II female volleyball players performed 10 countermovement jumps (CMJ) on a force platform two minutes after the last squat repetition of a high load (HL) or high volume (HV) squat protocol for a total of 20 minutes. Two minutes of rest was provided between each CMJ. The HL protocol culminated in the subjects having to perform three repetitions with a load equivalent to 90% one-repetition maximum (1-RM) back squat, while 12 repetitions with a load equivalent to 37% 1-RM were performed in the HV protocol. Jump height (JH) and vertical stiffness (VStiff) were calculated during each CMJ and the changes in these variables following the two squat protocols was assessed using an ANOVA model with repeated measures on two factors (Protocol [2-levels]; Time [2-levels]).

**RESULTS:** There was no significant difference in JH following the HL and HV protocols ( $p > 0.050$ ). A significant Protocol x Time interaction for VStiff resulted from the increase following the HL protocol being greater than that following the HL protocol ( $p = 0.034$ ).

**CONCLUSION:** Neither squat protocol provided any benefit in improving JH. However, the heavy squat protocol produced greater increases in VStiff during the CMJ. Because of the increased VStiff caused by the HL protocol, volleyball coaches may consider using such protocols with their players to improve performance in jumps performed from a run such as the spike.

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**1799 Board #149 May 27 3:30 PM - 5:00 PM**  
**Prediction Of The Total Energy Cost Of An Acute Bout Of Resistance Exercise In Young Men And Women**

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(No relationships reported)

ACSM currently recommends resistance training (RT) for each major muscle group at least 2 times per week with a traditional repetition range of 8-12 per set. Because many investigators/fitness professionals consider kcal expenditure when creating training protocols, energy costs during both RT and aerobic training must be considered.

**PURPOSE:** To develop a regression equation to predict kcal expenditure for a RT bout involving each major muscle group using VO<sub>2max</sub>, height, weight, lean body mass, fat mass, and total exercise volume (TV=sets\*reps\*wt) as independent variables.

**METHODS:** Twelve subjects (7 men, 5 women, age 21-25 yrs) were tested using the standard Bruce treadmill protocol for VO<sub>2max</sub>, and strength tested to determine their 3-5 repetition max (RM) on Kaiser® RT equipment 1 week prior to their experimental RT bout. Body composition was assessed using DEXA. For their experimental RT bout, a warm-up set followed by 2-3 sets of 8-12 reps at 60-70% predicted 1RM were performed for each exercise. Each set was started every two minutes. Exercises progressed in the following order: leg press, chest press, leg curl, lat pull, leg ext., triceps ext., biceps curl. Oxygen consumption was measured continuously throughout the RT bout using an automated metabolic cart. Multiple Linear Regression was used to determine the best model for prediction of kcal consumption.

**RESULTS:** Mean kcal expenditure for the entire RT bout was 221.8 $\pm$ 20.65 kcal (men = 272 $\pm$ 36 & women = 150 $\pm$ 16) with a mean kcal cost of 26.32-38.94 per exercise. Large muscle group/multi-joint exercises had the highest total kcal expenditures as expected. Collinearity diagnostics from the regression revealed that VO<sub>2max</sub> (L/min) and the square root of TV (TV<sup>0.5</sup>) were the only predictors needed in the model with all other variables being highly intercorrelated with VO<sub>2max</sub> (L/min), thus not adding significant improvement to the model. The prediction equation was ( $p < 0.05$ , R<sup>2</sup>=0.86):

Total kcal = (37.264\*VO<sub>2max</sub> L/min) + (1.087\*TV<sup>0.5</sup>) - 132.488

**CONCLUSIONS:**  $\text{VO}_{2\text{max}}$  (L/min) and  $\text{TV}^{0.5}$  were found to be significant predictors of the energy cost of a RT bout involving each major muscle group. In regards to fitness, performance, and weight management, this equation may aid practitioners and young exercising adults in documenting kcal expenditure from resistance training.

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**1800 Board #150 May 27 3:30 PM - 5:00 PM**  
**Effectiveness Of A 4-week Core Strengthening Program In Lactate And Running Speed**

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Core strengthening is advocated as beneficial for the stabilization and control of the trunk. Greater core stability may influence sports performance producing more efficient movements that affect running speed and blood lactate concentration.

**PURPOSE:** To evaluate the effectiveness of a 4-week core strengthening program on running speed and blood lactate in young healthy adults.

**METHODS:** Ten young healthy adults from both sexes (age:  $25.4 \pm 2.27$  yrs, height:  $66.85 \pm 11.79$  cm, BMI:  $24 \pm 2.63$ ) were randomly assigned to a control or core strengthening intervention group. Both groups performed the testing protocol at baseline and after 4-weeks. A warm-up session (5 min walking at 4 mph) was performed followed by 4 sets of running at 5, 6, 7 and 8 mph, 4 min per set in order to determine running speed and lactate concentration. Blood lactate was obtained at the end of each set. A lactate level of  $\geq 4$  mmol/L was the criteria used to establish the speed at which the subjects reached their anaerobic threshold. The core strengthening program consisted of a warm-up, seven strengthening exercises and a cool-down. The exercise program consisted of one set of 15 repetitions for each exercise three times a week (1 set/15 reps/3 times/week). The control group was encouraged to continue with their daily routine and not to engage in additional exercises. Independent samples T-test were used to compare variables at baseline. Univariate Analysis of Variance (ANOVA) was used to compare post running speed at which the cut-off lactate level was reached and post lactate levels at the faster speed reached by the subject at baseline.

**RESULTS:** There were no differences between groups at baseline. Although the intervention group improved after the intervention (speed: 6.0 to 6.4; lactate: 5.6 to 4.0) the ANOVA showed no statistically significant differences for running speed ( $p=0.789$ ) and lactate levels ( $p=0.419$ ).

**CONCLUSIONS:** Four weeks of core strengthening seems not to be enough to improve running speed at which anaerobic threshold is reached and reduce lactate levels when running at a constant speed. Nevertheless, a larger sample size and a longer intervention time is needed for core strengthening to have an effect on running speed and anaerobic threshold. NIH Grants G12RR03051 and 1P20 RR11126, and NSCA Foundation supported this project.

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**1801 Board #151 May 27 3:30 PM - 5:00 PM**  
**Sex Differences In Hamstring Relative Torque**

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(No relationships reported)

Males often produce greater torque than females by virtue of a greater quantity of muscle mass. Although muscle quality between sexes may not be different, it remains questionable whether males and females produce similar relative torque when controlling for cross-sectional area (CSA) and body mass.

**PURPOSE:** To determine if sex differences exist in lower body peak torque relative to 1) muscle CSA ( $\text{Nm}\cdot\text{cm}^{-2}$ ) and 2) body mass ( $\text{Nm}\cdot\text{kg}^{-1}$ ).

**METHODS:** Fifty-seven male (age  $23.67 \pm 2.17$  years; height  $178.39 \pm 7.58$  cm; mass  $80.49 \pm 15.33$  kg) and 61 female (age  $22.93 \pm 2.08$  years; height  $164.20 \pm 7.30$  cm; mass  $62.84 \pm 11.85$  kg) subjects performed three maximal concentric knee flexion repetitions of their dominant leg on an isokinetic dynamometer at 14 randomized speeds ( $0-400^\circ\cdot\text{s}^{-1}$ ). Muscle cross sectional area (CSA) of the hamstrings was calculated via the Housh equation (1995) using skinfold of the anterior thigh and mid-thigh circumference. Two separate ANOVAs were used to determine any differences in relative torque by sex.

**RESULTS:** Males were significantly heavier (males  $80.49 \pm 15.33$  kg, females  $62.84 \pm 11.85$  kg) and had significantly greater hamstring CSA than females (male  $25.84 \pm 4.74$   $\text{cm}^2$ , females  $17.80 \pm 4.87$   $\text{cm}^2$ ). When controlling for body mass, males produced significantly ( $P<0.05$ ) greater peak torque than females ( $0^\circ\cdot\text{s}^{-1}$ : males =  $1.71 \pm 0.24$   $\text{Nm}\cdot\text{kg}^{-1}$ ; females =  $1.44 \pm 0.28$   $\text{Nm}\cdot\text{kg}^{-1}$ ;  $210^\circ\cdot\text{s}^{-1}$ : males =  $1.33 \pm 0.21$   $\text{Nm}\cdot\text{kg}^{-1}$ ; females =  $1.13 \pm 0.25$   $\text{Nm}\cdot\text{kg}^{-1}$ ;  $400^\circ\cdot\text{s}^{-1}$ : males =  $1.07 \pm 0.20$   $\text{Nm}\cdot\text{kg}^{-1}$ ; females =  $0.92 \pm 0.21$   $\text{Nm}\cdot\text{kg}^{-1}$ ). Other speeds showed similar results. However, when controlling for CSA, peak torque was not significantly different between sexes ( $0^\circ\cdot\text{s}^{-1}$ : males =  $5.35 \pm 0.99$   $\text{Nm}\cdot\text{cm}^{-2}$ ; females =  $5.26 \pm 1.33$   $\text{Nm}\cdot\text{cm}^{-2}$ ;  $210^\circ\cdot\text{s}^{-1}$ : males =  $4.15 \pm 0.59$   $\text{Nm}\cdot\text{cm}^{-2}$ ; females =  $4.14 \pm 1.49$   $\text{Nm}\cdot\text{cm}^{-2}$ ;  $400^\circ\cdot\text{s}^{-1}$ : males =  $3.29 \pm 0.64$   $\text{Nm}\cdot\text{cm}^{-2}$ ; females =  $3.23 \pm 0.68$   $\text{Nm}\cdot\text{cm}^{-2}$ ). Other speeds showed similar results.

**CONCLUSIONS:** These results suggest that males produce greater torque per kilogram of body mass in knee flexion exercise than females. However, there appears to be no difference in relative hamstring peak torque produced between sexes when controlling for CSA.

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**1802 Board #152 May 27 3:30 PM - 5:00 PM**  
**Effects Of Strength And Endurance Training On Quadriceps And Hamstrings Using An Elliptical Device**

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(No relationships reported)

Background: The elliptical device is claimed to provide a low impact workout for cardiovascular training. Few studies, however, have focused on any strength and endurance gained by using the elliptical device.

**PURPOSE:** The purpose of this study was to determine if an elliptical device can elicit strength and endurance gains in the quadriceps and hamstrings muscles while subjects perform in a forward motion.

**METHODS:** Fourteen healthy female subjects, between the ages of 19-64 years participated in this study. Each performed on the Nautilus NE 3000 elliptical machine for fifteen minutes, two-three times per week for eight consecutive weeks. Strength of the quadriceps and hamstring muscles was measured using a 1RM on the Nautilus VR2 seated leg extension and flexion machines. Endurance gains in the quadriceps and hamstrings were assessed by calculating 70% of the initial 1RM for each, and completing as many as possible consecutive repetitions of bilateral knee extension and knee flexion on the VR2 machines.

**RESULTS:** The ANOVA showed a significant difference for strength gains in the quadriceps ( $F=68.29$ ,  $P<0.0001$ ) and hamstrings ( $F=55.08$ ,  $P<0.0001$ ) for the initial, four week, and eight week testing periods. The average increase in quadriceps strength for the eight weeks was  $40\pm18\%$ . The average increase in hamstrings strength for the eight weeks was  $25\pm12\%$ . The ANOVA showed a significant difference in endurance gains in the quadriceps ( $F=29.65$ ,  $P<0.0001$ ) and the hamstrings ( $F=14.26$ ,  $P<0.0001$ ) for the initial, four week, and eight week testing periods. The average increase in quadriceps endurance for the eight weeks was  $70\pm49\%$ . The average increase in hamstrings endurance for the eight weeks was  $120\pm101\%$ . The hamstring/quadriceps (H/Q) ratio also displayed a significant difference ( $F=8.39$ ) and had an average increase of  $7.87\pm9.77\%$  ( $P<0.05$ ) for the eight weeks.

**CONCLUSIONS:** The elliptical device can provide strength and endurance gains in both the quadriceps and hamstrings. The strengthening effect is greater for the quadriceps



than that of the hamstrings; however, the endurance gains were greater in the hamstrings than the quadriceps. The exercise specialist should be aware that these unequal strengthening effects lead to a decrease in the H/Q ratio.

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**1803 Board #153 May 27 3:30 PM - 5:00 PM**

**The Effects Of Maximum Voluntary Isometric Contraction On 1rm Performance In The Bench Press**

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(No relationships reported)

In previous studies, isometric lifting has produced varied results. These studies have examined both the acute and training effects of isometric contraction on the bench press. To date no studies have examined the acute, selective fatigue of the primer movers at 90 degrees of elbow flexion on the bench press exercise.

**PURPOSE:** The purpose of this study was to determine if Maximum Voluntary Isometric Contraction (MVIC) at 90 degrees of elbow flexion would affect performance in the bench press exercise.

**METHODS:** The participants involved in this study were eight female college track and field athletes (Height 1.72m±0.9, BMI 32.1±9.2) who compete in the throwing event (Hammer, Shot Put, Discus, Javelin). The average 1RM bench press for the participants was 59.5±19.8 kilograms. A counterbalanced, within subjects design was chosen for this study. Participants were asked to report to the weight room on two separate occasions. Both days began with a standard warm-up of the bench press exercise consisting of 70% 1RM for a set of five repetitions and 80% 1RM for 3 repetitions. After the warm-up both trial days consisted of three separate, single maximal attempts to set a new 1RM in the bench press. The two treatments that were counterbalanced were Standard (STAND) and MVIC. The STAND treatment consisted only of the three maximal lifts in the bench press exercise. The MVIC treatment consisted of a 30 second maximal voluntary isometric contraction against a stationary bar at 90 degrees of elbow flexion immediately prior to each single maximal bench press lift to induce fatigue. A 72 hour washout period was incorporated between treatments.

**RESULTS:** A significant difference ( $p=0.020$ ) was found between treatments by paired sample t-test analysis. The standard group (60.95kg±18.83) significantly out performed the isometric group (53.0kg±11.48).

**CONCLUSION:** It is apparent from the findings of this study that preferential fatigue of the prime movers at 90 degrees of elbow flexion acutely reduces performance in the bench press exercise. This suggests that strengthening the muscles at this joint angle through training may have the potential to increase strength in the bench press exercise.

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**1804 Board #154 May 27 3:30 PM - 5:00 PM**

**Effect Of Resistance Training Frequency On Body Composition In Middle-aged Women**

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(No relationships reported)

The effect of resistance training (RT) frequency on body composition has not been well studied in women, although they are at high risk for loss of lean mass with age.

**PURPOSE:** This study evaluated short-term effects of a 3- versus 4-day a week RT program on changes in absolute (kg) and relative (%) lean and fat mass.

**METHODS:** Nineteen untrained women (age 48 ± 1.2 years; BMI 28.8 ± 1.2) completed 8 weeks of RT. To promote adherence they self-selected assignment to either Group 3, which trained 3 nonconsecutive days of the week using a traditional total body protocol, or Group 4, which trained 4 consecutive days of the week using an alternating split training (upper-lower body) protocol. Group 4 completed 3 sets of 6 upper body exercises (chest press, latissimus pulldown, shoulder press, machine row, triceps pushdown, biceps curl) or 6 sets of 3 lower body exercises (leg press, leg extension, leg curl). Group 3 completed 3 sets of the same 8 exercises (excluding machine row) used for split training. Both groups completed 72 sets of 8-12 repetitions at 50-80% 1RM per week. Body composition was measured using air displacement plethysmography prior to and after completion of the RT program. To control for diet, participants were instructed not to change their intake or restrict calories during the study.

**RESULTS:** Both RT protocols were well-tolerated, had 98% adherence, and resulted in significant increases in upper and lower body strength ( $p < 0.01$ ). At baseline and after 8 weeks of RT there were no significant between-group differences in age, body mass, BMI, lean or fat mass. However, when both groups were combined there was a significant increase in absolute lean mass (1.1 ± 0.3 kg;  $p = 0.002$ ) accompanied by increases in body mass (1.04 ± 0.4 kg;  $p = 0.009$ ) and BMI (0.38 ± 0.1;  $p = 0.01$ ). A small, non-significant decrease in % body fat (-0.4 ± 0.3 %) was observed.

**CONCLUSIONS:** In untrained, middle-aged women initial, short-term gains in lean mass are not influenced by a training frequency of either 3 or 4 days a week. Consecutive-day split training is as well tolerated as traditional every-other-day total body training, even by novices. Therefore, for convenience and to promote adherence, women beginning a RT program should be taught both training protocols so they may schedule training sessions to fit their normal, weekly routine as closely as possible.

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**1805 Board #155 May 27 3:30 PM - 5:00 PM**

**Muscle Activation Pattern Is Similar Between The Pull-up And Lat-pull Exercise**

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(No relationships reported)

The lat pull-down (LP) exercise is commonly viewed as a corollary exercise to the pull-up (PU) and used to develop PU work capacity. Interestingly, neither 1-repetition maximum (1-RM) nor repetitions-to-failure (RTF; 60% of 1-RM) LP performance correlates with pull-up performance (Chandler et al., 2001).

**PURPOSE:** To determine the relationship between and muscle activation pattern of LP and PU performance.

**METHODS:** On two separate days, male subjects ( $n=9$ ; age: 20.3 ± 0.7 yrs; height: 177.7 ± 6.7 cm; mass: 78.3 ± 7.3 kg) performed a PU RTF test, a LP 1-RM test, and a LP RTF test at 60% of the LP 1-RM; pronated grip with controlled hand spacing. Surface EMG was collected during the first repetition of each exercise from the latissimus dorsi (LD), pectoralis major (PM), biceps brachii (BB), triceps brachii (TB), anterior deltoid (AD), and posterior deltoid (PD) muscle groups. The concentric phases of the EMG signals were integrated (iEMG) and normalized to EMG activity during a maximal voluntary isometric contraction (iEMG<sub>MVC</sub>) performed at the mid-range of each exercise.

**RESULTS:** The range of motion (ROM) was similar between LP (144±15°) and PU (132±20°). There was a weak, negative relationship between 1-RM LP (81.1±14.3 kg) and LP RTF ( $r=-0.44$ ). PU performance (14.8±5.6 reps; body mass 96% of 1-RM LP) was negatively correlated with 1-RM LP (81.1±14.3 kg;  $r=-0.53$ ) but not LP RTF (27.1±6.4 reps;  $r=-0.06$ ). However, work capacity (reps × load) was similar between PU RTF (1135±360 kg reps) and LP RTF (1297±6.4 kg reps). There was a progressive increase in iEMG/EMG<sub>MVC</sub> in PM, TB, LD, and PD throughout the concentric ROM in both PU and LP. iEMG/EMG<sub>MVC</sub> of PM, TB, AD, and PD was greater during PU than LP reflecting the greater load associated with PU (96% of 1-RM LP) as opposed to 60% of 1-RM. Interestingly LD muscle activity was not different between exercises.

**CONCLUSION:** Muscle activation pattern is similar in PU and LP; however the magnitude of the activation is greater during PU reflecting differences in load. Differences in performance of the PU and LP appear unrelated to the initial pattern of muscle activation.

Supported in part by PEO Soldier Grant #AHS 1131

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**1806 Board #156 May 27 3:30 PM - 5:00 PM**

### Elastic Band Bench Press Training Does Not Increase Power in Untrained Males

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It has been suggested that training with elastic bands in combination with free weights can potentially increase strength and power more so than free weights alone due to overstressing the concentric phase beyond the sticking point.

**PURPOSE:** The purpose of the study was to determine if using elastic bands during the bench press will increase power better than free weights alone.

**METHODS:** Eleven apparently healthy, untrained males (age 23±3 years) volunteered to participate in the 13 week study. During the first week all participants reported to the exercise physiology lab for a familiarization session whereby an instruction on how to perform the bench press was provided. This was followed by a one repetition maximum (1RM) to assess baseline strength. Following a 1RM power was assessed via a potentiometer using 50% of their 1RM. The training protocol consisted of five sets of five repetitions using 85% of the previous 1RM. Weeks two through four were used as a neural adaptation phase followed by a 1RM on week five. The subjects were then randomly assigned into one of two groups for the following weeks: groups that benched using 85% free weight tension with 15% elastic tension (BAND) or 100% free weight tension (STAND). The subjects were retested for strength and power during week nine and in weeks 10 through 12 the treatments were reversed.

**RESULTS:** Subjects' power was significantly increased throughout the 13 weeks ( $p = 0.00$ ). When covaried for order ANCOVA revealed that there was no main or interaction effect ( $p \geq 0.6$ ). Strength and power were also found to be strongly correlated in both treatments ( $p = 0.001$  for BAND &  $p = 0.003$  for STAND).

**CONCLUSIONS:** Based on these data the use of elastic bands with the bench press did not produce significantly greater gains in power vs. standard bench press, and that power and strength are strongly correlated regardless of the treatment.

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### 1807 Board #157 May 27 3:30 PM - 5:00 PM

#### Effects Of Resistance Exercise Of Different Intensity But Equal Work On Excess Post-exercise Oxygen Consumption

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(No relationships reported)

Excess post-exercise oxygen consumption (EPOC) is defined as an increase in oxygen consumption ( $\text{VO}_2$ ) following the completion of exercise. Previous research has primarily focused on the influence of endurance-type exercise on EPOC.

**PURPOSE:** The purpose of this study was to compare the effect of a light versus heavy resistance exercise protocol of equal work on EPOC.

**METHODS:** Ten male subjects performed two days of one-repetition maximum (1-RM) testing and two experimental trials (Light: 3 sets of 15 repetitions at 40% 1-RM; Heavy: 4 sets of 4 to 8 repetitions at 80 to 87.5% 1-RM).  $\text{VO}_2$ , caloric expenditure, blood lactate concentration, heart rate, and blood pressure were measured at baseline, 5, 15, 30, 60, 90 and 120 minutes post-exercise, and 24 hours post-exercise.

**RESULTS:** For both exercise protocols,  $\text{VO}_2$  and caloric expenditure were significantly greater at 5 min post-exercise compared to baseline. In addition, at 5 min post-exercise,  $\text{VO}_2$  and caloric expenditure were greater during the light protocol compared to the heavy protocol. During the 120 minutes post exercise, there was no significant difference in EPOC ( $44.0 \pm 43$  and  $39.1 \pm 44.3 \text{ mL} \cdot \text{kg}^{-1}$ ;  $P = 0.786$ ) or total caloric expenditure ( $15.1 \pm 13.8$  and  $12.9 \pm 16.9 \text{ kcal}$ ;  $P = 0.742$ ) between the light and heavy protocols. For the light protocol, blood lactate concentration was significantly greater at 5 min post-exercise compared to BASE but there were no statistical differences in blood lactate concentration between BASE and any other time points. For the heavy protocol, blood lactate concentration was significantly greater at 5, 15 and 30 min post-exercise compared to BASE but there were no statistical differences in blood lactate concentration between BASE and any other time points. When comparing the two protocols, blood lactate concentration was significantly greater at 5 and 30 min post-exercise during the light protocol compared to the heavy protocol.

**CONCLUSIONS:** The data suggests that for resistance exercise protocols with an equal work volume, there is no difference in the magnitude and duration of EPOC.

*This study was Supported by a Western Michigan University Graduate Student Research Grant.*

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### 1808 Board #158 May 27 3:30 PM - 5:00 PM

#### Muscle Activation Patterns And Repetitions-to-failure Performance In The Bench Press Exercise

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(No relationships reported)

The bench press (BP) exercise is used to determine and develop upper-body muscular strength and work capacity.

**PURPOSE:** To examine the muscle activation pattern during performance of a bench press repetitions-to-failure (RTF) test.

**METHODS:** Subjects ( $n=16$ ; Age:  $21 \pm 2$  yr; ht:  $179 \pm 6$  cm; wt:  $78 \pm 7$  kg) performed BP one-repetition maximum (1-RM) and RTF (60% 1-RM) test. Surface EMG was collected during each repetition of both tests from the pectoralis major (PM), triceps brachii (TB), anterior (AD) and posterior (PD) deltoid, latissimus dorsi (LD), and biceps brachii (BB) muscle groups. The concentric phase EMG signals were integrated (iEMG) and normalized to muscle group specific EMG activity collected during a maximal voluntary isometric contraction ( $\text{EMG}_{\text{MVC}}$ ) performed at the mid-range of the BP exercise and prior to initiating testing. Mean power frequency (MPF) was also determined for the concentric phase.

**RESULTS:** 1-RM BP ( $92.2 \pm 24.3$  kg) was moderately correlated with body mass ( $r=0.74$ ), fat-free mass ( $r=0.64$ ) and fat mass ( $r=0.71$ ). Subjects performed  $23.4 \pm 2.5$  reps during RTF. Although 1-RM was highly correlated with work capacity (load reps;  $1388 \pm 330 \text{ kg} \cdot \text{reps}$ ;  $r=0.89$ ) the relationship with RTF was negative and low ( $r=-0.22$ ). During RTF concentric contraction time increased ( $0.69 \pm 0.21$  to  $1.81 \pm 0.83$  sec), while range of motion ( $242 \pm 8^\circ$  to  $254 \pm 19^\circ$ ) and excentric contraction time ( $0.640$ - $0.900$  sec) did not change from the first to the last repetition. iEMG/  $\text{EMG}_{\text{MVC}}$  increased progressively from the beginning ( $-0.16$ - $0.30$ ) to the end ( $-0.21$ - $0.51$ ) of each concentric contraction in PM, TB, AD and LD during RTF. At failure iEMG/  $\text{EMG}_{\text{MVC}}$  increased at the beginning ( $-0.21$ - $0.46$ ) and end ( $-0.39$ - $0.83$ ) of the concentric contraction; the latter activity was equal to iEMG/  $\text{EMG}_{\text{MVC}}$  activity observed during 1-RM. MPF decreased in PM ( $55.2 \pm 8.1$  to  $47.1 \pm 5.6$  Hz) and TB ( $55.7 \pm 5.3$  to  $49.4 \pm 6.8$  Hz), while AD ( $54.2 \pm 4.4$  to  $53.5 \pm 3.5$  Hz) and LD ( $50.8 \pm 8.1$  to  $47.4 \pm 6.8$  Hz) remained unchanged.

**CONCLUSION:** There was a progressive increase in concentric contraction time and EMG activity and a decrease in MPF associated with muscle failure during RTF testing. The pattern and magnitude of EMG activity relative to  $\text{EMG}_{\text{MVC}}$  was similar in PM, TB, AD and LD muscle groups.

Supported in part by PEO Soldier Grant # AHS1131

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### 1809 Board #159 May 27 3:30 PM - 5:00 PM

#### Medial And Lateral Gastrocnemius Activation Differences During Heel Raise Exercise With Three Different Foot Positions

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(No relationships reported)

Instructional guidelines from some national exercise certification organizations recommend performing heel raise exercise with varying initial foot positions to alter the involvement of the gastrocnemius' medial (MG) or lateral (LG) head.

**PURPOSE:** To compare MG and LG activation during the concentric (CP) and eccentric (EP) phases of heel raise exercise using neutral (N), internally-rotated (IR) and externally-rotated (ER) foot positions. The term "foot position" was maintained for consistency with instructional texts, though the initial foot position reflects hip rotation.

**METHODS:** Twelve healthy subjects (9 male, 3 female;  $24.0 \pm 3.8$  yrs) with resistance training experience performed free-weight (bar loaded to 30% body mass) heel raise exercise on a 3.8 cm block. Surface electromyographic (EMG) activity was recorded during five repetitions under each of the N, IR and ER foot positions, divided into CP and EP phases, and ensemble averaged within phase. Mean EMG amplitude, normalized to maximum voluntary contraction, was calculated. Separate two-factor (position by head) repeated measures analysis of variance were used for each phase. Simple main effects post hoc analyses of the significant ( $P < .05$ ) interactions were conducted.

**RESULTS:** During EP, significantly greater MG activity compared to LG activity was revealed for both N and ER. During CP, significantly greater LG activity compared to the MG occurred for IR. Further, post hoc analyses on the EP revealed that MG activity using ER was significantly greater than MG activity using IR or N. Likewise, analysis of CP revealed that LG activity using IR was significantly greater than LG activity using ER or N.

**CONCLUSION:** Altering foot positions during the heel raise exercise does alter relative muscle activation as measured by surface EMG. The MG is activated to a significantly greater extent than the LG during EP using N and ER, while the LG displays significantly greater muscle activity than the MG during CP using IR. Further research is recommended to elucidate the role of the contraction phases in these differences.

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## 1810 Board #160 May 27 3:30 PM - 5:00 PM

### Effects Of Gender And Different Temperature Modalities On Contraction Force Following A Resistance Exercise Program

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**INTRODUCTION:** Different types of modalities that are applied post-therapy have been known to have an effect on muscle contraction force. Gender has also been shown to have an effect on maximal muscle contraction force.

**PURPOSE:** To examine the effects of gender, thermotherapy (THERM), and cryotherapy (CRYO) on skeletal muscle contraction force of the biceps muscle following a high volume and medium intensity resistance exercise program.

**METHODS:** Thirty one (31) subjects (16 males, 15 females) were randomly assigned to THERM, CRYO, and control (CON) groups. A 1-RM test was performed prior to any resistance training, and at 2, 4, and 6 weeks during training.

**RESULTS:** Significant ( $p = 0.008$ ) gender differences were observed on skeletal muscle contraction force (Females:  $22.4 \pm 2.3\%$  vs Males:  $10.1 \pm 2.1\%$ ) with females demonstrating a greater percentage increase. A significant treatment by gender difference was also observed [(CRYO: (Females:  $27.1 \pm 4.9.0\%$  vs Males:  $5.5 \pm 3.5\%$ ) CON: (Females:  $24.6 \pm 3.5\%$  vs Males:  $7.0 \pm 3.8\%$ )] with females demonstrating a greater percent increase compared to males following six weeks of resistance exercise program. A significant ( $p < 0.011$ ) increase in skeletal muscle contraction force over time was observed in all groups.

**CONCLUSION:** Gender, along with modality, demonstrated a significant difference in muscle contraction force following resistance exercise. In the group tested, females showed a higher potential for increase in skeletal muscle contraction force.

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## 1811 Board #161 May 27 3:30 PM - 5:00 PM

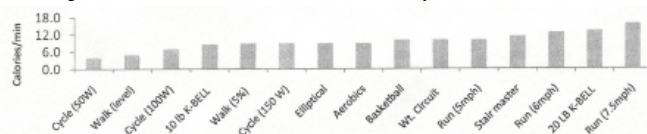
### Metabolic Demand Of A Kettlebell Workout Routine

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(No relationships reported)

Kettlebell routines work to train the body as a whole by improving function, stabilizing joints, and rehabbing athletes after injury. However, the metabolic demand of a single kettlebell routine as it compares to other modes of exercise has not been determined. The purpose of this study was to measure oxygen consumption while completing a kettlebell routine in an effort to accurately determine oxygen consumption and thereby caloric expenditure during the routine. Ten subjects (5 male, 5 female) completed multiple cycles of nine different kettlebell exercises in succession, with each cycle lasting approximately 5-7 minutes. Subjects went about the routine at a self selected pace using either a 10 lb kettlebell (females) or a 20 lb kettlebell (males). Throughout the routine, oxygen consumption (VO<sub>2</sub>) and heart rate (HR) were measured continuously (Oxycon Mobile, Cardinal Health, Inc.). Total test time ranged from 14-22 minutes. Mean values were determined for HR and VO<sub>2</sub> for each exercise, as well as for the entire routine. An overall average for HR and VO<sub>2</sub> was calculated for males and females. The Weir equation was used to calculate per minute caloric expenditure for each subject and to generate a mean caloric requirement for the kettlebell exercises and overall routine (See Fig. 1). Results indicate

this kettlebell routine provided a metabolic demand equal to that of typical exercises such as treadmill walking on an incline, stationary cycling, elliptical exercise, stairmaster or running. These data also demonstrate kettlebell activity could be used as a viable form of cross training to maintain health and improve overall fitness.



The study was funded by a grant from cfit2/believe/it, LLC. Mpls, MN, a distributors of kettlebells.

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## 1812 Board #162 May 27 3:30 PM - 5:00 PM

### No Significant Difference In Oxygen Consumption Between Circuit And Hypertrophy Training At Different Speeds

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Resistance training (RT) increases muscle mass and basal metabolic rate, and thus positively affects body composition. However, there is considerable debate over which RT protocol is most effective. Identifying RT protocols that acutely maximize caloric output may provide insight when addressing health concerns such as metabolic syndrome and sarcopenic obesity. Most studies that have measured caloric output during RT have compared protocols such as circuit to hypertrophy training using varying loads, volumes, and repetitions.

**PURPOSE:** To compare oxygen consumption ( $\text{VO}_2$ ), heart rate (HR), and lactate (La) responses to circuit (CIR) and hypertrophy (HYP) patterns under high-speed (HS) and controlled-speed (CS) conditions while holding volume, intensity, and lifting technique constant during a whole-body RT workout.

**METHODS:** Five resistance-trained male subjects ( $27.4 \pm 5.6$  yrs,  $84.8 \pm 13.3$  kg,  $178.8 \pm 10.9$  cm) participated in 5 testing and a 1RM day. Conditions were: control (CON), controlled speed hypertrophy (CSHYP) and circuit (CSCIR), and high-speed hypertrophy (HSYYP) and (HSCIR). Testing days consisted of a 30 min supine baseline measure, 39.5 min workout protocol, and 90 min supine EPOC measure, except CON, when the subject rested for the entire duration. Workouts consisted of 3 sets of 10 repetitions for 9 exercises at 50% 1RM, either as fast as possible or at a rate of 1.5s concentric/1.5s eccentric. HR and  $\text{VO}_2$  were measured continuously; 9 lactate samples were taken over the 2.7 hr protocol.

**RESULTS:** No significant differences were seen across baseline measures. During exercise all training conditions produced higher  $\text{VO}_2$ , HR, and La than CON. CSHYP increased HR and La more than either HS condition. Over the 90 min EPOC, HYP showed greater  $\text{VO}_2$  than CON; all conditions showed increased HR. CSHYP produced higher HR and La than HS. CIR showed greater La than HYP, while CS showed increased HR and La over HS; all were increased over CON.

**CONCLUSION:** Our pilot data show that under conditions where load, volume, and repetitions are held constant, CIR and HYP training appear to have equal capacity to elevate oxygen consumption regardless of training speed; however, HYP training produces slightly higher EPOC levels. Additionally, higher La levels and subject feedback indicate a greater effort during CS versus HS training.

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**1813 Board #163 May 27 3:30 PM - 5:00 PM**  
**Blood Lipid Profile Response To An Acute Bout of Resistance Training**

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Obesity, a risk factor for diabetes mellitus, is a growing epidemic. It is well known that the blood lipid profile improves with endurance training and resistance training. Whether improvements occur in the lipid profile in response to one session of resistance training are unclear.

**PURPOSE:** To determine the effect of an acute bout of resistance training on the blood lipid profile response in young adults.

**METHODS:** Twenty healthy recreationally trained college students (13M, 7F;  $20.1 \pm 1.3$  yr;  $82.0 \pm 24.4$  kg; BMI  $27.4 \pm 6.7$ , respectively) enrolled in a resistance training activity class volunteered for participation in this study. All participants were free of any illness or medication that might affect lipid profile. Workout modalities included resistance training machines and free weights. Fasting seated blood samples were taken immediately before (pre) and after (post) the class session and measured for total cholesterol (TC), high-density lipoproteins (HDL), low-density lipoproteins (LDL), triglycerides (TG) and TC/HDL ratio. Paired t-tests were used to compare the responses in the individual components of the pre-exercise and post-exercise lipid profile.

**RESULTS:** Data are reported as mean  $\pm$  SD. TC was reduced post-exercise vs. pre-exercise ( $139.2 \pm 34.8$  vs.  $145.2 \pm 39.4$  mg-dl<sup>-1</sup>,  $p=0.02$ ), as was LDL ( $88.0 \pm 29.0$  vs.  $96.7 \pm 42.2$  mg-dl<sup>-1</sup>,  $p=0.04$ ). There were no significant differences ( $p>0.05$ ) between pre- and post- HDL, TG, and TC/HDL.

**CONCLUSION:** From these data, participation in an acute bout of resistance training that was one hour in duration improved the TC and LDL components of the blood lipid profile. To better understand the longitudinal lipid profile response with resistance training across age, gender, and ethnicity, future research may involve measuring the lipid profile on a more frequent basis.

Supported by a Grant from the TAMUK College of Education.

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**1814 Board #164 May 27 3:30 PM - 5:00 PM**  
**Effect Of Concurrent Training On Blood Lipid Profile In Untrained Men**

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(No relationships reported)

Cardiovascular disease (CVD) is predicted to be the main cause of death in developed countries by 2020. Regular physical activity is believed to decrease the risk of CVD by increasing the turnover of lipid substrates, with effects on transport and cell availability. Previous investigations have shown that endurance training results in beneficial changes in the serum lipid profile. Available results concerning the effects of strength training on the serum lipid profile are more conflicting. There is little information regarding the effects of concurrent training (endurance and resistance training performed in the same overall regime) on blood lipid profile in sedentary male subjects.

**PURPOSE:** This study compared the effects of three different 8-wk training programs [endurance training (ET), strength training (ST) and concurrent training (CT)] on blood lipid profile and body composition in untrained young men.

**METHODS:** A total of 27 subjects were randomly allocated to an ET, ST or CT group which performed either progressive treadmill (ET), free weight (ST) or both the endurance and strength training requirements for 8 weeks. The endurance (E) training program involved running at 65% of HRmax for thirty minutes per session and three sessions per week where the HR reached 80% towards the end of the program. The strength (S) training program involved performing three sets of bench press, squat, pull down and legs curl with 50% of 1RM, 10 repetitions per set and three sessions per week where the intensity reached 80% of 1RM and where the repetition decreased to 6 towards the end of the program. The Concurrent (C) training program included both E and S training requirements.

**RESULTS:** High-density lipoprotein and low-density lipoprotein profiles significantly improved in the ET and CT groups ( $p < 0.01$ ) but not in the ST group. Triglyceride and total cholesterol profiles significantly improved in all three training groups. Total fat mass significantly decreased in the ET and CT groups ( $p < 0.001$ ) but not in the ST group, whereas fat free mass significantly increased in the ST and CT groups ( $p < 0.01$ ) but not in the ET group.

**CONCLUSION:** These results indicate that CT can be used to simultaneously improve both the serum lipid profile and body composition of previously untrained, apparently health young men.

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**1815 Board #165 May 27 3:30 PM - 5:00 PM**  
**Yoga And Functional Resistance Training Improves Body Composition,  $\text{VO}_{2\text{peak}}$  And Mood State In Women**

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(No relationships reported)

Yoga and functional resistance exercise are common modes of physical activity. However, there are limited numbers of randomized, controlled studies using objective quantitative measures comparing the relative effectiveness of each form of activity.

**PURPOSE:** To compare the effects of a 10-wk yoga vs. functional resistance training intervention on total and regional body fat distribution, blood lipids, aerobic capacity, and mood state.

**METHODS:** Thirty-three, healthy women ( $43.2 \pm 4.6$  yrs) were randomly assigned to 10-wks of Pulse Yoga (PY;  $n=8$ ), functional resistance training (FCT;  $n=9$ ), or wait-list control (C;  $n=8$ ). Experimental groups (PY, FCT) participated in three 60-75 min exercise sessions/wk, whereas controls maintained their pre-existing level of physical activity



(<60min physical activity/wk). All subjects followed an energy-balanced healthy eating plan throughout the 10-wks. Outcome assessments performed at baseline and after the 10-wk intervention included total and regional body composition analysis (DXA), blood lipid profile, Profile of Mood States (POMS), and aerobic fitness.

**RESULTS:** Twenty-five of the 33 women recruited and randomized were included in the analysis (three drop-outs, five non-compliant). Total %body fat and abdominal %body fat declined significantly ( $P<0.05$ ) in PY (-5.9%; -6.4%) and FCT (-5.8%; 8.8%) but remained unchanged in C. Total cholesterol levels decreased significantly ( $P<0.05$ ) in all three groups PY (12.5%), FCT (11.5%) and C (11.5%), whereas triglyceride levels decreased significantly in PY (32%) and C (23%) and remained unchanged in FCT. Tension decreased in FCT (7.5 vs. 4,  $P<0.05$ ) and vigor increased in PY (15 vs. 20.5,  $P<0.05$ ) following the intervention. Estimated  $\text{VO}_{2\text{peak}}$  increased significantly ( $P<0.05$ ) in both treatment groups following the training (PY; 30 vs. 35 ml/kg/min, 16.6%; FCT; 31 vs. 36 ml/kg/min, 16.8%).

**CONCLUSION:** Both yoga and functional resistance exercise training elicit favorable changes in total and regional body fat distribution and aerobic fitness which coincides with enhanced psychological mood state. These findings support the use of yoga and functional resistance exercise for improved body composition, cardiovascular and psychological health in middle aged women.

*Supported by funding from the Oscar Tang Foundation*

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**1816 Board #166 May 27 3:30 PM - 5:00 PM**

**Effect Of 12wks Intense Intermittent Running And High-resistance-training On Various Health Parameters In Untrained Men**

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*(No relationships reported)*

**INTRODUCTION:** A recent study has shown that regular soccer training has significant health beneficial effects for untrained males with elevated risk of lifestyle diseases. It elevated maximal oxygen uptake, lowered blood pressure (BP) and LDL cholesterol (Krstrup et al., 2008). Soccer is an intermittent activity with periods at near maximal heart rates and multiple strength related specific soccer movements.

**PURPOSE:** To study the effect of 12wks intense interval running or strength training on selected health variables.

**METHODS:** 16 untrained males (36.7 $\pm$ 5.7 yrs, 182 $\pm$ 6 cm, 93.7 $\pm$ 13.9 kg, 36.5 $\pm$ 6.4 ml  $\text{O}_2$ /kg/min) were randomly separated in two matched groups, i.e. one group performing intense interval running (IR) for 5x2 min with heart rates  $>90\%$ HR<sub>max</sub>, interspersed by 1-min recovery periods, and one group performing heavy-resistance strength training (ST) with multiple strength exercises for the legs (week 0-4: 12-16RM, week: 4-12: 6-10RM). Both groups trained 2.0 $\pm$ 0.3 times per week for 12 weeks. Blood pressure and blood glucose were determined after an overnight fast. On a separate day an exhaustive incremental treadmill test was completed.

**RESULTS:** After the training period, fasting blood glucose was reduced ( $P<0.05$ ) in IR (5.7 $\pm$ 0.2 vs. 5.2 $\pm$ 0.1mM). For IR, systolic blood pressure was 8mmHg lower ( $P<0.05$ ) after the training period, whereas no significant changes occurred for ST. After the training period, LDL-cholesterol was unaltered in IR (3.4 $\pm$ 0.2 vs. 3.3 $\pm$ 0.2mM;  $P>0.05$ ) and tended to be higher in ST (3.1 $\pm$ 0.3 vs. 3.5 $\pm$ 0.3mM;  $P=0.052$ ). After the training period, the maximal oxygen uptake increased by 14 $\pm$ 4% in IR, which was significantly more ( $P<0.05$ ) than in ST (4 $\pm$ 3%).

**CONCLUSION:** Short-duration intense intermittent training (~20 min per week) is more effective than high-resistance-training for short-term changes in aerobic power, fasting blood glucose and blood pressure in untrained males.

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**1817 Board #167 May 27 3:30 PM - 5:00 PM**

**Effect Of Weight Training On Power Performance And Heart Rate Variability During A 72-hour Recovery**

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*(No relationships reported)*

**PURPOSE:** This study determined the effect of strength training on heart rate variability (HRV) during a 72-h recovery for elite weight lifters, and its links to muscle strength, pain feeling and plasma creatine kinase level.

**METHODS:** Following a 10-d detraining period, seven weight lifters performed a 2-h strength training program including back squat, seated shoulder press, dead lifts, and front squat. Strength performance was evaluated at baseline (before training) and 3, 24, 48, 72 h following training. HRV (HF and LF/HF), pain index, plasma creatine kinase were measured.

**RESULTS:** Strength performance was recovered to baseline in approximately 24 h following training. Dead lifts and front squat were maximally increased above baseline in 48 h, whereas back squat and seated shoulder press were maximally increased above baseline in 72 h. Plasma creatine kinase level was peaked at 3 h following training and gradually decline for 72 h. Although the pain feeling was not completely cleared, vagal activity (mirrored by natural log HF) was maximal at 72 h after training.

**CONCLUSIONS:** Similar to most of previous finding, improvement in power performance occurred 48-72 h following strength training. The present study found an association between strength performance and vagal activity during a 72-h recovery period.

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**1818 Board #168 May 27 3:30 PM - 5:00 PM**

**Effect Of A 12-week Exercise Intervention On Body Composition Variables In African American Women**

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*(No relationships reported)*

**PURPOSE:** This study evaluated body composition changes in middle-aged, obese, African-American women after a 12-week exercise intervention.

**METHODS:** Height, weight, waist and hip circumferences, and body composition variables via dual-energy X-ray absorptiometry were measured in 20 African-American females (age: 49 $\pm$ 4 yr; BMI: 34.2 $\pm$ 4.9 kg/m<sup>2</sup>). Subjects were randomly placed into one of two exercise training groups. One group was instructed to increase their daily walking to  $\geq 10,000$  steps/day (W; n=10) and the other group was given the same walking prescription, but additionally strength trained 2 days/wk (WS; n=10). Subjects performed 3 sets of 8-12 repetitions of 10 exercises focusing on the major muscle groups. Strength was evaluated for the upper and lower body by performing 1-repetition maximum tests for the chest press and leg extension. A two-way repeated measures ANOVA was performed to examine changes between the two groups. Significance was accepted at  $p<0.05$ .

**RESULTS:** WS significantly increased daily walking (5344 $\pm$ 1944 to 8037 $\pm$ 1137 steps/day;  $p<0.01$ ), while W showed a non-significant increase in daily walking (6203 $\pm$ 2840 to 7924 $\pm$ 1862 steps/day;  $p=0.08$ ). WS significantly increased upper (106 $\pm$ 12 to 125 $\pm$ 10 kg) and lower body (104 $\pm$ 22 to 125 $\pm$ 24 kg) strength ( $p<0.01$ ) and W showed no change for either measure. There was also a significant decrease in waist circumference for only WS (91.5 $\pm$ 7.9 to 89.6 $\pm$ 7.1 cm;  $p=0.025$ ). Values for body weight, BMI, % body fat, lean body mass, and bone density did not significantly change in either group after the 12-week intervention compared to baseline.

**CONCLUSIONS:** Strength training combined with a pedometer-based walking program increased walking volume and muscular strength, and decreased waist circumferences in obese, middle-aged, African-American women. This reduction in waist circumference may have significant health implications for risk factors of cardiovascular disease.



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**B-35 Free Communication/Poster - Restrictive Blood Flow and Muscle Adaptation**

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**1819 Board #169 May 27 2:00 PM - 3:30 PM****Eccentric Exercise Training-induced Skeletal Muscle Hypertrophy Is Augmented By Concomitant Blood Flow Restriction**Mizuki Sudo, Yutaka Kano. *Univ. of Electro-communications Dept. of Appl. Physics & Chemistry, Chofu, Tokyo, Japan.*

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(No relationships reported)

Eccentric contractions (ECC) induce skeletal muscle damage as well as stimulating muscle hypertrophy and hyperplasia. However, our previous study (Med. Sci. Sports Exer. 40: S196, 2008) demonstrated that ECC-induced skeletal muscle damage is suppressed by performing ECC whilst blood flow is restricted (BFR). It has been recently reported that restriction of muscle blood flow during low intensity concentric muscle contractions potentiate muscle hypertrophy (Fujita et al. J. Appl. Physiol. 103: 903-10, 2007).

**PURPOSE:** To test the hypothesis that ECC training-induced skeletal muscle hypertrophy is augmented by concomitant BFR.

**METHOD:** Wistar rats (male, 12 week-old) were divided into four groups: normal control group (CONT, n=6), blood flow restriction group (BFR, n=6), ECC without BFR group (ECC, n=6) and ECC with BFR group (BFR+ECC, n=4). In anesthetized rats, the right tibialis anterior muscle (TA) was subjected to 40 times-repeated ECC with/without occlusion pressure (~200 mmHg, by thigh cuff occlusion). ECC was evoked by surface electric stimulation (100 Hz, ~5 V) while the muscle was being simultaneously stretched by a synchronized electromotor. Training was conducted 2 days/wk, for 6 wks. TA muscles were removed 24 hours after the last exercise training bout and muscle fiber cross-sectional areas (CSA) were evaluated morphometrically from hematoxylin-eosin stained thick sections.

**RESULTS:** The muscle-to-body weight ratio (mg/g) increased significantly ( $P<0.05$ ) after training in both ECC ( $1.87 \pm 0.1$ ) and BFR+ECC ( $1.95 \pm 0.1$ ) compared with CONT ( $1.56 \pm 0.1$ ). The range of CSA was larger in both ECC ( $21\text{--}5936\mu\text{m}^2$ ) and BFR+ECC ( $156\text{--}5295\mu\text{m}^2$ ) compared with CONT ( $78\text{--}4423\mu\text{m}^2$ ). Mean CSA was significantly increased in BFR+ECC ( $1658 \pm 32\mu\text{m}^2$ ) compared with both CONT ( $1199 \pm 97\mu\text{m}^2$ ) and ECC ( $1316 \pm 109\mu\text{m}^2$ ). There was no statistical difference in mean CSA between ECC and CONT, in part because a large number of small regenerating fibers were observed in ECC but interestingly not in ECC+BFR.

**CONCLUSION:** ECC training-induced skeletal muscle hypertrophy is augmented by concomitant BFR which also appears to decrease the presence of small regenerating fibers.

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**1820 Board #170 May 27 2:00 PM - 3:30 PM****Kinetics of Intramuscular Inorganic Phosphate During Low Intensity Exercise With Blood Flow Restriction**Masato Sugaya<sup>1</sup>, Satoshi Fujita<sup>1</sup>, Riki Ogasawara<sup>1</sup>, Hayao Ozaki<sup>1</sup>, Mikako Sakamaki<sup>1</sup>, Tadashi Suga<sup>2</sup>, Masashi Omokawa<sup>2</sup>, Shingo Takada<sup>2</sup>, Yoshiaki Sato<sup>1</sup>, Koichi Okita<sup>2</sup>, Takashi Abe<sup>1</sup>. <sup>1</sup>University of Tokyo, kashiwa, Japan. <sup>2</sup>Hokusho University, ebetsu, Japan.

(No relationships reported)

Under the same loading condition, dynamic exercise combined with blood flow restriction (BFR) causes more rapid reduction in muscle power (muscle fatigue) than without blood flow restriction. Furthermore, low-intensity resistance exercise combined with BFR causes as much muscle fatigue as that of high-intensity exercise. However, the mechanisms of such exercise induced muscle fatigue with BFR are unknown. Recent studies have suggested that the accumulation of inorganic phosphate (Pi), which accelerates under ischemic exercise, may also contribute to muscle fatigue.

**PURPOSE:** To investigate the kinetics of intramuscular Pi concentration during resistance exercise with blood flow restriction.

**METHODS:** Ten healthy young men ( $24.9 \pm 5.4$  yrs,  $174.4 \pm 7.1$  cm,  $71.1 \pm 10.0$  kg) performed unilateral planter flexion exercise (30 reps  $\dot{A}f_{-1}$  set followed by 15 reps  $\dot{A}f_{-3}$  sets with 30-seconds rest between sets) in a supine position in phosphorus magnetic resonance spectroscopy (MRS system). Each subject underwent three exercise conditions; at low-intensity (20%1-RM) either with (L-BFR) or without (L-CON) blood flow restriction, and high-intensity exercise (HIGH; 70%1RM, 15 reps  $\dot{A}f_{-3}$  sets with 3 min rest between sets) without blood flow restriction. For L-BFR, proximal part of thigh in the exercising leg was pressurized at 220 mmHg with inflexible cuff (5cm wide). Change in intramuscular Pi was monitored continuously during the entire protocol.

**RESULTS:** During exercise, Pi increased progressively and similarly for L-BFR and L-CON group. However, during the rest interval, the rate of decline (recovery rate) was slower in L-BFR such that the % change in Pi was significantly higher in L-BFR than L-CON before the initiation of following set. As a result, the % change in Pi at the end of 4<sup>th</sup> set was significantly higher in L-BFR than L-CON (L-BFR;  $94.0 \pm 30.3$  %, L-CON;  $64.0 \pm 20.2$  %). However, % change in Pi for HIGH was still significantly higher than L-BFR and L-CON.

**CONCLUSIONS:** Low-intensity resistance exercise combined with blood flow restriction induced accumulation of Pi faster than control exercise mainly due to the delayed recovery during the rest periods.

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**1821 Board #171 May 27 2:00 PM - 3:30 PM****Effect Of Blood Flow Restricted Exercise On Delayed Onset Muscle Soreness**Jonathan Umbel<sup>1</sup>, Richard L. Hoffman<sup>1</sup>, Douglas Dearth<sup>1</sup>, Gary S. Chleboun<sup>1</sup>, Todd M. Manini<sup>2</sup>, Brian C. Clark<sup>1</sup>. <sup>1</sup>Ohio University, Athens, OH.<sup>2</sup>University of Florida, Gainesville, FL.

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(No relationships reported)

**PURPOSE:** To determine whether low-intensity (LI) blood flow restricted exercise (BFRE) induces delayed-onset muscle soreness (DOMS), and evaluate the contribution of the BFRE concentric (CON) versus eccentric (ECC) actions on DOMS.

**METHODS:** We performed two experiments. In experiment 1, nine subjects ( $25 \pm 5$  yrs) performed 3-sets of unilateral knee extension BFRE (CON and ECC) at 35% of maximal voluntary contraction (MVC) to failure with a proximally located thigh cuff inflated 30% above systolic blood pressure. Subjects repeated the protocol with the contralateral limb without flow restriction. In experiment 2, nine different subjects ( $22 \pm 6$  yrs) performed the aforementioned BFRE protocol with one limb performing only the CON action and the contralateral performing the ECC actions. The following indices of DOMS were assessed before exercise and 24, 48, and 96-hours post: soreness (0-10 scale), algometry (pain-pressure threshold; PPT), MVC and vastus lateralis cross-sectional area (CSA) measured with ultrasound imaging to assess muscle swelling.

**RESULTS:** Experiment 1: BFRE resulted in a 24% reduction in the PPT, an 8-14% reduction in strength and a 4-5% increase in CSA 24-48 hours post-exercise ( $p<0.05$ ). No changes were observed following LI exercise without restriction. Experiment 2: CON BFRE resulted in a 20% reduction in the PPT, and a 3-6% increase in CSA 24-48 hours post-exercise ( $p<0.05$ ). No changes were observed following ECC BFRE.

**CONCLUSIONS:** BFRE induces DOMS, with the CON action contributing more than the ECC. Further investigation into the feasibility of BFRE is warranted, and additional work is needed to determine the mechanism behind BFRE-induced DOMS.

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**1822 Board #172 May 27 2:00 PM - 3:30 PM**

**The Effects Of Differing Thigh Composition On Tissue Oxygenation Of The Quadriceps Following Vascular Restriction**

Jacqueline Escobar<sup>1</sup>, Murat Karabulut<sup>1</sup>, Takashi Abe<sup>2</sup>, Yoshiaki Sato<sup>3</sup>, Michael G. Bembien, FACSM<sup>4</sup>. <sup>1</sup>University of Texas at Brownsville, Brownsville, TX. <sup>2</sup>University of Tokyo, Chiba, Japan. <sup>3</sup>University of Tokyo, Tokyo, Japan. <sup>4</sup>University of Oklahoma, Norman, OK.

(No relationships reported)

KAATSU is a new training technique which can utilize different initial pressures (ranging between 30 and 70 mmHg) prior to an incremental increase in pressure to restrict blood flow during exercise, however it has not been investigated if tissue oxygenation would be affected by the composition of the restricted limb.

**PURPOSE:** To examine the effects of subcutaneous fat and lean muscle mass on tissue oxygenation of the quadriceps muscles while using three different initial restriction pressures.

**METHODS:** Six healthy males (30.0±4.6 years) had their thigh size measured by circumferences, skinfolds, ultrasound, and dual energy x-ray absorptiometry (DXA) to determine volume and thickness of subcutaneous fat and regional bone free muscle mass. Following skin preparation, Near-Infrared Spectroscopy was placed over the mid-thigh to measure tissue oxygenation. The KAATSU belt was placed on the upper most portion of the thigh, and participants then experienced initial pressures of 30, 50, and 70 mmHg in random order on three separate days. Tissue oxygenation was recorded at rest (lying down) once initial pressure was set, then following six pressures (120, 140, 160, 180, 200, and 220 mmHg) were sequentially applied to restrict blood flow for 4-min with 2-min rest periods between trials without pressure. Pearson correlations explored relationships between variables with the level of significance set at 0.05.

**RESULTS:** Correlations between leg LBM and tissue oxygenation were significant and strong ( $r = 0.87$  to  $0.97$ ) when initial pressure was set at 70 mmHg, however, there was only minimal association with subcutaneous fat. A significant positive correlation was detected between tissue oxygenation and thigh circumference at 70 mmHg ( $r = 0.85$ ), however when the restriction pressure was increased, correlations became non-significant and moderate in nature ( $r = 0.58$  to  $0.78$ ). Tissue oxygenation was generally inversely or weakly related to thigh circumference ( $r = -0.62$  to  $0.32$ ), subcutaneous fat ( $r = -0.53$  to  $0.41$ ), and leg LBM ( $r = -0.45$  to  $0.34$ ) when initial pressures were set at 30 and 50 mmHg.

**CONCLUSIONS:** The findings indicated that when using the highest initial restrictive pressure of 70 mmHg, tissue oxygenation was positively correlated with leg muscle mass due to greater blood pooling.

**1823 Board #173 May 27 2:00 PM - 3:30 PM**

**The Effect Of 4-week Low-intensity Ischemic Training On Quadriceps Size, Performance And Oxygen Availability**

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(No relationships reported)

Low-intensity/high-repetition exercise combined with restricted blood flow has been reported effective for increasing muscle mass and muscle strength. In contrast, ischemic exercise has been also shown to have an opposite effect: enhanced muscle aerobic metabolism and endurance capacity.

**PURPOSE:** To evaluate the effect of ischemic training on quadriceps performance, cross-sectional area (CSA) and O<sub>2</sub> availability.

**METHODS:** Ten healthy males trained on a leg-extension machine at loads equal to 15% of maximal voluntary contraction (MVC) force for 16 training sessions. One leg (I-leg) was trained with vascular occlusion induced by cuffs ( $\geq 230$  mmHg), whereas the other leg (C-leg) completed the same training volume without blood flow restrictions. Peak muscle strength was assessed with isometric MVC force, while endurance capacity was evaluated with one control and one ischemic test of repetitive load lifting to volitional failure. Oxygen availability in v. lateralis and activation of rectus f. and v. medialis during the endurance trials were measured with near-infrared spectroscopy and surface EMG. Muscle CSA was measured with a series of slices acquired by MRI. All tests and measurements were performed prior to and after training. Differences in means were tested using factorial ANOVA.

**RESULTS:** After training, a 9±2%, 5±1% and 7±1% increase ( $P < 0.05$ ) in CSA of rectus f., v. lateralis and v. medialis was observed in the I-leg, respectively. There was no change in MVC force in either I-leg or C-leg. Number of repetitions during control endurance test with I-leg and C-leg increased ( $P < 0.01$ ) by 63±9% and 36±8%, respectively. Root mean square EMG amplitudes of all muscles remained similar in both legs. The attained plateau of relative decrease in oxy-haemoglobin was reduced ( $P < 0.01$ ) by 15.7±0.4 µmol in I-leg and 6.7±0.4 µmol in C-leg. In contrast, the mean relative increase in total haemoglobin was higher ( $P < 0.01$ ) by 9.3±0.2 µmol in I-leg and 5.4±0.2 µmol in C-leg. The slope of change in both oxy- and deoxy-haemoglobin at the onset of exercise increased ( $P < 0.05$ ) in both legs, but more in I-leg.

**CONCLUSION:** Ischemic training substantially augments endurance capacity of m. quadriceps, which can be attributed mainly to enhanced muscle blood supply and O<sub>2</sub> availability. Increased muscle CSA may be an index of ischemia-induced capillarisation.

**1824 Board #174 May 27 2:00 PM - 3:30 PM**

**Influence Of Endurance Training Connected With Intermittent Hypoxia On Muscle Tissue Adaptations**

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(No relationships reported)

Mechanisms of muscle tissue adaptation to endurance training (ET) under influence of intermittent hypoxic training (IHT) are poorly understood.

**PURPOSE:** To compare muscle tissue adaptations induced by ET combined with IHT to those occurring with ET only at the same relative workload.

**METHODS:** Sixty Wistar rats were divided into 4 groups, defined as follows: 1 - control; 2 - ET: rats were swimming with a load which corresponded to 70-75% VO<sub>2</sub> max for 4 weeks with duration 30 min/day; 3 - IHT: rats were breathing with hypoxic mixture containing 12 % O<sub>2</sub> for 15 min with 15-min rest intervals, 5 times daily; 4 - ET+IHT: rats underwent the IHT sessions, as in III, combined with exercise sessions, as in II, for the last 2 weeks of ET. Physical endurance, maximal oxygen uptake VO<sub>2</sub> max, muscle PO<sub>2</sub> (P<sub>m</sub>O<sub>2</sub>), blood and muscle pH were determined. It was also investigated the muscle metabolic parameters (lactate and pyruvate concentration, lactate/pyruvate and NAD/NADH ratios, succinate dehydrogenase activity, ADP-stimulated mitochondrial respiration).

**RESULTS:** Endurance, VO<sub>2</sub> max, and P<sub>m</sub>O<sub>2</sub> maximally increased (5 times, 16 and 60%, respectively, compared to control) in those animals that simultaneously underwent ET and IHT. After using of the testing intensive physical workload, there was registered in group 1 a significant decrease in P<sub>m</sub>O<sub>2</sub> (from 23.5 ± 2.1 to 16.4 ± 1.9 mm Hg), blood pH (from 7.36 ± 0.012 to 6.88 ± 0.022), and muscle pH (from 6.88 ± 0.031 to 6.23 ± 0.024). The animals in group 4 demonstrated after the testing workload a non-significant decrease in P<sub>m</sub>O<sub>2</sub> (from 39.5 ± 3.3 to 34.8 ± 3.1 mm Hg), blood pH (from 7.32 ± 0.030 to 7.11 ± 0.028), and muscle pH (from 6.86 ± 0.024 to 6.48 ± 0.024). Such testing workload led to the lesser shifts of metabolic parameters witnessing for the tissue hypoxia development in muscle of rats adapted both to IHT and ET than in rats adapted to ET only. ET + IHT led to a mostly expressed increase in the mitochondrial respiration control (V<sub>3</sub>/V<sub>4</sub>) and ADP/O ratio under α-ketoglutarate oxidation compared to those values under succinate oxidation.

**CONCLUSIONS:** Combination IHT with ET is found to be the most productive model for improving oxygen transport to and within muscle cells and increasing the NADH-dependent oxidation pathway role in mitochondrial energy production.

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**1825 Board #175 May 27 2:00 PM - 3:30 PM****Acute Systemic Growth Responses To Low Intensity Blood Flow Restricted Resistance Exercise**

Todd M. Manini<sup>1</sup>, Brian C. Clark<sup>2</sup>, Frank M. Skidmore<sup>1</sup>, Joshua F. Yarrow<sup>1</sup>, Stephen E. Borst<sup>1</sup>. <sup>1</sup>University of Florida, Gainesville, FL. <sup>2</sup>Ohio University, Athens, OH.

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Previous research has demonstrated that blood flow restriction during low intensity resistance exercise (BFR-Low) results in a potent muscle growth response in humans. However, it is unclear whether this stimulus is similar to that provoked with free-flow high intensity resistance exercise (FF-HI).

**PURPOSE:** To determine the acute growth hormone (GH) and insulin-like growth factor (IGF-1) responses to BFR-Low and FF-HI in young adults. Additionally, because BFR may induce adverse reactions we evaluated cardiovascular, endothelial inflammation with vascular cell adhesion molecule (VCAM) and blood coagulation (D-dimer) responses.

**METHODS:** Ten healthy subjects aged 20-39 years reported to the laboratory between 7 and 9 AM on two separate occasions in a fasted condition. Knee extension exercise was performed at 20% of maximal strength for the BFR-Low condition in comparison to a FF-HI performed at 80% of maximal strength. Both conditions were performed for 5 sets until task failure. During BFR-Low exercise, a 10 cm wide tourniquet cuff was placed around the upper thigh at 1.5 systolic blood pressure immediately before exercise and remained inflated (~15 minutes). Blood was sampled every 10 minutes for 150 minutes to assess GH responses and IGF-1 was measured at baseline and 90 minutes post-exercise.

**RESULTS:** Subjects demonstrated a greater mean increase in GH levels with BFR-Low exercise ( $2.1 \pm 2.1$  ng/ml) when compared to FF-HI ( $1.5 \pm 2.6$  ng/ml), but this difference was not statistically different ( $p = 0.61$ ). IGF-1 levels demonstrated no change regardless of the exercise condition. Peak heart rate (HR) and systolic blood pressure (BP) showed similar responses to both conditions (HR: BFR-Low:  $83.8 \pm 12.4$ ; FF-HI:  $84.8 \pm 6.7$  bpm) (SBP: BFR-Low:  $148.8 \pm .9$  vs. FF-HI:  $139.0 \pm 15.6$  mmHg). Peak diastolic blood pressure was elevated to a greater extent during BFR-Low exercise (BFR-Low:  $103 \pm 9.7$ ; FF-HI:  $92.6 \pm 12.4$ ,  $p=0.05$ ). D-dimer, a degradation product of crosslinked fibrin and VCAM levels showed no change 30 min post exercise for either condition.

**CONCLUSIONS:** Resistance exercise performed at low intensity with BFR has a similar systemic acute growth, blood coagulation and endothelial inflammatory response, but greater cardiovascular demand when compared to resistance exercise performed at a high intensity.

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**1826 Board #176 May 27 2:00 PM - 3:30 PM****Changes In Tissue Oxygenation And Muscular Function In Response To Vascular Restriction**

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A single bout of low-intensity resistance exercise (20% 1-RM) combined with vascular restriction (i.e., KAATSU training) takes about 3-5 min to elicit a fatigue response. It has been reported that vascular restriction alone has been used to prevent atrophy, therefore, it would be important to determine how different pressures of blood flow restriction, applied for similar durations, can alter the metabolic demands of skeletal muscle and change muscle function.

**PURPOSE:** To examine the effects of altering vascular restriction pressure of the leg on percent voluntary activation (PVA) of the medial gastrocnemius (MG), tissue oxygenation of the calf muscles, and the electromyographic (EMG) and mechanomyographic (MMG) responses of MG.

**METHODS:** Thirteen young healthy males (Mean  $\pm$  SD age =  $24.6 \pm 5.3$  years; height =  $175.7 \pm 5.3$  cm; weight =  $77.7 \pm 7.5$  kg) performed one maximal isometric voluntary contraction (MVC) of the right plantar flexors at baseline. Then, following 2-min rest, six different pressures (40, 120, 160, 180, 200, 250 mmHg) were sequentially applied to restrict blood flow for 4-min with 2-min rest periods between trials with no pressure. At the end of each pressure setting, a MVC was performed. PVA, EMG and MMG responses were assessed during the twitch interpolation technique and tissue oxygenation was measured by near infrared spectroscopy. A repeated measures ANOVA was used to determine the main effects for trial with the level of significance set at 0.05.

**RESULTS:** The results showed that tissue oxygenation significantly decreased with increasing pressures ( $p < 0.05$ , ranged from 81% to 46%). However, there were no significant changes in MVC torque, PVA, EMG amplitude, EMG mean power frequency (MPF), MMG amplitude, and MMG MPF.

**CONCLUSIONS:** Four minute periods of restricting blood flow to the lower limb with pressures up to 250 mmHg were not sufficient to induce a significant metabolic challenge that would cause changes in muscular function.

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**1827 Board #177 May 27 2:00 PM - 3:30 PM****Improved Skeletal Muscle Mechanical Efficiency With Reduced Blood Flow Induced By Pharmacological Blockade**

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Recent studies have reported that during submaximal exercise under conditions of reduced blood flow, induced by pharmacological blockade of nitric oxide synthase (NOS) and prostaglandin (PG) synthesis, the  $\dot{V}O_2$  of the muscle is reduced for a given power output (Mortensen et al. *J Physiol.* 581: 853-861, 2007).

**PURPOSE:** To test the hypothesis that reduced nitric oxide (NO) and PG availability alters mitochondrial function, resulting in improved mechanical efficiency.

**METHODS:** Seven healthy subjects ( $24 \pm 0.8$  yrs) had catheters placed in the femoral artery of their exercising leg and performed 3 bouts of single leg knee-extension exercise ( $19.5 \pm 1$  W) under the following conditions: (1) Control, (2) L-NMMA (single block), and (3) L-NMMA + Indomethacin (double block). Using <sup>31</sup>P magnetic resonance spectroscopy (MRS), we monitored the levels of phosphocreatine (PCr) breakdown and PCr recovery kinetics of the quadriceps muscles during and after 4 min of dynamic exercise. In the single and double block conditions, L-NMMA (1.0 mg/min/kg leg mass) was infused alone or in combination with Indomethacin (50  $\mu$ g/min/kg leg mass) for 4 min, prior to and during exercise, and for 2 min of the recovery period.

**RESULTS:** There was a reduction in the amount of PCr breakdown in the double block condition compared to the control condition ( $41.2 \pm 3$  vs  $55.8 \pm 4$  % of resting level,  $p < 0.05$ ). No difference was observed in PCr levels between the control and single block condition. PCr recovery kinetics were not different across the 3 conditions.

**CONCLUSION:** Given the relationship between PCr breakdown and muscle  $\dot{V}O_2$ , the data reveal that mechanical efficiency is improved when NO and PG synthesis are reduced by pharmacological blockade. The reduced PCr breakdown and lack of impairment in PCr recovery kinetics in the face of likely reduced muscle blood flow suggests that reduced NO and PG availability improve mitochondrial efficiency.

Supported by the Novo Nordisk Foundation.

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**1828 Board #178 May 27 2:00 PM - 3:30 PM**  
**Five Week Assessment Of In-water Power Output In Competitive Swimmers**

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The use of commercially available semi-tethered resistive swim training devices as a means of introducing in-water "overload" during training in competitive swimming is common place. However, only limited research has been completed analyzing the efficacy of such devices as a means to improve performance during a competitive swim season.

**PURPOSE:** To characterize potential differences in power output in competitive swimmers following a 5 week in-water resistive training program.

**METHODS:** 18 competitive swimmers (8 female, 10 male) took part in a 5-week 'in-water' resistive training program utilizing a power rack (i.e. system of pulleys and weights that allows a swimmer to be tethered via waist belt to the resistive load while swimming). Each swimmer completed a pre and post-assessment. The assessment consisted of a series of 10 meter maximal freestyle swimming bouts with an increasing resistive load on each consecutive bout. From there, 80% of peak power was calculated and the corresponding load was utilized for the 5-week training period. Each swimmer completed two training sessions per week (total of 9 sessions). The first session began with 8 repetitions with approximately one minute of rest between each repetition. In each successive week the repetitions were increased by two bouts with the final training session consisting of 16 repetitions. Speed, stroke count and resistance were recorded for each bout.

**RESULTS:** Paired samples t-tests displayed significant ( $p < 0.001$ ) increases in power output (61.4 W vs. 66.1 W) and distance per swim stroke (0.62 m/stroke vs. 0.67 m/stroke) from pre to post assessments. There was no significant difference in swim stroke rate (strokes/second) from pre to post assessment and thus increases in velocity were a function of DPS and not stroke rate.

**CONCLUSION:** The results of this project suggest that in-water resistive training has the ability to increase swimming power output. While improvements in power are important, it is the relationship between the increases in power and swim velocity that interest coaches. The project suggests that training of this nature is capable of improving swim velocity (at least in a tethered condition) via increases in DPS and not swimming stroke rate.

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**1829 Board #179 May 27 2:00 PM - 3:30 PM**  
**Unique Aspects Of The Pacing Pattern In 800m Running And 200m Swimming**

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The pattern of energy distribution, reflected by movement velocity is thought to be negatively accelerated in 800m running and relatively even in 200m swimming. However, official split times may lack the temporal resolution to fully appreciate the pacing pattern.

**PURPOSE:** This study was designed to make high temporal resolution observations of the pacing pattern in WR performances for 800m running and 200m swimming (time base ~2 min).

**METHODS:** Archival video records of WR performances were reviewed and hand timed, using natural markers in the environment (with official race splits as a correlating factor) to allow measurement of mean velocity at ~12% distance increments (100m and 25m for running and swimming, respectively). Velocity curves were fitted using a best fit polynomial (3<sup>rd</sup> order) and with a simple linear model.

**RESULTS:** The mean (with official split) performances were: 102.28±0.99s (49.72±1.03, 52.49±0.37) for 800m and 104.31±1.04s (25.74±0.98, 25.97±1.03, 26.19±1.14, 26.34±1.32) for 200m. With velocities expressed relative to the mean velocity of the race, using a linear model, both the 800m ( $R^2=0.22$ ) and 200m ( $R^2=0.25$ ) were negatively accelerated, with the negative acceleration more pronounced in the 800m. This pattern persisted even when the opening segment (100m or 25m) was removed. When a best fit model was applied, the 800m ( $R^2=0.42$ ) was described by an overall negatively accelerated biphasic curve, with evidence of an end spurt during the last 100m. For the 200m ( $R^2=0.46$ ), there was evidence of large velocity differences during the first and last 25m of each length of the pool, associated with an increase in speed from the push off and progressively slower free swimming velocities during the last 25m of successive pool lengths.

**CONCLUSIONS:** The results support the concept that the pacing strategy during 800m running and 200m swimming is more complex than reflected by official race splits, and that velocity data with higher temporal resolution may be of considerable value relative to understanding the energy distribution of competition.

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**1830 Board #180 May 27 2:00 PM - 3:30 PM**  
**Effects Of 2min Active Recovery On A "Booster" VO<sub>2</sub>Max Test Using Male Cross Country Runners**

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Maximal aerobic capacity (VO<sub>2</sub>max) tests typically end at the point of volitional exhaustion. However, previous research with averagely fit individuals and highly fit female athletes suggest that concluding a maximal treadmill test with 2min active recovery and allowing subjects to exercise a second time at the workload eliciting volitional exhaustion results in significantly greater VO<sub>2</sub> max values (1.4% and 4.2% mean increase, respectively). The potential effects of this testing sequence (2min recovery) on VO<sub>2</sub>max treadmill tests has not been evaluated utilizing highly fit NCAA male distance runners.

**PURPOSE:** To examine changes in VO<sub>2</sub>max values following 2min of active recovery at the conclusion of a treadmill GXT to volitional exhaustion.

**METHODS:** Ten NCAA Division II male X-country runners completed a max treadmill GXT until reaching volitional exhaustion (MAX1). Immediately following 2min active recovery (at 0% grade & 2.5 mph), each subject exercised to volitional exhaustion a second time (MAX2). MAX1 and MAX2 were compared using a paired T-test. Differences were considered significant at  $p < 0.05$ .

**RESULTS:** No significant differences ( $p = 0.38$ ) occurred between MAX1 ( $64.7 \pm 3.8$  ml/kg/min) and MAX2 ( $64.2 \pm 4.8$  ml/kg/min). The mean change from MAX1 to MAX2 following 2min active recovery was -0.8% with individual values ranging from -7.7% to +2.6%. However, 50% of the subjects benefited (+1.4% mean increase) from the booster test with individual increases of +0.2% up to +2.6%.

**CONCLUSION:** Mean results suggest that 2min active recovery may not allow significantly greater VO<sub>2</sub> max values to be achieved by highly fit male runners during treadmill testing, yet 50% of the subjects increased their VO<sub>2</sub>max during the "booster max" treadmill protocol. Further research is needed to determine if fitness level, running experience, age, sport specificity, or other variables might affect this exercise testing protocol.

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**1831 Board #181 May 27 2:00 PM - 3:30 PM**  
**Comparison Of Coach Vs Athlete Ratings Of Training: Effect Of Sex And Performance Ability**



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Previous studies demonstrate a disparity between coaches training plans and athletes training, with athletes often working hard on coach intended easy days, and unable to work hard on coach intended heavy days.

**PURPOSE:** We compared training duration, intensity and cumulative training load between coach and swimmers, and whether differences were related to sex or performance ability.

**METHODS:** NCAA Division III swimmers (13males, 15females), trained by the same coach, recorded training over 6 weeks during the middle of the season. For each practice the coach rated the intended training duration, intensity and Load using the Session RPE method. The athletes rated each training session independently, as well as reported any non-coach prescribed exercise. Athlete performance was ranked by national qualifiers (NQ) (n=6), conference point scorers (CPS) (n=12), conference participants (CP) (n=10).

**RESULTS:** Although, for coach vs all swimmer comparisons, there was no significant difference in the mean training Load (442+314 vs 416+4-6,  $R^2=0.38$ ), duration (79+49 vs 77+66 min,  $R^2=0.44$ ) or RPE (4.1+2.8 vs 3.4+3.0,  $R^2=0.44$ ), the  $R^2$  values were rather low. There were no differences in the coach vs athlete matching of training patterns attributable to gender or swimming ability. Differences in the execution of training were attributable to missing training sessions secondary to illness or study, but were not different in relation to sex (males=17.2%, females=15.6%) or swimming ability (NQ=17.2%, CPS=15.6%, CP=17.7%) or to performing unscheduled recreational exercise not accounted for in the coaches plan, in relation to sex (males=13.6%, females=15.6%) or swimming ability (NQ=15.2%, CPS=16.5%, CP=12.5%).

**CONCLUSIONS:** Despite a successful competitive season (36%NQ + 43% CPS), the execution of the coaches training plan was generally unsatisfactory. These results suggest that strategies to better correlate athlete execution of the coaches training plan might augment performance.

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**1832 Board #182 May 27 2:00 PM - 3:30 PM**  
**Age-related Performance Decrements In Elite Age-group Triathletes**

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Highly trained age-group triathletes vie for the few coveted slots for World Championships by competing at selected qualifying events around the world. However, little is known about age-related performance decrements in elite multi-discipline endurance sports such as triathlons.

**PURPOSE:** To determine the magnitude and rate of decline in overall and sub-discipline triathlon performance across an 18-70yr age-span in males and females (n=70 per age group).

**METHODS:** Completion time, along with swim, bike, and run performances of the top five finishers in each age category at world-championship "Ironman 70.3" qualifying events (n=14) were retrospectively assessed. Age-group completion time and split times for swim (1.9km), cycle (90.1km), and run (21.1 km) components were compared (ANOVA-Bonferroni post-hoc). Absolute and relative differences among age groups were calculated and comparisons made between males and females at each age level.

**RESULTS:** Age impacted triathlon performance ( $p=0.0001$ ), however decrements were not evident until age 45yrs for either completion time or for any sub-component performance, for either gender. Performance decrements (per half-decade) for the 45yr and older age groups were smaller for cycling (4-7%) than for either running (7-13%) or swimming (7-24%), with an ordinal relationship noted between age and percent decrement per half-decade. For each age group, males were consistently faster than females in both overall and in sub-components (12% to 20%) with greater differences in the older age categories.

**CONCLUSIONS:** Highly trained males and females maintained endurance performance into the fifth decade of life. Overall performance declined nonlinearly after age 45yrs, with the more complex motor skill swim and the weight-bearing impact-oriented run showing greater declines than the mechanically constrained and low-impact cycling component. Performance-based analysis of world-class age group athletes offers a unique opportunity to investigate the relationship between aging and exercise capacity.

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**1833 Board #183 May 27 2:00 PM - 3:30 PM**  
**Upper Extremity Power Characteristics In Men's National Team Gymnasts**

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(No relationships reported)

Men's gymnastics is a highly upper-body strength and power dominant sport. However there is a paucity of information about the upper-body power characteristics of this population. This information is necessary for developing monitoring and talent identification programs for this sport.

**PURPOSE:** The purpose of this study was to compare the upper-body power characteristics of men's national team gymnasts in three explosive push-up tasks, mimicking the static, countermovement, and drop jumps typically used for assessing lower extremity power.

**METHODS:** U.S. Men's Gymnastics Junior and Senior National Teams (n = 16) performed two trials each of single maximal-effort push-up tests on a force platform (1000Hz). The push-up tests included a static push-up (SP) performed with the gymnasts starting in the fully flexed down position of a pushup and then propelling themselves upward and away from the force platform. For the counter-movement push-up test (CMP) the gymnasts started in the extended push-up position, and then performed a counter-movement to push away from the force platform. Finally, the drop push-up (DP) involved the athletes dropping from raised surfaces (36.5 cm), one under each hand, onto the force platform. They then propelled themselves upward as quickly as possible after hand contact. Repeated measures ANOVAs were performed on 4 power variables derived from the force-time record.

**RESULTS:** Lower values for vertical velocity, push height of flight, and peak power were observed for the CMP (1.44±0.88 m/s, 0.14±0.12 m, 1066.8±438.1 W) and SP (1.61±0.64 m/s, 0.15±0.11 m, 1181.7±397.9 W) compared to DP (3.35±1.17 m/s, 0.64±0.54 m, 2752.4±869.1 W), ( $p < 0.001$ ), but did not differ from each other. Peak force was similar between the CMP and DP, but greater when compared to the SP.

**CONCLUSION:** The comparisons showed the importance of a rapid stretch-shortening cycle in upper body power performance in men's national team gymnasts.

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**1834 Board #184 May 27 2:00 PM - 3:30 PM**  
**Imposing A Theoretical Optimal Pacing Strategy Compared To Self-paced Competition In 1500-m Speed Skating**

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**PURPOSE:** Humans are well equipped to adequately choose the right pace on a specific effort, such as a 1500-m speed skating. The purpose of the present study was to investigate if a theoretically optimal pacing profile, overriding self-paced strategy, yielded better performance.



**METHODS:** 7 national level speed-skaters performed a self-paced 1500 m and a 1500 m with an imposed pacing strategy. The races were analyzed by obtaining velocity (every 100 m) and body position (every 200 m) to calculate total mechanical power output. Together with gross efficiency and aerobic power output, obtained in separate trials, data were used to calculate anaerobic power output profiles. An energy flow model was applied to the 1500-m self-paced trial and a range of pacing strategies was simulated for each individual by varying the distribution of anaerobic energy ( $P_{an}$ ) over time ( $t$ ). Athletes were instructed to skate more like the theoretically optimal pacing profile and resulting performance was compared to self-paced performance.

**RESULTS:** Confirming previous results, the energy flow model predicted a faster start strategy to be optimal. However, final times of the imposed strategy trials were about 2 s slower than self-paced performance ( $115.39 \pm 4.45$  s vs  $117.29 \pm 3.53$  s). Total power distribution per lap differed, with a higher value over the first 300 m for the imposed strategy ( $637.0 \pm 49.4$  W vs.  $612.5 \pm 50.0$  W). All parameters of anaerobic power distribution over time, described by a mono-exponential equation, did not differ (self-paced:  $P_{an} = 102.2 + 673.0 * e^{(-0.056 * t)}$  vs. imposed:  $P_{an} = 91.6 + 710.9 * e^{(-0.054 * t)}$ ). The effort of a faster first lap resulted in a changed skating position. The summation of increased knee- and trunk-angles resulted in a higher aerodynamic drag coefficient throughout the race.

**CONCLUSION:** Without appropriate training, imposing a theoretically optimal pacing profile does not lead to better performance. An imposed fast start has relatively large consequences on speed skating technique, affecting work per stroke and aerodynamics negatively. Since the ability to maintain body position is an important performance determining factor in skating, a predefined movement where body weight has to be carried continuously, it might be beneficial to train this aspect of performance combined with pacing strategy.

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**1835 Board #185 May 27 2:00 PM - 3:30 PM**  
**Performance Comparison Of The Cartwheel Vs Glide Shot Put Techniques**

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(No relationships reported)

An emerging technique in the shot put is the use of a cartwheel prior to release, such as a gymnast would use to generate horizontal velocity in tumbling. It is hypothesized that the position of the body at landing may result in a large muscular stretch-shortening response in the trunk, which combined with the horizontal velocity generated by the cartwheel may lead to greater velocity of the shot at release thus increasing horizontal distance.

**PURPOSE:** The purpose of this study was to compare the kinematics of the cartwheel (CW) and glide (G) techniques in the shot put in three female heptathletes.

**METHODS:** Three individual case studies were performed. Subjects put a 4 kg women's indoor shot for all trials. Each subject received extensive training in the CW technique and all were deemed proficient in this technique prior to data collection. Ten trials of each technique were completed on separate days. All trials were videotaped (60 Hz), and the horizontal distance of each trial were recorded. Performances were digitized (Peak Motus) and release variables calculated. Descriptive statistics of mean, standard deviation, and coefficient of variation for each subject were used to compare the variables of release height, angle, and velocity, and horizontal distance of all 60 trials.

**RESULTS:** All subjects experienced their single best throw using CW (6.49, 6.04, 8.77 m) compared to G (5.35, 5.89, 8.63 m). Subject 2 showed decreased variation of performance suggesting increased performance stability with CW compared to G. Across the 10 trials, average release height in the CW (2.14, 2.6, 2.44 m) was greater than the G (1.86, 1.84, 2.23 m), as was release angle (CW 17.9°, 14.4°, 33.6° vs G 14.1°, 12.5°, 30.3°) for all subjects.

**CONCLUSION:** The cartwheel technique shows promise as a beneficial technique for heptathletes. Further research is needed to determine performer characteristics and applicability of this technique.

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**1836 Board #186 May 27 2:00 PM - 3:30 PM**  
**Relationship Between Laboratory Testing And On-ice Skating Performance In Division I Men'S Hockey Athletes**

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(No relationships reported)

**PURPOSE:** Few data exist examining the ability of laboratory testing of strength and anaerobic power to predict on-ice skating ability. We examined the relationship between off-ice laboratory testing and on-ice skating performance in Division I men's hockey athletes.

**METHODS:** 21 males ( $20.7 \pm 0.35$  years) participated in the assessment of body composition, isokinetic quadriceps and hamstring strength, and anaerobic muscle power via Wingate 30 s cycle ergometer test. Air displacement plethysmography was used to determine % body fat (%FAT), fat-free mass (FFM), and fat mass (FM). Peak torque and total work during 10 maximal effort repetitions at  $120^\circ \text{s}^{-1}$  was measured during concentric muscle actions using a Cybex isokinetic dynamometer. Muscle power was measured using a computerized Monark cycle ergometer with flywheel resistance set at 7.5% of body mass. On-ice skating performance was measured during six timed 87.78 m sprints with subjects wearing full hockey equipment. On-ice linear momentum was calculated from the skating test. Correlation coefficients were used to determine relationships between laboratory testing performance and on-ice performance.

**RESULTS:** Subjects weighed  $88.4 \text{ kg} \pm 1.75 \text{ kg}$  and were  $11.6 \pm 1.02$  %FAT. A significant correlation was found between Wingate peak anaerobic power ( $1302.8 \pm 185.1$  W) and on-ice linear momentum ( $1077.2 \pm 104.4 \text{ kgm s}^{-1}$ ),  $r(19) = .73$ ,  $p = .0002$ . Other significant correlations were observed between Wingate average anaerobic power per kilogram body mass ( $11.7 \pm 0.9$  W) over the first 10 seconds and the average on-ice sprint time ( $7.97 \pm 0.22$  s),  $r(19) = -.51$ ,  $p = .019$  and peak anaerobic power per kilogram body mass ( $14.8 \pm 1.5$  W) and average on-ice sprint time ( $7.97 \pm 0.22$  s),  $r(19) = -.43$ ,  $p = .049$ . The first five seconds of average power on the Wingate test per kilogram body mass ( $12.8 \pm 1.1$ ) and average on-ice sprint time ( $7.97 \pm 0.22$  s) was also significant,  $r(19) = -.55$ ,  $p = .01$ .

**CONCLUSIONS:** Several measures of anaerobic power were significantly correlated to on-ice skating performance. It is possible to predict on-ice skating performance from common laboratory measures of anaerobic muscle power.

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**1837 Board #187 May 27 2:00 PM - 3:30 PM**  
**Age-related Performance Declines In Men's Freestyle Swimming Events**

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(No relationships reported)

Routine, daily exercise has been shown to decrease mortality and morbidity risk in older adults (Pateron, Jones, and Rice, 2007), however the role of continued exercise on athletic performance is less clear. Athletic performance is expected to decrease dramatically during the sixth decade of life (Tanaka and Seals, 2003), but more research is needed to determine how long athletic performance can be maintained.

**PURPOSE:** This analysis was designed to determine the relationship between age and freestyle swim performance in men.

**METHODS:** Data was collected from the 'Top Ten' times for 2006 and 2007, as reported on the United States Masters Swimming website (usms.org). Times from 6 freestyle events (short course yards) were collected for 13 age groups, from 25-29 years old, and in 5 year increments up to 85-89 years old. Data were analyzed using a two-way ANOVA with SPSS.

**RESULTS:** Statistical analysis found swim times of 25 year olds up to 54 year olds in the 50 yd and 200 yd freestyle were the same. The 100 yd freestyle showed equivalent swim times for age 25 to 64. The 500, 1000 and 1650 yd freestyle events had equivalent swim times for ages 25 to 59. Swimmers older than these ranges showed increasing

rates of decline in performance. The individual events showed significant differences in the age\*distance interaction. Regression analysis found an increasing rate of decline as race distance increased (range of 0.0607 to 2.0064 s · yr<sup>-1</sup>).

**CONCLUSIONS:** Swimmers are able to maintain athletic performance into their 50s, and into the 60s for the 100 yd freestyle. This data supports maintenance of athletic performance well into middle age with consistent exercise. A previous study of Masters Track Athletes found significant differences for each decade of age after 30 (Baker, Tang, and Turner, 2003). In contrast, these results show no significant differences until at least 55 years old. The age range with equivalent performances was shared by the longer distance events (500 - 1650 yd), however there was no consistent pattern for age-related changes as indicated by the significant age\*distance interaction. Performance appears to be better preserved in the shorter distance events based on the regression analysis of each event.

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**1838 Board #188 May 27 2:00 PM - 3:30 PM**  
**A Method To Obtain Instantaneous Power Output Data Of Athletes During Competition**

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**BACKGROUND:** During high level competition humans are approaching their power output (PO) limits. Performance depends not only on the produced amount of energy but also on how the energy is distributed, the pacing strategy. There is limited data available on how energy is distributed during competition. To understand how humans use their energetic resources it would be useful to combine velocity data with data on technique so that instantaneous PO can be approximated.

**PURPOSE:** To develop a method to approximate the instantaneous PO of athletes during competition.

**METHODS:** During the 2002 Winter Olympics from all male speed skaters (n=47) in the 1500m competition high resolution velocity data with optical tracking technology (Sportvision, USA) and video data in the sagittal plane (collected 2 x per lap) were collected. Trunk and knee position from the video data together with mass and height were used in existing models to obtain aerodynamic characteristics of the skaters. An Energy Flow Model was constructed for each skater and optimization techniques were used to approximate PO parameters in order to fit the high resolution velocity data.

**RESULTS:** On average the 1500m was skated in 107.77s (SD±2.0). We were able to reproduce the observed velocity profiles of the skaters with our optimized Energy Flow Model. The calculated instantaneous PO (in Watt) of the skaters at the 1500m can be described with the first order expression:  $PO = 376 + 648 * e^{(-0.063 * t)}$ , with  $t$  is time. When the best 10 skaters were compared to the performers ranked 20<sup>th</sup> to 30<sup>th</sup> ( $PO_{best10} = 393 + 710 * e^{(-0.058 * t)}$  vs.  $PO_{20-30} = 386 + 631 * e^{(-0.069 * t)}$ ) it became clear that best performances on the 1500m were reached with a pacing strategy, in which a higher PO was generated in the beginning of the race. The difference in time between both groups (105.33s ±0.63 vs. 108.37s ±1.61) was mainly caused by a higher velocity of the faster group in the first half of the race.

**CONCLUSION:** It was possible to approximate instantaneous power output by means of an Energy Flow Model, with high resolution velocity data and aerodynamic characteristics of the skaters as input variables.

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**1839 Board #189 May 27 2:00 PM - 3:30 PM**  
**Comparison Of Monitoring Tools For Training Intensity In Swimmers**

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(No relationships reported)

Blood lactate concentration [BL] and respiratory gas exchange are widely used to prescribe athletic training intensity. However, whether intensity thresholds defined from these measurements are interchangeable is relatively unknown.

**PURPOSE:** The purpose of this study was to determine the relationship between the [BL] threshold and the ventilatory threshold (VT) in swimmers.

**METHODS:** Division III collegiate swimmers (8 male, 7 female, aged 19.7 ± 1.5 years) performed an incremental tethered VO<sub>2</sub> test and an incremental 6 x 200-m swim to measure [BL]. The VT and respiratory compensation threshold (RCT) were detected using the v-slope method and confirmed by ventilatory equivalents. [BL] threshold was determined as the first inflection in the [BLa]-velocity curve as well as the interpolated speed at [BL]=4mmol\*l<sup>-1</sup>. Heart rate (HR) threshold was defined as a percentage of maximum HR. Velocity and power output were calculated for each of the 200m swims.

**RESULTS:** Comparing the individual HR corresponding to VT, RCT, and LT, there was no significant relationship between HR at LT and VT ( $r = 0.21$ ) or between LT and RCT ( $r = 0.17$ ). There was a moderate correlation ( $r = 0.60$ ) between the percent of maximum velocity at LT (92% ± 4.0) and VT (84% ± 5.0). The percent of maximum power at LT (77% ± 9.0) was significantly correlated with both percent maximum power at VT (57% ± 9.0,  $r = 0.72$ ) and RCT (66% ± 7.0,  $r = 0.64$ ). In contrast, no significant correlation was found between any of the thresholds in terms of percent of maximum HR.

**CONCLUSION:** These results suggest that LT, VT, and RCT represent individually separate swimming training intensities and are not broadly interchangeable. However, the significant relationship between LT and VT, represented as a percent maximum swimming velocity or swimming power, suggests that further exploration be performed on the topic of monitoring training intensity with physiological thresholds.

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**1840 Board #190 May 27 2:00 PM - 3:30 PM**  
**Comparisons Of Relationships To Bone Mineral Density In Division III Female Collegiate Athletes.**

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(No relationships reported)

While participation in sport and activity has positive influences on bone other factors are hypothesized to affect bone mineral density including dietary influences and menstrual cycle changes.

**PURPOSE:** The purpose of this study was to determine the association between dietary intake and menstrual cycle fluctuations to bone mineral density (BMD) in Division III collegiate female athletes.

**METHODS:** Fifty-three female collegiate athletes (aged 20.1 ± 1.1 years) from three different sports (swimming, gymnastics, basketball) were measured once during their respective pre-season training. Measures included dual energy X-ray absorptiometry to determine total BMD and bone mineral content (BMC). Height (cm), weight (kg), and age of menarche were also measured. All athletes completed a 24 hour dietary recall with prompting questions and food models and data was analyzed using ESHA Food Processor for total calories and calcium intake. Finally, use of oral contraceptives and menstrual cycle regularity over the course of one year was recorded. Pearson correlations were calculated and a step wise regression was performed to determine potential predictors of BMD. Additional comparisons were made between outcome variables and sport, use of oral contraceptives, and menstrual cycle regularity.

**RESULTS:** Significant relationships were found between BMD and weight, calcium, and BMC. Step wise regression analysis revealed the only significant predictor of BMD was weight ( $r=0.40$ ,  $r^2=0.16$ ). BMC was the only significant relationship that was maintained when separated by sport. ANOVA ( $P < 0.05$ ) determined that BMD, BMC, height, and weight were significantly different between sports with basketball players having the highest BMD, BMC, and being the tallest and heaviest. Comparisons by use of oral contraceptives and regularity of menstrual cycle revealed no significant differences.

**CONCLUSIONS:** These observations are similar to others suggesting a relationship between high loading sports and bone mineral density. However, while other studies suggest a relationship between dietary intake and menstrual cycle regularity to BMD, none was found in this study. Nonetheless, further information regarding the influence of these variables to

**1841 Board #191 May 27 2:00 PM - 3:30 PM**

**Heart Rate And Core Temperature Responses Of Pit Crew Athletes During Elite Automobile Races.**

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With the growing popularity of the National Association for Stock Car Auto Racing (NASCAR) there is a demand for skilled pit crew athletes that will aid in the success of NASCAR teams. There is limited information regarding the physiological demands and subsequent effect on the performance of pit crew athletes.

**PURPOSE:** The goal of this study was to determine the heart rate (HR) and core temperature (CT) response to race situations in pit crew athletes.

**METHODS:** HR and CT of pit crew athletes (n=6) were measured during six NASCAR Sprint Cup races using ingestible sensors (HQ Inc.). The HR and CT measurements were made before the race began, every 15 mins after the start of the race, and immediately after each pit stop.

**RESULTS:** The data showed that during the race, as compared to baseline, CT increased  $0.78 \pm 0.26^\circ\text{C}$  and HR increased  $23 \pm 16$  bpm as compared to baseline (both  $p < 0.001$ ).

Discussion: The increase in CT and HR in pit crew athletes during a Sprint Cup race could have a negative effect on performance.

**1842 Board #192 May 27 2:00 PM - 3:30 PM**

**What Dictates The Self Selection Of Recovery Time In Multiple Repeat Sprint Training?**

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Recent research has investigated the dynamics of multiple repeat sprint training (MSRT). There are many applications of this modality to coaching and performance (e.g., Work:Rest intervals). The impact of self-selection of the recovery interval time on various physiological indices has yet to be explored.

**PURPOSE:** To explore the effect of self selection of recovery times on various intensity indices during repeat sprint running.

**METHODS:** Twenty physically active males (age=21.3±2.3) performed four separate bouts of 12 repeated 30 yard sprints (spt) with a self-selected recovery time (SSREC) between each sprint. Only data from bout four is presented in this abstract. Each SPT and REC was timed using photocells. In addition, the subject wore a downloadable heart rate monitor and was asked their rating of perceived exertion (RPE; 6-20 scale) after sprints 3, 6, 9 and 12. A maximal treadmill exercise test was administered within one week of the MRST for the determination of various aerobic capacity measures (e.g.,  $\text{VO}_{2\text{max}}$ ).

**RESULTS:** Three distinct groups emerged based upon the recovery (REC) data collected; specifically the pattern and coefficient of variation (CV) of the REC times. Those three groups were: I steady SSREC (n=3), II increasing SSREC (n=12) and III variable SSREC (n=5). The data table follows:

Group	Ave SPT time (sec)	Ave REC time (sec)	delta RPE (spt 3 to 12)	HR Rec % (delta HR REC / REC time)	$\text{VO}_{2\text{max}}$ (ml/kg/min)	REC CV (sec)
I	4.31±.07	73.49±12.59	1.06±.24	0.31±.11	51.07±5.54	6.37±2.62
II	4.40±.16	76.21±13.95	0.50±.26	0.32±.12	56.22±6.54	15.45±2.10
III	4.52±.31	83.09±13.97	0.27±.18	0.30±.07	45.15±1.80	24.54±4.56

\* delta RPE significantly different ( $\alpha < .05$ ) by groups using Kruskal-Wallis statistical test.

**CONCLUSION:** The RPE appeared to influence the self-selection of recovery time more so than did other measured indices. It was the change in RPE over time that seemed to influence SSREC. However, RPE did not appear to correlate well with the intensity of the MSRT. Metabolic data (e.g., Blood Lactates) may further elucidate this relationship.

**1843 Board #193 May 27 2:00 PM - 3:30 PM**

**Identification Of Bias In The Natural Progression Of Swim Performance**

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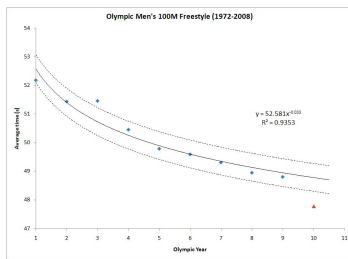
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The longitudinal progression of athletic records has been described by best fit curves which can be used to extrapolate future athletic performances. Any subsequent significant deviations from these curves would suggest compelling evidence of cataclysmic changes introduced into the sport.

**PURPOSE:** We evaluated elite swim performances to determine if bias can be identified within competitive swimming.

**METHODS:** The fastest eight men and women performances of Olympic swimming events from 1972 through 2004 were analyzed. Using the mean time across all years, a best-fit power curve [ $\text{time} = a \cdot \text{year}^b$ ] was calculated for each swim event. These equations were used to predict the finish time of the 2008 Olympics. A 95% confidence interval was established about the mean to determine if actual times were faster or slower than predicted. A binomial test of statistical significance was used to test whether or not the year as a whole was above or below the prediction line ( $p < 0.05$ ). These procedures were repeated for each of the previous five Olympic Games.



**RESULTS:** In 2008, 26/26 (100%) events were below the prediction line and 17/26 (65%) events were faster than predicted. However, for the previous five Olympics combined, only 11/122 (9%) events were faster and 10/122 (8%) events were slower than predicted. In 2000, 20/26 events were below the predicted values. In contrast, 20/24 events in 1996 were above the predicted values.

**CONCLUSIONS:** It is expected that swim performances improve over time and we have shown that they do so in a predictable manner. These results indicate a bias has been identified for the 2000 and 2008 Olympic Games such that these performances were faster than predicted. Conversely, the 1996 Games were slower than predicted.

**1844 Board #194 May 27 2:00 PM - 3:30 PM**  
**Age Classification In Usa Swimming Are Current Competitive Age Groups Appropriate?**

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Age classification in youth sports is an attempt to equalize competition, to enhance the chances of success, and to reduce the risk of injury associated with size and strength mismatches for all participants. USA Swimming has established 4 unisex age-groups according to chronological age (CA). The groups are composed of plural CAs; 10 yrs & under, 11-12, 13-14, and 15 yrs & over. However, due to considerable differences in growth and maturational status among adolescents within any given CA, by combining swimmers of different CA into a group the opportunity to compete equally may simply not be so.

**PURPOSE:** The aims of the study were to evaluate the current age classifications enforced by USA Swimming and to potentially provide a statistical rationale for proposing alternative age classifications.

**METHODS:** Performances were acquired through the website of USA Swimming for the top U.S. 100 men and women swimmers for each age (5 yrs to 20 yrs and >21 yrs) over the last 3 years. Data for each age were pooled and averaged for 3 separate distances (50-, 100-, and 200-yard freestyle). A  $17 \times 2 \times 3$  (age  $\times$  sex  $\times$  distance) ANOVA with Tukey's post-hoc test was used to analyze differences in performance between swimmers of different CA and to provide potential age classifications.

**RESULTS:** Significant differences ( $p < 0.01$ ) in mean times between all ages were revealed up to 13, 13, and 14 yrs in women in the 50-, 100-, and 200-yard freestyle, respectively. When collapsing distance, differences were found up to 14 yrs, and 3 homogeneous subsets were identified between the ages of 15 and 20 yrs (15-16, 16-18, and 17-20 yrs) in women swimmers. For the men, differences were found up to 15, 16, and 16 yrs old for three distances, respectively. As collapsing distances, there were differences up to 16 yrs old. Three subsets (17-18, 18-19, and 19-20 yrs) were also demonstrated in men swimmers.

**CONCLUSIONS:** Because differences in performance exist among swimmers within the current defined age groups (11 year-old vs. 12 year-old for example), stratifying swimmers using a single CA may be a better method for insuring fairness and equality in competition. The significant differences in swim time disappear at a younger age in women when compared to men, which may be due to sex differences in growth and maturational timing.

**1845 Board #195 May 27 2:00 PM - 3:30 PM**  
**Comparing Practice And Game Heart Rate Response In Women's College Ice Hockey Players**

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Ice hockey competition requires players to use all energy systems within intermittent work and rest periods. Collegiate coaches try to mimic energy use during practice while addressing tactical aspects of team play. These coaches must consider 2-4 practices and 2-3 games per competition week, for a seven-month period, with 3-5 weeks of no competition. Coaches must also avoid under or over-training athletes.

**PURPOSE:** Compare cardiovascular demands of ice hockey practices to games in collegiate women's ice hockey athletes.

**METHODS:** During a 5-day competition week, twelve elite Division I women's ice hockey players were monitored in 3 on-ice practice sessions, 1 off-ice anaerobic bike session, and 2 competitions. Athletes wore Suunto heart rate monitors. The participants were forwards (n=6), defensemen (n=5), and goaltender (n=1). Not all players participated in all sessions, though (n=90%) in each session. Maximum heart rate (HR max) was determined as the highest on-ice heart rate achieved.

**RESULTS:** All analysis was performed with Suunto Team Manager Software. Mean percentages were based on individual total session times. During practice, these times varied due to extra tactical work and with games remained the same for everyone. The mean percentage of time spent at percent of HR max are listed as follows:

	>90%	90-80%	80-70%	70-60%	<60%
Practice 1	1	18	23	23	26
Bike Sprints	1	31	40	20	1
Practice 2	0	10	20	21	41
Practice 3	1	15	20	23	41
Game 1	10	28	29	26	8
Game 2	7	25	23	33	14

**CONCLUSION:** A significant percentage of time was spent in >90% HR max and 90-80% HR max in games then practices. The bicycle sprints achieved a greater percentage of time at 90-80% and 80-70% then practices and games. Continued research is needed to determine results over a greater amount of sessions and to avoid possible detraining effects occurring in-season.

**1846 Board #196 May 27 2:00 PM - 3:30 PM**  
**Vo<sub>2peak</sub> Validation Using A Scifit™ Arm Ergometer And Relationship To Performance In Trained Swimmers.**

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Upper body exercise is an important factor in training and exercise prescription in various populations, therefore it is important that we can properly quantify performance as well as provide a means for accurate, consistent testing. Arm ergometry provides professionals the ability to measure metabolic changes in populations who have partial or complete loss of function in the lower extremities (e.g. paraplegics). Arm ergometry may also be a useful testing/training approach for athletes that primarily utilize upper body musculature (e.g. swimmers).

**PURPOSE:** Using trained swimmers, to determine if the Upper Body Ergometer (Pro II Arm Ergometer; SciFit, OK) is i) an accurate and reliable device for the determination of  $VO_{2peak}$ , ii) to determine if there was a training effect in an incremental  $VO_{2peak}$  protocol and iii) to determine the relationship between  $VO_{2peak}$  obtained using this device and swimming performance

**METHODS:** Ph 1: To determine validity and reliability, trained male swimmers ( $n = 8$ ;  $28.5 \pm 9.5$  yrs) performed two incremental protocols ( $VO_{2peak}$ ) consisting of a four min warm-up at 15W followed by two min at 50W and progressing 10W every two min until volitional exhaustion. Ph 2: Inter-collegiate Division I swimmers ( $n=8$ ), also performed a 400 m swim trial following a  $VO_{2peak}$  to determine the relationship between  $VO_{2peak}$  using this ergometer and swim performance. Pearson's product correlations, ANOVA and reliability were calculated using SPSS 15.0 (SPSS Inc., IL;  $\alpha=0.05$ ).

**RESULTS:** There was a linear relationship between workload and  $VO_2$  in all trials ( $R = .96$ ;  $p \leq .01$ ) while Cronbach's alpha for test-retest reliability for  $VO_2$  was .98. There were no significant differences in performance by trial in WL ( $p = .272$ ) or  $VO_2$  ( $p = .151$ ). Swimming performance times showed moderately strong negative correlation with  $VO_{2peak}$  ( $R = -.692$ ;  $P = .039$ ).

**CONCLUSIONS:** SciFit Pro II Arm Ergometer is an accurate and reliable device for determination of  $VO_{2peak}$  in trained swimmers and there was no training effect when using this device. The relationship between performance time and  $VO_{2peak}$  determined on this ergometer indicated it may be of value as a dry land training device for collegiate swimmers.

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**1847 Board #197 May 27 2:00 PM - 3:30 PM**  
**Comparison Of A Monark Cycle Ergometer And A Velotron In Measuring Physiologic Responses In Trained Cyclists.**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to examine the power output and physiological responses of trained cyclists to maximal oxygen uptake testing ( $VO_{2max}$ ) on a standard laboratory cycle ergometer (i.e. Monark) and cyclist-specific designed ergometer (i.e. Velotron).

**METHODS:** Thirty trained cyclists performed a  $VO_{2max}$  test on both cycle ergometers. Test order was counterbalanced between the Monark and Velotron. Initial power output for both tests was 100 Watts and power output increased by 20 Watts every minute until volitional fatigue. Oxygen uptake, ventilation, heart rate, and ratings of perceived exertion (RPE) were monitored throughout the tests. Paired t-tests were used to examine differences in  $VO_{2max}$ , maximum heart rate (HRmax), peak power output (PPO), ventilatory threshold (VT), heart rate at VT (HRvt), power output at VT (POvt), and RPE between the two maximal tests.

**RESULTS:** Results indicated that PPO ( $p = 0.001$ ) and POvt ( $p = 0.013$ ) were significantly higher when cyclists were tested on the Velotron (PPO =  $326 + 65$  W, POvt =  $243 + 54$  W) compared to the Monark (PPO =  $310 + 59$  W, POvt =  $234 + 46$  W). There were no significant differences in  $VO_{2max}$ , HRmax, HRvt, VT or RPE between the two ergometers.

**CONCLUSIONS:** The primary finding was that cyclists achieved a higher power output at maximal and threshold intensities when tested on the Velotron. When using PO to determine changes in performance or establish training intensities, cyclists should be tested on an ergometer that most closely resembles their personal riding mechanics.

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**1848 Board #198 May 27 2:00 PM - 3:30 PM**  
**Does Acute Stretching Modify A Surfer's Ability To Keep A Teetering Board Horizontal?**

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(No relationships reported)

**PURPOSE:** Since the sensitivity of the stretch reflex is influenced by acute stretching activities, it was questioned whether an acute stretch would influence a surfer's ability to maintain a teetering board at the horizontal position.

**METHODS:** Ten male surfers with more than two years of experience did three trials of four 30 s tests on a stabilometer on four separate days. The test criterion was the average time during the three 30 s trials that each subject could keep the stabilometer at 180°. Each subject balanced with their feet either parallel (PR) or perpendicular (PD) to the stabilometer's axis of rotation. PR and PD were both done following either 30 minutes of quiet sitting (non-stretched, NS) or 30 minutes of stretching activities (stretched, S). Stretching exercises consisted of various assisted and unassisted static stretches of the hamstring, quadriceps and calf muscle groups.

**RESULTS:** Improved flexibility following the stretching exercises was demonstrated by significant ( $p < 0.05$ ) increases in each subject's sit-and-reach for both PR-S ( $6.5 \text{ cm} \pm 1.6$ ) and PD-S ( $6.4 \text{ cm} \pm 2.0$ ). Balance time was not significantly different following the stretching regimen for either the PR-NS vs. PR-S ( $27.5 \text{ s} \pm 3.5$  vs.  $27.3 \text{ s} \pm 4.2$ ), or the PD-NS vs. PD-S ( $20.1 \text{ s} \pm 6.2$  vs.  $23.2 \text{ s} \pm 5.8$ ).

**CONCLUSIONS:** Even though acute stretching reduces the stretch reflex, this reduction was insufficient to alter the surfer's ability to maintain a teetering board at the horizontal position. Apparently, experience in maintaining balance on an unsteady surface can overcome any loss in peripheral proprioception.

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**1849 Board #199 May 27 2:00 PM - 3:30 PM**  
**Comparison Of Single And Multi-sport Athletes' Performance On The Y Balance Test**

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**PURPOSE:** To compare Y Balance Test scores in high school athletes that compete in one sport compared to a similar group of high school athletes who compete in multiple sports.

**METHODS:** These data are part of a larger scale study that is examining Y Balance Test scores in athletes in various sports and competition levels. Ninety-two high school athletes that participated in only one sport were matched, by gender and sport played, to athletes who participated in multiple sports. All athletes completed informed consent and were free from injury at the time of testing. Each athlete performed the Y Balance Test protocol that examines lower extremity reach distance during unilateral stance in the anterior, posteromedial, and posterolateral reach directions. The greatest reach distance of three trials in each reach direction was used for analysis. All reach distances were normalized to limb length. One-way ANOVAs were performed to examine differences between the single sport and multiple sport athletes.

**RESULTS:** While no significant differences existed for height and weight between the two groups ( $p > 0.05$ ), single sport athletes were older than multiple sport athletes by 6 months on average ( $p < 0.05$ ). For the Y Balance Test scores, no significant differences were observed for any of the reach distances when normalized to limb length ( $p > 0.05$ ). In addition, no significant differences were found when making bilateral comparisons for the specific reach directions ( $p > 0.05$ ).

**CONCLUSIONS:** Participating in multiple sports does not appear to improve performance on distance reach score for any of the three reach directions on the Y Balance Test.



**1850 Board #200 May 27 2:00 PM - 3:30 PM**  
**No Change In Muscular Endurance, Flexibility, Anaerobic Power, And Recovery After Ingesting Oxygen Enhanced Water**

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(No relationships reported)

Adequate oxygen utilization is necessary to properly recover from an exhaustive anaerobic exercise bout, enhance performance related to muscular endurance and flexibility, or to aid in recovery. On this premise, additional oxygen uptake may augment overall performance and recovery and is a major claim of Perfect Empowered Drinking Water™ (PH<sub>2</sub>O) (London, UT).

**PURPOSE:** To investigate the purported claims of PH<sub>2</sub>O, including enhanced performance and recovery during strength, flexibility, and anaerobic power exercise.

**METHODS:** This was a randomized, double-blind, placebo controlled trial in which eight moderately trained, male cyclists performed push-ups to fatigue (PU) set to a metronome (25 reps/minute), sit and reach (S&R), total body rotation on right and left sides (TBRR and TBRL, respectively), arm pull on right and left sides (APR and APL, respectively), and two, 30-second Wingate tests (W1 and W2) separated by a 90-second active and 90-second passive recovery on three separate occasions under the following conditions: control (C), tap water (TW), and PH<sub>2</sub>O. Four ounces of water (either TW or PH<sub>2</sub>O) were ingested prior to the strength and flexibility tests, then again prior to and within 60-seconds after W1. Comparisons between conditions were conducted using a one-way ANOVA with significance set at  $p < 0.05$ .

**RESULTS:** Subject characteristics (mean  $\pm$  SD) included age ( $28.0 \pm 6.0$  years), height ( $178.0 \pm 5.4$  cm), and body weight (BW) ( $73.0 \pm 6.7$  kg). No significant differences between conditions were observed. TBRR ( $18.3 \pm 6.6$  inches), average power W1 ( $655.3 \pm 55.5$  Watts (W) and  $9.0 \pm 0.8$  W/kg BW), and average power W2 ( $520.1 \pm 112.0$  W) were greatest with C. PU ( $37.3 \pm 9.1$  reps), TBRL ( $17.9 \pm 5.4$  inches), APR ( $11.6 \pm .7$  rating of perceived exertion (RPE)), APL ( $11.8 \pm .7$  RPE), peak power W2 ( $1324.0 \pm 141.7$  W and  $18.4 \pm 2.9$  W/kg BW), and average power W2 ( $7.6 \pm 0.5$  W/kg BW) were greatest with TW. S&R ( $13.9 \pm 4.4$  inches), and peak power W1 ( $1490.3 \pm 145.1$  W and  $20.8 \pm 3.6$  W/kg BW), were greatest with PH<sub>2</sub>O.

**CONCLUSION:** Results indicated that ingestion of oxygen rich water before and after specific types of exercise did not significantly improve performance, including enhanced recovery between two Wingate cycle tests separated by 3-minutes of active/passive recovery. However, on several parameters, PH<sub>2</sub>O seemed to induce a greater mean score.

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**1851 Board #201 May 27 2:00 PM - 3:30 PM**  
**Cardiac Autonomic Responses To Repeated Shuttle Sprints**

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Team sport match play requires athletes to perform a number of repeated shuttle sprints. However, the acute effects of these repeated sprint sequences on lactic acidosis and resulting autonomic state perturbation are not known.

**PURPOSE:** To observe and compare the blood lactate and post-exercise cardiac autonomic responses of a repeated shuttle-sprint ability test (RSSA test) with the 30-15 Intermittent Fitness Test (30-15<sub>IFT</sub>); the latter test representing a standard for exhaustive supramaximal effort.

**METHODS:** Thirteen adult team sport players performed the RSSA test and 30-15<sub>IFT</sub> on separate days in a counter-balanced order. The RSSA test consisted of six repetitions of maximal 2 x 15 m shuttle sprints (~5 s) departing every 20 s, while 30-15<sub>IFT</sub> involved progressive 30 s shuttle runs interspersed with 15 s of passive recovery until exhaustion. Blood lactate was measured before and after the tests, while autonomic responses were assessed using immediate heart rate (HR) recovery (e.g., HRR<sub>60s</sub>) and heart rate variability (HRV) indices.

**RESULTS:** Peak blood lactate ( $10.6 \pm 2.1$  vs.  $10.2 \pm 2.8$  mM) and HRR<sub>60s</sub> ( $36.4 \pm 7.8$  vs.  $39.3 \pm 7.9$  bpm) were similar after both the RSSA test and 30-15<sub>IFT</sub>. With the exception of the vagal-related time-varying root mean square of successive R-R interval differences at each 30 s, which recovered earlier after the RSSA test compared with 30-15<sub>IFT</sub>, all HRV indices decreased similarly after both tests in comparison to baseline values.

**CONCLUSIONS:** the RSSA test was shown to induce comparable levels of lactic acidosis and post-exercise autonomic state as the 30-15<sub>IFT</sub>. These levels of metabolic and autonomic states are likely to occur during team sport match play.

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**1852 Board #202 May 27 2:00 PM - 3:30 PM**  
**Influence Of Recovery Duration Following A Potentiating Stimulus On Muscular Power In Recreationally Trained Individuals**

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**PURPOSE:** Athletes competing in explosive sports often experience temporarily increased muscular power following a heavy load exercise called postactivation potentiation (PAP). Previous research examining recreationally trained individuals (RTI), however, shows mixed results under similar conditions. As the balance between PAP and fatigue mechanisms following a heavy load exercise influences the overall outcome, the recovery duration following the stimulus might explain the inconsistent results noted in RTI. Therefore, the purpose of this study was to investigate the effect of recovery duration following a potentiating stimulus on muscular power in RTI.

**METHODS:** Seven male RTI (age =  $24 \pm 4$  y, height =  $173.8 \pm 10.7$  cm, mass =  $90.1 \pm 28.2$  kg, 1RM to body mass ratio =  $1.4 \pm 0.3$ ) with at least one year of back squat experience completed six experimental trials. The first session assessed subjects' height, mass, and 1RM on the parallel back squat. The second session (control) assessed subjects' baseline power measures on a 30 s Wingate Test using 7.5% of baseline body mass as resistance. For sessions 3-6, subjects performed a potentiating exercise (1 set of 5 repetitions at 85% 1RM), rested for 5, 10, 15, or 20 min, and performed an identical Wingate Test. Subjects experienced rest durations in randomized order on separate days.

**RESULTS:** No significant differences ( $p > 0.05$ ) existed among control and experimental trials in absolute peak power, absolute average power, relative peak power, relative average power, and fatigue index.

**CONCLUSIONS:** These results indicate that a heavy load squat protocol known to stimulate PAP in competitive athletes failed to induce PAP in RTI regardless of rest duration. This suggests that discrepancies in previous literature describing RTI cannot be explained by differences in recovery period among studies. RTI might display these inconsistencies because "recreational training" encompasses a wide spectrum of training intensities, i.e. better trained RTI might demonstrate PAP similar to athletes while less advanced RTI fail to experience similar benefits. In conclusion, heavy load squats did not improve subsequent performance following any rest periods, suggesting that the effectiveness of potentiating stimuli does not vary as a function of fatigue in recreationally trained individuals.

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**1853 Board #203 May 27 2:00 PM - 3:30 PM****Trimp Methodological Issues. A New Accurate Methodology**

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Training impulse concept (TRIMP) uses a fixed exponential function to quantify aerobic training load, and modified TRIMP (TRIMP<sub>mod</sub>) uses an individual exponential function to quantify more accurately.

**PURPOSE:** To compare workload quantification between TRIMP, TRIMP<sub>mod</sub> and a new proposed methodology.

**METHODS:** 20 amateur road cyclists (AC), 20 Pro Tour cyclists (PC), 19 young soccer players (YS), and 19 elite rowers (ER), performed a maximal progressive test until exhaustion. Heart rate (HR), and blood lactate concentration ([La<sup>-</sup>]) were measured throughout the tests. TRIMP and TRIMP<sub>mod</sub> were calculated. A polynomial equation which fit the best to the relation [La<sup>-</sup>]-%HR<sub>max</sub> was used as a new methodology to calculate TRIMP<sub>fit</sub>. A theoretical exercise duration of 60 min was used in all cases. Three methodologies were compared at 2 specific points (LT, OBLA). Coefficient of determination (R<sup>2</sup>) was calculated in order to establish the equation that fit the best. All variables were analyzed by one-way ANOVA.

**RESULTS:** The R<sup>2</sup> of polynomial equations (3<sup>rd</sup> to 5<sup>th</sup> degree) to calculate TRIMP<sub>fit</sub> was significantly higher than the R<sup>2</sup> of the exponential equations to calculate TRIMP<sub>mod</sub> (R<sup>2</sup> = 0.8285 ± 0.1189 vs. 0.9835 ± 0.0270, respectively) (p<0.01). TRIMP has a tendency to underestimate TRIMP<sub>mod</sub> and TRIMP<sub>fit</sub>. Furthermore, TRIMP<sub>mod</sub> has a tendency to overestimate TRIMP<sub>fit</sub> at lactate threshold (LT) exercise intensities. At higher intensities (OBLA), TRIMP<sub>fit</sub> is overestimated or underestimated depending of athletes' adaptation of athletes to maximal exercise.

	TRIMP		TRIMP <sub>mod</sub>		TRIMP <sub>fit</sub>	
	LT	OBLA	LT	OBLA	LT	OBLA
AC	73 ± 19 <sup>a</sup>	203 ± 40 <sup>c, e</sup>	101 ± 21 <sup>a, b</sup>	240 ± 0 <sup>c, d</sup>	82 ± 25 <sup>b</sup>	345 ± 178 <sup>d, e</sup>
PC	113 ± 25	194 ± 30 <sup>g, h</sup>	117 ± 34 <sup>f</sup>	240 ± 0 <sup>g</sup>	97 ± 40 <sup>f</sup>	249 ± 80 <sup>h</sup>
YS	114 ± 18 <sup>i</sup>	188 ± 22 <sup>k, m</sup>	133 ± 28 <sup>i, j</sup>	240 ± 0 <sup>k, l</sup>	115 ± 32 <sup>j</sup>	217 ± 46 <sup>l, m</sup>
ER	115 ± 19 <sup>n, p</sup>	151 ± 25 <sup>q, s</sup>	162 ± 31 <sup>n, o</sup>	240 ± 0 <sup>q, r</sup>	136 ± 32 <sup>n, p</sup>	194 ± 34 <sup>r, s</sup>

a, b, g, i, k, n, q, r, s p<0.001; c, e, f, h, j, m, o p<0.01; d, l, p p<0.05.

**CONCLUSION:** The polynomial equation that fits the best to the [La<sup>-</sup>]-%HR<sub>max</sub> relation is the most accurate way to calculate TRIMP<sub>fit</sub>.

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**1854 Board #204 May 27 2:00 PM - 3:30 PM****Warm-up And Physical Performance: What Is The Relationship? A Systematic Review With Meta Analysis**

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(No relationships reported)

Although the practice of warm-up is widely used, the value of completing one is a worthy research question. At present, it is not known whether warming-up is benefiting, harming, or having no effect on individuals.

**PURPOSE:** To review the existing scientific evidence relating performance to warm-up.

**METHODS:** A systematic review and meta analysis was undertaken. Relevant studies were identified by searching Medline, SPORTDiscus, and PubMed (1966 - April 2007). This review included studies that investigated the effects of warming-up on performance improvement in physical activities. Studies were included only if the participants were human, and only if the warm-up included activities other than just stretching. Studies reported in languages other than English were not included. The quality of included studies was assessed independently by two assessors using the PEDro scale.

**RESULTS:** 32 studies, all of high quality (6.5 - 9 (mean = 7.6) out of 10 on the PEDro rating scale) reported sufficient data (quality score >6) on the effects of warming-up on improving performance in humans. Warm-up was shown to improve performance in 79% of the criterions examined.

**CONCLUSION:** This analysis has demonstrated that performance improvements can be demonstrated following completion of adequate warm-up activities. This review has also shown that there is little evidence to suggest that warming-up is detrimental to sports participants. Further well-conducted randomised controlled trials are needed to determine the role of warming-up prior to exercise in relation to performance improvement.

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**B-37 Free Communication/Poster - Worksite Interventions**

MAY 27, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**1855 Board #205 May 27 3:30 PM - 5:00 PM****The Effects Of A Multi-level Physical Activity And Health Promotion Intervention On A Group Of Females In The Worksite Setting**

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(Sponsor: Georgia C. Frey, FACSM)

(No relationships reported)

Worksite health programs may be an effective manner to reach the general population in an effort to promote increased physical activity and improve health. Furthermore, multilevel interventions targeting multiple behaviors have been shown to be more effective than a single approach.

**PURPOSE:** To analyze the impact of a multilevel physical activity intervention on physical activity and cardiovascular risk factors in the worksite population.

**METHODS:** Subjects included 16 female university employees aged 43.5 years  $\pm$  16.1 who participated in a weekly class tailored to increase physical activity (Active Living Every Day) while utilizing a wireless accelerometer device and a web-based tracking program. Height, weight, body mass index (BMI), percent body fat (%BF) and blood pressure were determined via standard procedures at baseline and at the end of the program. Physical activity was quantified through the use of a wireless accelerometer. A repeated measures ANOVA was utilized to examine differences between baseline and post intervention.

**RESULTS:** The mean pre-intervention BMI was 34.3  $\pm$  9.5 placing 88% of subjects into either the overweight or obese category. A significant decrease in diastolic blood pressure (79.4 $\pm$ 10.2 to 75.8 $\pm$ 8.8), weight (90.0 $\pm$ 24.6 to 87.5 $\pm$ 23.7) and BMI (34.3  $\pm$  9.5 pre to 33.4 $\pm$ 9.3) were noted from baseline to post-intervention. Values for %BF and systolic blood pressure decreased and physical activity increased; however, these changes were not significant.

**CONCLUSION:** Our results indicate that the multilevel physical activity intervention was successful at reducing cardiovascular risk factors such as body weight, diastolic blood pressure, and BMI; however, considering the limited number of participants, further research is needed to determine if this approach will be consistent within the general worksite population.

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**1856 Board #206 May 27 3:30 PM - 5:00 PM**

**A Hospital-based Wellness Program: Effects On Employees' Sickness-related Absenteeism**

Gianfranco Stupar<sup>1</sup>, Auro Gombacci<sup>1</sup>, Cesarina Listuzzi<sup>2</sup>, Natalia Rosignoli<sup>3</sup>, Kyriakos Tsapralis<sup>1</sup>, Riccardo Zero<sup>1</sup>. <sup>1</sup>Trieste Sports Medicine Center, Trieste, Italy. <sup>2</sup>Azienda Ospedaliero-Universitaria "Ospedali Riuniti" Trieste, Trieste, Italy. <sup>3</sup>Azienda Ospedaliero-Universitaria "Ospedali Riuniti" Trieste, Trieste, Italy.

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(No relationships reported)

"Ospedali Riuniti", an Italian public hospital with 1400 beds and 3000 employees, has implemented a health promotion program ("Wellness Program"), which aims to improve employees' Wellness.

The program, medically led by a Sports Medicine specialist, is multitasking-structured and organized into five so-called Activities, strongly linked together: Fitness, Nutrition and Metabolism, Smoke-Out, Mind&Body and Kids' Wellness.

**PURPOSE:** To assess a possible reduction in sickness-related absences (SRA) between employees enrolled in the program.

**METHODS:** a sample of 200 employees, enrolled in the program and participating to the programs' activities for a two years period, were monitored for their sickness-related absences from work for a period of four months before ( $t_0$ ) and after ( $t_1$ ) their program participation. SRA were divided into two categories: short length (SL; 0-3 days) and long length (LL; 4 days or more).

**RESULTS:** we observed a decrease in SRA of employees involved in the activities of the program. In  $t_1$ , employees with no SRA raised from 50 to 55% of the sample; employees with SL decreased from 25% to 12%. Days of SL-SRA were reduced by 42.9%; days of LL-SRA were reduced by 12.7%.

**CONCLUSION:** our data support previous scientific evidence of a valuable reduction of SRA following the implementation of multifactorial, wellness-oriented, health promotion programs in the workplace; we remark the importance of a well designed evaluation process as a part of the core strategy of any workplace health promotion program.

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**1857 Board #207 May 27 3:30 PM - 5:00 PM**

**Women Health Care Workers' Response To Coaching Intervention To Reduce Chd And Stroke Risk Factors**

Tomas Green<sup>1</sup>, Cresendo Eldridge<sup>1</sup>, Michele Hunnicutt<sup>1</sup>, Jaya Paraniham<sup>1</sup>, Leif Peterson<sup>1</sup>, Tinker Murray, FACSM<sup>2</sup>. <sup>1</sup>The Methodist Hospital, Houston, TX. <sup>2</sup>Texas State University, San Marcos, TX.

(No relationships reported)

**PURPOSE:** To determine the efficacy of a free onsite employee wellness coaching program as an intervention for promoting healthy lifestyle changes in women to lower their targeted health risks associated with the onset of CHD and stroke.

**METHODS:** Employees (N=63, age = 43 $\pm$ 10.8) were selectively evaluated for this study after their participation in the 2006 and 2007 annual employee health fairs. The inclusion criterion for participation was subjects have a BMI  $\geq$  25 and at least one more CHD health risk factor. They also had to be willing to participate for 26 weeks in the Healthy Lifestyle Coaching program. During the health fair, each employee completed a health risk appraisal, finger prick blood draw, and biometric assessments. The 6 month intervention required each participant to attend a 30 minute weekly coaching session with an ACSM Certified Wellness Coach. Data were analyzed for baseline and post assessments for BMI, weight, waist girth, total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, glucose, and blood pressure.

**RESULTS:** A Bonferroni-corrected t-test analysis revealed significant differences ( $p < 0.005$ ) in BMI (34.3  $\pm$  6.0 to 32.4  $\pm$  5.5), weight (202.3  $\pm$  42.8 to 189.8  $\pm$  36.9), waist girth (40.8  $\pm$  6.2 to 38.0  $\pm$  5.2), total cholesterol (201.8  $\pm$  38.5 to 189.2  $\pm$  34.6), systolic blood pressure (126.8 $\pm$ 10.5 to 120.7 $\pm$ 12.3), and diastolic blood pressure (81.6  $\pm$  8.3 to 77.1  $\pm$  9.8). Although there was no statistical significant change in, HDL cholesterol, LDL cholesterol, and triglycerides, each of these variables improved.

**CONCLUSIONS:** Study results demonstrate that a work-site coaching intervention is an effective resource to help women modify lifestyle behaviors directly related to CVD. Further research is needed to determine work-site coaching effectiveness in alternative working environments, and the sustainability of positive lifestyle changes.

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**1858 Board #208 May 27 3:30 PM - 5:00 PM**

**Evaluation Of Clinical Outcomes Of Female Participants In The UMDNJ Worksite Wellness Program**

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**PURPOSE:** To measure the effect of a university based worksite wellness program on clinical outcomes in female participants from baseline to 12 weeks, and at follow-up; and to examine differences in week 12 outcomes between those who did and did not return for follow-up

**METHODS:** Female subjects (N=78; age = 47.96  $\pm$  8.75) participated in a 12-week, university-based wellness program that consisted of 12 weekly group sessions and three individual sessions on topics related to nutrition, physical activity, and behavior modification. Body weight, BMI, waist (WC) and hip (HC) circumferences, systolic and diastolic blood pressures (SBP, DBP), percent body fat, total cholesterol (TC) and non-fasting glucose were measured at baseline, week 12 and follow-up. Follow-up was done at one point in time which represented six, nine, or 12 months after intervention; 54 subjects returned compared with 24 who did not return. Univariate analyses were used for each of the clinical outcome measures.

**RESULTS:** All subjects improved at the end of the 12-week intervention with reductions in: body weight (1.70  $\pm$  2.44 kg,  $p < 0.001$ ), BMI (0.63  $\pm$  0.90,  $p = 0.000$ ), SBP (2.33  $\pm$  8.80 mm/Hg,  $p = 0.005$ ), DBP (1.70  $\pm$  7.76 mm/Hg,  $p = 0.016$ ), WC (2.87  $\pm$  3.15 cm,  $p < 0.001$ ), HC (2.20  $\pm$  2.68 cm,  $p < 0.001$ ) and percent body fat 0.55  $\pm$  2.02,  $p = 0.006$ ). Weight reduction at week 12 was positively correlated with BMI ( $r = 0.997$ ,  $p = 0.01$ ), WC ( $r = 0.388$ ,  $p = 0.01$ ), and HC ( $r = 0.522$ ,  $p = 0.01$ ). Those that returned for follow-up had a lower mean body weight at baseline (190.8 lbs  $\pm$  44.7) and week-12 (187.7 lbs  $\pm$  44.6). There was a significant interaction for HC in those that returned for follow-up compared to those who did not return ( $p = 0.002$ ). Those that returned for follow-up ( $n = 57$ ) had a decrease in HC from week 1 to 12 of 1.61 cm ( $\pm 2.25$  cm) compared to a greater decrease of 3.58cm ( $\pm 3.11$  cm) for those who did not return.

**CONCLUSIONS:** The worksite wellness program had a positive impact on improving clinical outcome measures in females after the 12-week intervention. For those who returned for post-intervention follow-up, there was maintenance of the improvements from the end of the program. For those who did not return for follow-up, they may have experienced recidivism.

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**1859 Board #209 May 27 3:30 PM - 5:00 PM**  
**Impact Of Worksite Health Promotion On Corporate Environmental Health, Culture And Individual Employee Health Risks**

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(No relationships reported)

**PURPOSE:** Western New York Wellness Works (WNYWW) is a community-based research initiative designed to examine the individual, cultural, and environmental outcomes of self-directed programming in diverse, small- to medium-sized organizations.

**METHODS:** An RFP was released and applicants responded with proposals for two year worksite wellness interventions that demonstrated evidence of employee need and interest, proof of organizational commitment, and 1-to-1 matched funding of up to \$25k/year. Individual, cultural, and environmental outcomes were measured by individual health risk appraisals (HRA), individual health culture assessments (HCA), and organizational Heart Check Plus (HCP), respectively. Pre-post comparisons of HCP were examined for all organizations that completed the initiative and for individuals who completed HRAs and HCAs (n pre = 1472; n post = 1721).

**RESULTS:** 10 organizations, representing 6895 employees completed the initiative. Aggregate analyses revealed overall organizational environmental improvements (37.6% to 66.3%,  $p < 0.001$ ) as well as significant improvements in HCP environmental components including smoking, nutrition and physical activity (all  $p < 0.01$ ). Positive cultural changes included significant increases in % of employees who reported their co-workers expect each other to exercise regularly (pre=37.2%, post=44.6%,  $p < 0.001$ ), maintain a healthy weight (pre=44.7%, post=50.2%,  $p < 0.01$ ), eat nutritious foods (pre=41.8, post=47.1,  $p < 0.01$ ) and eat foods low in fat/sugar (pre=39.9%, post=44.8%,  $p < 0.05$ ). As measured through the HRA, a higher percentage of employees were aware of their blood pressure (pre=57.1%; post=61.8%,  $p < 0.05$ ) and cholesterol (pre= 45.4%; post=50.0%) ( $p < 0.05$ ) and were non-smokers (pre=81.0%, post=86.0%,  $p < 0.01$ ) but no significant changes were noted for BMI, physical activity or dietary intake of fat or fiber.

**CONCLUSIONS:** Our findings indicate that the WNYWW self-directed health promotion programs were effective in changing worksite environments, corporate culture and employees' risk factor knowledge, but that significant changes in individual health behaviors may require more intense intervention than those undertaken by the participating companies.

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**C-24 Free Communication/Poster - Accelerometry: Adults**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**1860 Board #1 May 28 8:00 AM - 9:30 AM**  
**Comparison Of Accelerometer And Physical Activity Questionnaire Data In Middle-aged Women**

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**PURPOSE:** To compare physical activity (PA) estimates from two accelerometer-based prediction equations with PA questionnaires (PAQ) designed for use in middle-aged women.

**METHODS:** Data were obtained from the Evaluation of Physical Activity Measures in Middle-Aged Women study. Participants included 66 women [(mean  $\pm$  SD), aged 52.6  $\pm$  5.4 years] who wore an ActiGraph accelerometer daily, for 35 consecutive days and completed four PAQs: 1) past week (PW) and 2) past month (PM) modifiable activity questionnaire (MAQ), 3) Nurses' Health Study (NHS) and 4) Women's Health Initiative (WHI) PAQs. Volume of PA, in MET-h/wk, was estimated from accelerometer data using the Freedson et al. and Swartz et al. prediction equations. PAQ summary scores are in MET-h/wk. Spearman rank order correlation coefficients ( $\rho$ ) were used to compare accelerometer and PAQ derived MET-h/wk. Percent (%) error of the PAQs was calculated as  $[(\text{PAQ} - \text{accelerometer}) / \text{accelerometer}] * 100$ . All summary data are presented as median (25<sup>th</sup>, 75<sup>th</sup> percentiles).

**RESULTS:** MET-h/wk for the accelerometer data using the Freedson and Swartz equations were 11.4 (8.9, 12.7) and 17.3 (13.9, 19.0), respectively. MET-h/wk scores for the PMMAQ, PWMAQ, NHS and WHI PAQs were 24.8 (10.7, 38.0), 21.9 (9.3, 35.8), 23.5 (12.0, 44.3), and 19.3 (10.5, 33.4), respectively. All PAQs were related to the Freedson derived MET-h/wk estimates [ $\rho = 0.28$  to  $0.49$  (all  $p < 0.03$ )], with the strongest associations observed with both MAQ versions. All PAQs, except the WHI, were associated with the Swartz derived MET-h/wk estimates [ $\rho = 0.27$  to  $0.44$  (all  $p < 0.03$ )], with the strongest association observed with the PWMAQ. All PAQs overestimated the Freedson derived MET-h/wk, with median % error ranging from 60.6 to 101.4%, with the WHI having the lowest and NHS having highest % error. For the Swartz equation, the median % error of the PAQ MET-h/wk was lower, with values ranging from 5.8 to 35.0%. Similarly, the WHI and NHS had the lowest and highest % error, respectively.

**CONCLUSIONS:** Data describe the difference between accelerometer and PAQ predicted MET-h/wk and support prior observations that PA levels are typically overestimated when measured with PAQs.

Funded by the American College of Sports Medicine, Paffenbarger-Blair Endowment.

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**1861 Board #2 May 28 8:00 AM - 9:30 AM**  
**Evaluating Accelerometer Cut-points To Classify Physical Activity Levels In Overweight/obese Middle-age-to-older Women**

Stephen Herrmann<sup>1</sup>, Teresa Abraham<sup>1</sup>, Barbara Ainsworth, FACSM<sup>1</sup>, Muriel Gilman<sup>2</sup>. <sup>1</sup>Arizona State University, Mesa, AZ. <sup>2</sup>Bemidji State University, Bemidji, MN.

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Physical activity (PA) patterns of middle-age and older adults differ by type and intensity from younger adults. Due to age-related changes in fitness, older adults may spend more time in lower absolute intensity PA and perceive it as moderate or vigorous PA. Similar situations may exist for overweight/obese adults who may have weight-related increases in the energy cost of movement. Differences in movement patterns may lead to misclassification of PA if measurement standards are based on younger, leaner populations. Advances in ActiGraph accelerometer scoring protocols permit classification of a wider range of PA than previously identified allowing studies of inactivity and lifestyle PA on health outcomes.

**PURPOSE:** To compare differences in min/day spent in levels of PA using Freedson's three-category and Matthews' modified five-category accelerometer cut-points.

**METHODS:** Cross-sectional study with 44 women (age, 50.4  $\pm$  10.2 yr; BMI, 32.3  $\pm$  5.7) wearing an ActiGraph (previously CSA) accelerometer for 8.1  $\pm$  3.6 days, averaging

888.3 ± 68.6 min/d. Movement counts (cts) were collected under free-living conditions and categorized by intensity using Freedson cut-points [light (<1951 cts), moderate (1952-5724 cts), vigorous (>5725 cts)] and the three additional Matthews' modified cut-points [inactive (0 - 99 cts), light lifestyle (100 - 759 cts), moderate lifestyle (760 - 1951 cts). Since data were skewed, they were normalized using log transformations with data presented as the geometric mean.

**RESULTS:** Using Freedson's cut-points, most of the time was spent in light PA (873.9 min/d) as compared to moderate (10.4 min/d) and vigorous-intensity PA (1.24 min/d). With Matthews' modified cut-points, light and moderate-intensity time was redistributed as inactivity (588.4 min/d), light lifestyle (198.4 min/d), moderate lifestyle (52.2 min/d). Moderate walking and vigorous PA remained the same.

**CONCLUSIONS:** These data show the impact of establishing accelerometer cut-points that reflect time spent in varying PA at the lower intensity movement spectrum. Data are needed to compare the cut-points levels with health outcomes in varying populations to determine their sensitivity for health promotion research and to establish their utility in surveillance systems to characterize population PA levels.

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**1862 Board #3 May 28 8:00 AM - 9:30 AM**  
**Accelerometer-determined Steps/day In U.S. Adults**

Catrine Tudor-Locke, FACSM, William D. Johnson, Peter T. Katzmarzyk, FACSM. *Pennington Biomedical Research Center, Baton Rouge, LA.*  
(No relationships reported)

The 2005-2006 National Health and Nutrition Examination Survey (NHANES) released, for the first time, ActiGraph AM-7164 accelerometer-defined step data in addition to time in intensity (defined by activity counts). This accelerometer is known to have a lower sensitivity threshold than accepted pedometers, leading to relatively higher step estimates. **PURPOSED:** To provide the population- and sex-specific epidemiology of accelerometer-determined steps/day with and without censoring steps detected at the lowest end of the activity spectrum (i.e., inactivity).

**METHODS:** Step data were recorded minute-by-minute. Steps/minute were summed over the 1,440-minute day to produce a cumulative daily record. Daily steps were summed and divided by the number of days the accelerometer was worn to derive average steps/day. The analysis sample represents 3,744 participants ≥20 years of age who had at least one valid day (i.e., at least 10 hours) of monitoring. Means (SEM) for steps/day were computed using all steps (i.e., uncensored) and again after censoring those steps taken at an intensity <500 activity counts/minute (indicative of inactivity).

**RESULTS:** The sample took 9,676 ± 107 uncensored steps/day or 6,540 ± 106 censored steps/day, representing an approximate difference of 3,000 steps/day. Extrapolating from this nationally representative sample, 64 % of U.S. adults take ≥ 7,500 steps/day (i.e., they are considered to be somewhat active to highly active), if uncensored steps are considered, and only 31% if censored steps are considered.

**CONCLUSIONS:** The results indicate that adults take approximately 10,000 uncensored accelerometer-determined steps/day, which is improbable considering other studies of free-living physical activity in the U.S. Further, it suggests a level of steps/day that is used to identify active individuals and therefore insinuates that physical activity intervention is unwarranted in this country. In reality however, evidence continues to accumulate that the American obesity epidemic persists and is actually growing in magnitude unthwarted. Until a valid conversion factor is ascertained for translating accelerometer- and pedometer-determined steps, our use of the <500 activity count/minute threshold has considerable merit.

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**1863 Board #4 May 28 8:00 AM - 9:30 AM**  
**Effects Of Varied Accelerometer Wear Time Requirements On Physical Activity Data In African American Women**

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(No relationships reported)

**PURPOSE:** Accelerometers are often used to objectively assess physical activity (PA) in intervention studies. Most studies have subjects wear the accelerometer for 7 d/wk, and utilize at least 3 days of movement data to reflect a usual week's PA pattern. The standard practice requires days with accelerometer recordings < 10 hr/day to be deleted. To minimize deleting data and to potentially increase the number of d/wk accelerometer data are used for analyses, we hypothesized that reducing the minimum hr/day wear time will have little or no difference in the minutes spent in varying intensity levels while increasing the days/wk and subjects with data eligible for analyses. We examined what impact varying the criteria for accelerometer wear time had on min/day (varied intensities), d/wk, and number of subjects with eligible data.

**METHODS:** 237 African American women (age 51.7 ± 10.5; BMI 34.9 ± 10.1) wore an ActiGraph accelerometer for 7 days. Data were summed separately across 10, 9, 8, 7, and 6 hrs/day to reflect minimal daily wear times. Based on Matthews' modified cut-point counts (cts), minutes in inactivity (0-100 cts), light (101-759 cts), moderate lifestyle (760-5724 cts), moderate walking (1952-5724 cts), and vigorous PA (≥ 5725 cts) were computed for each wear time. SAS 9.2 repeated measures analyses were used to determine differences in number of subjects, days/wk, and mean min/day at each PA intensity level for each wear time. Alpha was set at p < .01.

**RESULTS:** Significant differences were observed in min/day and days/wk between 6, 7, 8, 9, and 10 hrs/day wear times for all PA levels, except vigorous intensity, which was not significantly different for min/d or d/wk across wear times. For moderate lifestyle PA, a wear time of 8 hr/d (vs. 10 hr/d) increased the number of subjects with acceptable data by 13, increased the d/wk from 3.9 to 4.5, and reduced the min/day of activity from 115.6 to 109.9 minutes. Lowering the threshold from 8 to 6 hrs /d added 0.4 days, 7 subjects, and decreased activity to 105.2 minutes.

**CONCLUSIONS:** For this sample, a decrease in the accelerometer wear time from 10 to 8 hr/d was more inclusive of subject data with little loss in the minutes accumulated at each intensity level. Additional decreases in hours yielded little added value.

Funded by a grant from the National Heart Lung and Blood Institute to (HL073001).

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**1864 Board #5 May 28 8:00 AM - 9:30 AM**  
**Accelerometer Assessment Of Physical Activity Vs. Inactivity In Hispanic Adults Living With Hiv**

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Physical activity (PA) and physical inactivity (PI) are two ends of a behavioral continuum that greatly impacts health. However, the objective assessment of PI has not been well characterized.

**PURPOSE:** To test the hypotheses that 1) light physical activity (LPA), and moderate to vigorous PA (MVPA) will be inversely associated with PI when objectively assessed with accelerometer, and 2) the proportion of participants classified as active and not-inactive will be opposed to the proportion classified as not-active and inactive.

**METHODS:** A group of 56 Hispanic adults (males 34, females 22, age 46.5±8.8 yrs, BMI 26.8±5.3) living with HIV wore the accelerometer ActiGraph for 7-days. Min/week of no-activity, light, moderate, and vigorous activity was determined using <100, 100-1951, 1952-5724, and >5724 activity counts, respectively. Classification of PA (active vs. not-active) was based on the achievement of ≥150 min/week of MVPA, and classification of PI (inactive vs. not-inactive) was based on the average number of min/day of no-activity.

**RESULTS:** Mean min/day of no-activity, light, moderate and vigorous activity was 1090.2±121.9, 320.1±119.4, 31.3±17.1, and 3.9±9.7, respectively. Using both methods of classification, 62.5% were active-not-inactive, and 65.5% were inactive-not-active ( $\chi^2$  test for independence P=0.04). MVPA was inversely associated with PI (r = -0.35, P= 0.02), but the strongest inverse association was between LPA and inactivity (r = -0.96, P<0.001). PA and PI were not associated with health parameters such as BMI, waist circumference, and life satisfaction.



**CONCLUSION:** Although PA and PI are inversely associated, they appear to measure different behavioral constructs, suggesting that activity is not the opposite end of inactivity.

*Supported by NIH/NCRR 5 R25 RR17589, NIH/NCI P20 CA096257, and NIH/CTSA KL2-RR024151*

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**1865 Board #6 May 28 8:00 AM - 9:30 AM**

**Differences In Accelerometer Output Across Site Placement And Body Mass Index Category.**

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*(No relationships reported)*

**PURPOSE:** The primary purpose of this study was to explore the effect of accelerometer (ACC) placement at the hip versus low back (LB) on monitor output (counts·min<sup>-1</sup>) during treadmill walking. The secondary purpose was to examine differences in ACC counts·min<sup>-1</sup> measured in normal compared to overweight and obese adults at the hip and LB.

**METHODS:** Sixty adults (mean age 54.5 ± 10.3 yrs) completed a five-stage treadmill walking test (2.0-4.0 mph; increasing in 0.5 mph increments every five minutes) while wearing two Actigraph 7164 ACC (Actigraph LLC, Pensacola, FL) affixed to an elastic belt and worn around the waist. Specifically, one ACC was placed vertically at the right anterior axillary line at waist level and a second ACC mounted vertically at the center of gravity on the LB (lumbar vertebrae 4-5). Paired samples *t*-tests were run to compare ACC counts·min<sup>-1</sup> measured at the hip versus the LB at each speed for the group as well as by body mass index (BMI) category (normal vs. overweight /obese). Independent samples *t*-tests were conducted to explore differences in BMI category for ACC counts·min<sup>-1</sup> measured at both the hip and LB for each speed.

**RESULTS:** There were significant differences between hip and LB ACC counts·min<sup>-1</sup> measured at all treadmill speeds (*p*<0.001). When splitting the sample by BMI category (normal [mean BMI: 22.6 kg·m<sup>-2</sup>] vs. overweight/obese [mean BMI: 28.3 kg·m<sup>-2</sup>], hip and LB ACC counts·min<sup>-1</sup> were significantly different for both BMI categories at each speed (*p*<0.001). There were no significant differences in ACC counts·min<sup>-1</sup> measured independently at the hip or LB when comparing normal to overweight /obese at any of the treadmill walking speeds.

**CONCLUSIONS:** Data from this study suggest there are significant differences in ACC output between hip and LB placement. As a result, it becomes difficult to compare ACC outcomes across studies where researchers favor either placement to determine the time spent in various intensities of physical activity. Additionally, erroneous results are likely if hip generated cut points are applied to LB placement studies. Data from this study supports no differences in ACC output when comparing across BMI category.

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**1866 Board #7 May 28 8:00 AM - 9:30 AM**

**Comparison Of Output From Four Different Actigraph Accelerometers**

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*(No relationships reported)*

Motion sensors from Actigraph are the most commonly used accelerometers in physical activity research. Currently, researchers can use the 7164 or one of three different versions of the GT1M to objectively measure physical activity. However, it is not clear if there is a difference between outputs obtained from each of these four accelerometers.

**PURPOSE:** To examine if differences exist between outputs from the 7164 and the three versions of the GT1M at a given walking or running speed.

**METHODS:** Ten male participants (23.6 ± 2.9 yrs) completed two sessions of walking and running for three minutes on a treadmill at ten different speeds while wearing either the 7164 and the latest GT1M or version one (V1) and version two (V2) of the GT1M. Participants walked at 1.9, 3.1, and 4.4 mph followed by running at 5.0, 6.2, 7.5, 8.7, 10.0, 11.2, and 12.4 mph. The accelerometers were worn on the left and right anterior axillary lines at the waist. Testing was performed on two different days and a counterbalanced within subjects design was used to account for potential differences attributable to accelerometer placement.

**RESULTS:** Repeated measures ANOVA followed by post-hoc pairwise comparisons with bonferroni corrections were used to examine outputs from the accelerometers (*p*<0.008). There were no significant differences at any given walking or running speed between the accelerometers. At all running speeds, outputs from the 7164 and V2 displayed the lowest and highest counts/min (cpm) values, respectively. Between these two accelerometers, there was a steady increase in the mean difference scores ranging between 200 + 340 cpm at 5 mph and 612 + 372 cpm at 12.4 mph. Output from all accelerometers peaked at 8.7 mph (mean range: 8974 + 677 to 9412 + 982 cpm) and then gradually declined with increasing speed. The mean difference score at peak output was greatest between the 7164 and V2 at 439 + 565 cpm.

**CONCLUSIONS:** Although there were no statistically significant differences between outputs from all the accelerometers, the large standard deviations observed at various speeds indicate that there is a high level of variability in the 7164 and V2 response for different people.

*Supported by NIH R21CA122430*

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**1867 Board #8 May 28 8:00 AM - 9:30 AM**

**Validity Of An Armband Physical Activity Monitor In Measuring Energy Expenditure During Eighteen Different Activities**

Paige Dudley, David R. Bassett, FACSM, Dinesh John, Scott E. Crouter, FACSM. *University of Tennessee, Knoxville, TN.*

*(No relationships reported)*

**PURPOSE:** To examine the validity of an armband physical activity monitor in estimating energy expenditure (EE) over a wide range of physical activities.

**METHODS:** 68 participants (mean age = 39.5 ± 13.0 yrs.) performed one of three routines consisting of six activities (approximately 10 min. each) while wearing the armband and the Cosmed K4b<sup>2</sup> portable metabolic unit. A break of 3 to 5 minutes was given between activities. Routine 1 (n=25) (Indoor Home-based Activities) included TV watching, reading, doing laundry, ironing, light cleaning, and aerobics. Routine 2 (n=22) (Miscellaneous Activities) included driving, Frisbee golf, grass trimming, gardening, moving dirt with a wheelbarrow, and loading and unloading boxes (6.8kg). Routine 3 (n=21) (Outdoor Aerobic Activities) included road walking, track walking, walking with a bag (6.8 kg), singles tennis, track running, and road running.

**RESULTS:** Mean differences between the EE values in METS (criterion minus estimated) for all routines are as follows. Routine 1: watching TV (-0.1), reading (-0.1), laundry (0.1), ironing (-1.3), light cleaning (-0.4), and aerobics (0.4). Routine 2: driving (-0.6), Frisbee golf (-0.9), grass trimming (-0.5), gardening (-1.5), moving dirt with a wheelbarrow (-0.1), loading and unloading boxes (0.1). The mean MET value differences for Routine 3 were as follows: road walking (-1.0), track walking (-0.8), walking with a bag (-0.6), tennis (1.6), track running (2.2), and road running (2.1). Repeated measures ANOVA followed by post-hoc pairwise comparisons with bonferroni corrections were used to compare criterion versus estimated measures (*p*<0.008). Results showed that the armband significantly overestimated EE during low intensity activities like ironing (by 70%), light cleaning (by 15%), driving (by 74%), Frisbee Golf (by 24%), gardening (by 55%), and road walking (by 26%) and also significantly underestimated higher intensity activities like tennis (by 20%) and both kinds of running (by 20%).

**CONCLUSION:** Although the armband estimates for nine out of the 18 activities were within 16% of the criterion, the armband showed a statistical difference from the criterion for several activities. Algorithms need to be refined to increase the accuracy of EE estimations.

*Supported by NIH R21CA122430*

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**1868 Board #9 May 28 8:00 AM - 9:30 AM**

**A Comprehensive Evaluation Of Accelerometer Energy Expenditure And Met Prediction Equations**

Kate Lyden, Sarah L. Kozey, Cheryl A. Howe, John W. Staudenmayer, Patty S. Freedson, FACSM. *University of Massachusetts, Amherst, MA.*  
(Sponsor: Patty S. Freedson, FACSM)  
(No relationships reported)

Numerous accelerometers and prediction methods are used to estimate energy expenditure (EE). Validation studies have been limited to small sample sizes in which participants complete a narrow range of activities.

**PURPOSE:** To evaluate the ability of one proprietary and ten published prediction equations to estimate EE from three commercially available activity monitors (AM).

**METHODS:** 252 participants completed an average of 6 treadmill (TRD) (1.34, 1.56, 2.23 m.sec-1 each at 0% and 3% grade) and 5 self-paced activities of daily living (ADLs). ADLs were randomly selected from a menu of 17 activities. AMs were worn while EE was measured using a portable metabolic unit.

**RESULTS:** An average of 2438 samples were used to assess the validity of eleven prediction equations, including the Freedson MET (F), Swartz MET (S), two Crouter MET equations (C1) and (C2), Heil 1R (H1) and 2R (HH1) MET, Heil 1R (H2) and 2R (HH2) kcal, Freedson kcal (F2), Chen kcal (CH) and one proprietary kcal (P). When TRD and ADL activities were evaluated together, each equation, except F2, significantly underestimated EE. When evaluated separately, each equation significantly underestimated ADLs, while TRD activities were significantly underestimated by 8 equations, significantly overestimated by 2 equations and accurately predicted by S and H2. Percent bias and precision were determined for all activities combined, ADLs, and TRDs.

% Bias (Precision) METs							% Bias (Precision) kcals-min-1					
	F	S	C1	C2	H1	HH1	H2	HH2	F2	CH	P	
All	-24.6 (1.92)	-10.4 (1.91)	-18.6 (2.13)	-9.7 (2.49)	-21.0 (2.20)	-20.5 (2.14)	-21.3 (2.61)	-21.1 (2.52)	-2.0 (2.71)	-34.5 (2.55)	-7.8 (2.79)	
ADL	-39.8 (2.30)	-21.7 (2.33)	-12.1 (2.46)	-15.6 (2.62)	-40.7 (2.48)	-37.0 (2.50)	-48.3 (3.00)	-43.4 (3.02)	-17.8 (3.24)	-42.0 (3.11)	-30.9 (3.41)	
TRD	-13.4 (1.25)	-2.0 (1.28)	-23.8 (1.71)	-5.3 (2.35)	-6.2 (1.44)	-8.1 (1.42)	-1.8 (1.53)	-4.8 (1.49)	9.7 (1.9)	-29.3 (1.94)	8.7 (1.56)	

On average, ADLs were underestimated by 31.8% and TRDs were underestimated by 6.9%.

**CONCLUSION:** The AM prediction equations did not yield accurate point estimates of METs or EE across a broad range of activities. Future research should focus on developing more precise methods to estimate EE from AMs.

Supported by NIH CA121005

# 1869 Board #10 May 28 8:00 AM - 9:30 AM Body Mass Index Affects Accelerometer Counts During Walking

Yuri Feito, David Bassett, Jr, FACSM, Dixie Thompson, FACSM, Brian Tyo. *University of Tennessee, Knoxville, TN.*  
(No relationships reported)

Accelerometers have been used to provide objective measures of physical activity and energy expenditure in free-living individuals. However, to our knowledge, output from these devices has not been compared between normal, overweight and obese individuals.

**PURPOSE:** To determine the effects of body mass index (BMI) on accelerometer counts during treadmill walking.

**METHODS:** Fifty-six adults (M= 28; F= 28) took part in the study. They wore an omnidirectional accelerometer (ActiCal™, (AC)) and a uniaxial accelerometer (ActiGraph™ GT1M (AG)) on the right and left hip, respectively, while walking at 40, 67, and 90 m·min<sup>-1</sup>.

**RESULTS:** Results are shown in Table 1 as Mean ± SE.

Table 1: Activity Counts-min-1				
Device	BMI Category (kg/m <sup>2</sup> )	40 m · min-1	67 m · min-1	90 m · min-1
AC	≤ 24.9	382 ± 36	1418 ± 73	2890 ± 94
	25.0 - 29.9	400 ± 60	1496 ± 122	3075 ± 158
	≥ 30.0†	615 ± 59	1684 ± 120	3397 ± 156
AG	≤ 24.9	512 ± 51	2152 ± 99	3904 ± 142
	25.0 - 29.9	679 ± 84	2340 ± 162	4217 ± 234
	≥ 30.0	930 ± 102	2457 ± 198	4318 ± 286

† Significant difference between obese group and other two groups (p< 0.05)

**CONCLUSION:** Our data suggest that BMI does not have a statistical significant effect on the activity counts recorded by the AG. However, BMI does affect the AC with the obese group recording 13% and 17% higher activity counts than the overweight and normal weight groups, respectively (p< 0.05). Researchers should be aware of these effects and further research should be conducted to explain these differences.

# 1870 Board #11 May 28 8:00 AM - 9:30 AM Validation Of Accelerometers During Walking At Three Step Frequency On Various Walking Speeds

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(No relationships reported)

The influences of walking speeds on the validation of uni- and tri-axial accelerometers have been clearly demonstrated, but it is unclear whether the alterations of step frequency during walking would affect the accurate estimation of the accelerometers.

**PURPOSE:** To test the validation of uni- (Lifecorder (LC), Suzuken Inc., Japan) and tri-axial accelerometers (Activity monitor (AM), Matsushita Electronic Works, Ltd., Japan; Active style pro (ASP), Omron Health Care Co., Ltd., Japan) under various walking conditions altered by three different step frequency.

**METHODS:** Healthy men and women (n=18, age=29.6 yrs) volunteered as subjects. Three trials (55, 75, and 95 m/min) were designed to manipulate three step frequency - low (- 15% of normal step frequency), normal, and high (+ 15%) - on each walking speed. Subjects were attached to a facemask connected to the Douglas bag, to the LC on the left side of the waist at midline of left thigh, to the AM on the left side of the waist, and to the ASP on the right side of the waist. The subjects walked for 5 minutes matching each step frequency, and respiratory measurements were also made during the last 2 minutes.

**RESULTS:** When examining the percent error between measured METs (Douglas bag) and predicted METs (accelerometers), the LC at the low step frequency became greater as walking speed increases (significantly underestimated by 25 %, 34 %, and 42 % at the 55, 75, and 95m/min, respectively). There was a significant correlation between the percent error and step frequency in pooled all trials (controlling for speed,  $r=0.75$ ,  $p<0.0001$ ). A multiple regression analysis of predictors of the percent error (including step frequency, speed, and sex) showed that step frequency was the strongest predictor ( $b = 0.895$ ). In contrast, the AM and ASP well performed in the speed of 55 or 75 m/min whereas slightly underestimated at the low step frequency in the speed of 95 m/min. There were no statistical differences between in the percent of error and step frequency in the AM, but a weak correlation in the ASP ( $r=0.23$ ,  $p < 0.01$ ) was observed.

**CONCLUSIONS:** The accuracy of the Lifecorder, a uniaxial accelerometer, is affected by the alterations of step frequency during walking, however, those of Activity monitor and Active style pro, a triaxial accelerometer, are less affected by them.

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**1871 Board #12 May 28 8:00 AM - 9:30 AM**

**Validation Of The 1r And 2r Regression Models To Predict Energy Expenditure Using The Actical Accelerometer**

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(No relationships reported)

Accelerometers are used to objectively measure activity energy expenditure (AEE). A new approach for estimating AEE employs either a single (1R) or double (2R) regression equation. The 1R was developed on treadmill (TM) activities and activities of daily living (ADLs) of various intensities. The 2R consists two non-overlapping linear regression equations, one for light to moderate and another for vigorous activity.

**PURPOSE:** To validate the 1R and 2R models for predicting AEE from activity counts.

**METHODS:** 102 subjects (64 female and 37 male) ( $X \pm SD$  age =  $34.9 \pm 12.4$  y) completed 6 TM activities and 17 ADL's. Activities were performed for 7 min with subjects wearing a portable metabolic measurement system. Resting metabolic rate (RMR) was measured prior to the activity protocol to determine AEE (total energy expenditure - RMR). Pearson correlation coefficients were computed to examine the relationship between predicted and measured AEE. A repeated measures ANOVA was used to examine the difference between measured AEE (AEE<sub>meas</sub>) and Actical estimated AEE (AEE<sub>est</sub>) from the 1R and 2R equations.

**RESULTS:** AEE<sub>meas</sub> and AEE<sub>est</sub> were highly correlated for 7 out of 15 activities for 1R ( $R^2 = 0.71 - 0.92$ ) and for 5 out of 15 activities for the 2R equation ( $R^2 = 0.70 - 0.91$ ). AEE<sub>meas</sub> and AEE<sub>est</sub> were significantly different for all intensity levels for both the 1R and 2R equations ( $p < 0.0001$ ).

	Light Activities	Moderate Activities	Vigorous Activities
1R (kcal·kg <sup>-1</sup> ·min <sup>-1</sup> )	0.002 (±0.003)	0.048 (±0.019)	0.096 (±0.043)
2R (kcal·kg <sup>-1</sup> ·min <sup>-1</sup> )	0.002 (±0.003)	0.047 (±0.019)	0.098 (±0.046)

**CONCLUSION:** AEE<sub>meas</sub> and AEE<sub>est</sub> for 1R and 2R equations were correlated for a limited number of activities. Neither equation accurately estimated AEE when MET intensity values were assigned to the activities. Point estimates of AEE from the activity monitor yielded differences that over time would lead to an underestimation of AEE.

Supported by NIH RO1 CA121005

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**1872 Board #13 May 28 8:00 AM - 9:30 AM**

**Effect Of Monitor Placement On 3dNX™ Accelerometer Output During Treadmill Exercise**

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(No relationships reported)

Accelerometers are commonly used to provide estimates of energy expenditure and quantify physical activity patterns during a wide range of free-living activities.

**PURPOSE:** To assess the effect of monitor placement on triaxial accelerometer count magnitude during incremental treadmill exercise. **METHOD:** Five male and 6 female, recreationally-active subjects (age  $22 \pm 3$  yr; height  $173 \pm 9$  cm; mass  $71 \pm 11$  kg) completed two incremental treadmill protocols separated by no more than five days. The protocol consisted of three 5-minute walking stages (4, 5 and 6 km·h<sup>-1</sup>), three 5-minute jogging stages (8, 10 and 12 km·h<sup>-1</sup>) and four 30-second sprints (14, 16, 18 and 20 km·h<sup>-1</sup>). Each subject wore four 3dNX™ units on an elastic belt; two positioned in the small of the back (lumbar 4-5) and one positioned on each hip (midaxillary line). The sum of the counts from all 3 axes were stored every 5 s. Five-second epoch accelerometer counts were averaged over each stage. The effects of placement (hip and back) and speed, which were considered fixed, and the interaction effects (placement x speed) on count magnitude were tested by ANOVA.

**RESULTS:** Overall there were no significant differences in count magnitude between hip and back placement ( $p = 0.738$ ). A borderline interaction effect was observed between placement and speed ( $p = 0.059$ ). Paired t-tests showed significant differences at 4, 5, 8, 10 and 12 km·h<sup>-1</sup>. Hip placement resulted in higher count magnitude than back placement at 4 and 5 km·h<sup>-1</sup>, on average 10 % and 6 % higher respectively. Back placement yielded higher count magnitude than hip placement at 8, 10 and 12 km·h<sup>-1</sup>, on average 8 %, 7 % and 3 % higher respectively.

**CONCLUSION:** There were small differences in count magnitude when the monitor was worn on the hip and the back. The direction and magnitude of the differences depend on the speed of the treadmill exercise.

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**C-25 Free Communication/Poster - Accelerometry: Youth**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**1873 Board #14 May 28 9:00 AM - 10:30 AM**

**Exploring Validity And Reliability Of Physical Activity Questionnaire For Children (PAQ-C) And Modifications Using**

## Accelerometry

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(No relationships reported)

**BACKGROUND:** Self-report physical activity (PA) tools are problematic in children and yet remain important, as they are inexpensive and easy to administer. The PAQ-C is a self-report instrument for children aged 8-14 years that has been validated previously using accelerometry (1 minute epochs). The Action Schools! BC (AS! BC) study used the PAQ-C and accelerometry to assess PA but modified the first question of the PAQ-C to generate a continuous variable (minutes of PA/day).

**PURPOSE:** The purpose of this study was to explore, 1) concurrent validity for both the PAQ-C summary score and the modified question, using accelerometry data collected every 15 seconds and 2) the psycho-metric properties of the PAQ-C.

**METHODS:** Data were collected during the baseline phase of the AS! BC Dissemination Trial (October 2005 - January 2006). Six hundred and forty-four children consented to both the questionnaire and accelerometry assessment. Complete data were available for 313 children (aged  $9.9 \pm 0.6$  yr). Students with a minimum of 3 days of accelerometry data collected in the same 7-day period as the PAQ-C were included in the sub-analysis (n=44). Physical activity was measured with an ActiGraph GT1M monitor and analyzed as 15-second epochs for 3-5 days (minimum 10 hr/d).

**RESULTS:** The PAQ-C PA score was significantly associated with accelerometry variables; minutes of MVPA/day ( $r=.482$ ,  $p<.001$ ), counts/day ( $r=.431$ ,  $p<.004$ ) and counts/min ( $r=.462$ ,  $p<.002$ ). Minutes of MVPA calculated from the modified Question 1 were significantly associated with MVPA/day by accelerometry ( $r=.316$ ,  $p<.0001$ ). Internal consistency of the PAQ-C (n=644) was acceptable (Chronbach's alpha .755).

**CONCLUSION:** Our analysis confirmed the validity of the PAQ-C and the modified question 1 as a stand-alone 7-day recall measure when compared to accelerometry. Thus, we suggest that the PAQ-C or its modified question 1 are viable alternatives to objective physical activity measurement.

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### 1874 Board #15 May 28 9:00 AM - 10:30 AM Physical Activity Patterns Measured By Accelerometry In 6-10 Year Old Swedish Children

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(No relationships reported)

**PURPOSE:** To study differences in patterns of objectively measured physical activity between weekdays and weekend days and between different time blocks during the day in relation to age and gender. This knowledge is of great importance when planning preventive initiatives aimed at increasing levels of physical activity in children.

**METHODS:** A total of 653 girls and 640 boys provided valid weekly accelerometer measurements of physical activity. Twenty randomly selected children from 10 schools were measured every week (2002-2005). Time periods were divided into school time (8am-1.30pm), after school care time (1.30pm-4pm) and evening time (4pm-9pm).

**RESULTS:** Physical activity levels were significantly lower during weekends compared to weekdays in all age groups and this pattern was similar across low, medium and high active children. Physical activity levels were highest during school time and after school care time on weekdays compared to all other time periods. The difference in activity levels between boys and girls was highest during school time and after school care time. Furthermore, the results show an age related decline in physical activity between ages 6-10 years for both girls and boys.

**CONCLUSIONS:** It is important to counterbalance the age related decline in physical activity in children as early as from the age of six years. It is significant to target girls to become more active in the school setting when the difference in physical activity levels between girls and boys is most pronounced. However, it appears difficult to compensate the low levels of activity during weekends and evenings by increased physical activity at school. Increased family involvement seems to be a prerequisite for a successful physical activity intervention in this age group.

Supported by Signhild Engkvist Foundation and GCI Foundation.

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### 1875 Board #16 May 28 9:00 AM - 10:30 AM Predicting Energy Expenditure From Accelerometer Counts At 12 And 16 Years In The Same Individuals

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(No relationships reported)

Accelerometry is an objective method of assessing levels and patterns of physical activity and is relatively precise. To be able to further explore the association between accelerometer counts and health outcomes, it is important to know how such measures of movement relate to energy expenditure.

**PURPOSE:** To determine how accurately an equation developed in 12 year old children predicts energy expenditure from accelerometer counts during free-living activities in the same children aged 16.

**METHODS:** Children aged 12 were recruited from a large birth cohort, the Avon Longitudinal Study of Parents and Children (ALSPAC). Accelerometer counts, oxygen uptake ( $\text{VO}_2$ ) and carbon dioxide output ( $\text{VCO}_2$ ) were recorded during four activities (slow walking, fast walking, hopscotch and jogging) at age 12 and again at age 16. Energy expenditure per kg was calculated from  $\text{VO}_2$  and  $\text{VCO}_2$ . Random intercepts modelling (to allow for multiple measurements on each child) was used to construct a prediction equation for the 12 year olds, with gender as a possible confounder. Limits of agreement were used to assess the adequacy of the equation in the same children at age 16.

**RESULTS:** Valid data were obtained for 22 children at both age 12 (mean age 12.4 years, SD 0.2 years) and at age 16 (mean age 15.9 years, SD 0.2 years). The prediction equation obtained at age 12 was: Energy expenditure ( $\text{kJ} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ) =  $0.0695 + 0.000105 \times \text{counts per minute} + 0.0546 \times \text{gender}$  (0=female, 1=male). When applied to the same children at age 16, this equation tended to over-estimate energy expenditure (mean difference between predicted and actual values  $0.15 \text{ kJ} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ). The 95% limits of agreement were -0.17, 0.46.

**CONCLUSION:** An equation predicting energy expenditure from accelerometer counts at age 12 does not accurately describe the relationship between the two measurements in the same children at age 16. In longitudinal studies such as ALSPAC, it will be necessary to derive new equations at each age. Further data are being collected (approximately 60 subjects in total) and this analysis will be repeated using all available data.

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### 1876 Board #17 May 28 9:00 AM - 10:30 AM Youth Accelerometer Cutoffs For Moderate-to-vigorous Physical Activity: A Sensitivity Analysis

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(No relationships reported)

The various accelerometer count cutoffs available for youth and adult populations may not be compatible with each other; an important issue due to an increasing interest in

tracking health behaviors as adolescents transition into young adulthood.

**PURPOSE:** To 1) determine the effect of various cutoffs for determining adolescent moderate-to-vigorous physical activity (MVPA) and 2) identify the congruence between youth and adult cutoffs.

**METHODS:** Baseline data from a longitudinal observational study were used (N=288, 49% male, mean age=15+1.8 years, age range 11-17, 97% White). ActiGraph (Pensacola, FL) data were collected in 30-second intervals for one week and categorized as MVPA if the data point was above the count cutoff used. The Freedson/Trost (FT) equation was applied to the data entering either 3 METS, 4 METS or an age-adjusted MET value to theoretically adjust for children's higher resting metabolic rates.

**RESULTS:** The table contains the results of the repeated measures analysis.

Variable	Cutoffpoint				
	FT-3	FT-4	FT-METadj	Puyau	TAAG
MVPA min.day-1	55+29.4a	30+19.2b	31+19.0b	20+15.0c	23+16.7c
> 60 min.day-1 of MVPA (%)	37.0	4.9	6.4	3.5	3.8
Values with different letters are significantly different from each other (p<0.0001)					
FT-3 = FT equation with age and 3 METS					
FT-4 = FT equation with age and 4 METS					
FT-METadj = FT equation with age and age-adjusted METS					

For a 17-year old the MVPA cutoffs using the FT-4, Puyau, and TAAG equations are 3239, 3200, and 3000 cnts·min<sup>-1</sup>, respectively. The FT-3 and FT-MET<sub>adj</sub> 17-year old cutoffs (2069, 2349 cnts·min<sup>-1</sup>, respectively) provide the most congruence with the adult NHANES MVPA cutoff (2020 cnts·min<sup>-1</sup>).

**CONCLUSION:** The cutoff used to categorize intensity of activity can significantly affect physical activity outcome variables. The FT-3 and FT-MET<sub>adj</sub> were the most congruent with the adult cutoff. The FT-MET<sub>adj</sub> cutoff may be more appropriate for those studying a wide age range of youth and those with both adolescents and young adults in their datasets. Funding source: NCI's Transdisciplinary Research in Energetics & Cancer Initiative (NCI Grant 1 U54 CA116849-01)

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#### 1877 Board #18 May 28 9:00 AM - 10:30 AM

##### Intra-individual Variation Of Physical Activity At Ages 12-14 As Assessed By Accelerometry

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(No relationships reported)

Accurate estimates of habitual physical activity (PA) are essential when examining the associations between PA and health outcomes. Intra-individual variation throughout the year may lead to inaccurate assessment, and few studies have examined intra-individual variation over a year in children.

**PURPOSE:** To use accelerometry to estimate and compare intra-individual variation of children's PA (over the course of a year) at two timepoints during adolescence, and to compare estimates at age 14 with previously reported estimates at age 12 years.

**METHODS:** As part of the Avon Longitudinal Study of Parents and Children (ALSPAC), all children attending clinics at 12 and 14 years were asked to wear accelerometers for 7 days to obtain counts per minute (cpm) data to quantify total activity. At age 12 years, 349 children were also asked to wear the accelerometer for 7 days on 3 further occasions throughout the year. At age 14 years, 104 children were also asked to wear the accelerometer for 3 days on 3 further occasions throughout the year. Random intercepts models were used to estimate the inter- and intra-individual components of PA at each of the 2 timepoints.

**RESULTS:** Data were considered valid if the accelerometer was worn for at least 10 hours for at least 3 days. A total of 315 children had valid data for at least 2 measurement occasions at the 1<sup>st</sup> timepoint, and 61 children had valid data for at least 2 measurement occasions at the 2<sup>nd</sup> timepoint. The unadjusted intraclass correlation coefficient (ICC) for cpm was 0.54 at the 1<sup>st</sup> timepoint and 0.50 at the 2<sup>nd</sup> timepoint. After adjustment for gender, age and BMI, values were 0.49 and 0.53 respectively. After further adjustment for month of measurement, values were 0.53 and 0.55 respectively.

**CONCLUSION:** There is substantial intra-individual variation in objectively measured PA, which is of the same order of magnitude for different ages during adolescence. Any study using a single measurement occasion with PA as the exposure should take account of this by adjusting for regression dilution.

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#### 1878 Board #19 May 28 9:00 AM - 10:30 AM

##### Predictive Validity Of A Triaxial Accelerometer Met Prediction Equation For Children And Adolescents

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(No relationships reported)

Accelerometers are a widely used objective measure of physical activity (PA) in studies involving youth. Youth specific cut-points for the estimation of time spent in sedentary (SED), light (LPA), moderate (MPA), and vigorous (VPA) PA have been developed, but these have not been evaluated for validity in an independent sample.

**PURPOSE:** This study evaluated the predictive validity of a previously published triaxial accelerometer MET prediction equation (Rowlands et al., 2004) for children.

**METHODS:** 100 (61 boys, 39 girls) children and adolescents (mean age: 11.2 ± 2.7 yr, ht: 149.1 ± 17.7 cm, wt: 44.1 ± 17.3 kg, BMI%: 58.2 ± 26.5) completed 12 standardized activity trials (AT's). AT's included 1 resting AT (supine lying), 2 sitting AT's (writing and computer game), 5 lifestyle AT's (sweeping, laundry, throw and catch, aerobics, and basketball), and 4 locomotive AT's (slow walking, fast walking, fast treadmill walking, and running). Each AT lasted 5 min with the exception of the resting trial (10 min). During each AT, participants wore a triaxial accelerometer on the left and right hip. VO2 was measured by a portable indirect calorimetry system. Differences between measured and predicted METs were assessed using dependent t-tests. Classification accuracy was assessed using percent agreement (%Ag), sensitivity (Se), and specificity (Sp).

**RESULTS:** The equation under-predicted the MET level of the resting, sitting, and lifestyle AT's (P<0.0001), and over-predicted the MET level of the locomotive AT's (P<0.05). The magnitude of underestimation ranged from 1.2 METs for resting to 2.2 METs for basketball. The magnitude of overestimation ranged from 0.9 METs for fast walking to 2.1 METs for running. The correlation between predicted and observed METs was 0.89 (P < 0.0001). For SED, %Ag, Se, and Sp were 67.3%, 100%, and 62.5%. For LPA, %Ag, Se, and Sp were 66.1%, 4.2%, and 87.8%. For MPA, %Ag, Se, and Sp were 69.9%, 44.3%, and 88.8%. For VPA, %Ag, Se, and Sp were 87.6%, 67.6%, and 92.3%. For MVPA, %Ag, Se, and Sp were 81.9%, 71.4%, and 98.6%.

**CONCLUSIONS:** These data show that the Rowlands triaxial accelerometer equation does not accurately predict METs but may be useful for classifying MVPA.

Supported by Grant R01HD055400 from the National Institute Of Child Health And Human Development.



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1879 Board #20 May 28 9:00 AM - 10:30 AM

**Effect Of Epoch Length On Objectively-measured Physical Activity In Middle School Students**

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Accelerometers are used to measure different intensities and durations of physical activity. It has been suggested that researchers use short sampling intervals, or epochs, to assess the intermittent patterns of physical activity indicative of children. Less is known about the appropriate epoch for assessing physical activity in middle school students. Because accelerometers sum activity counts over the selected epoch, short bursts of moderate or vigorous activity, which generate high activity counts, may not be detected when activity counts are summed over longer epochs (e.g., 1 minute).

**PURPOSE:** The purpose of this study was to investigate the effect of different epochs on the assessment of physical activity in middle school students using Actigraph accelerometers.

**METHODS:** Fifty-seven boys and girls (mean age =  $11.0 \pm 0.5$  years) wore an Actigraph GT1M accelerometer set to record in 15-second epochs on their right hips for seven consecutive days. Fifteen-second epochs were reintegrated into 60-second epochs for comparison. Previously published age-specific equations were used to establish cut-points for moderate (4 METs), moderate-to-vigorous, and vigorous (7 METs) intensity activity for each epoch setting. Paired samples t-tests were used to evaluate mean differences between estimated minutes of each outcome variable for each epoch setting.

**RESULTS:** A significant epoch effect was present for time spent at moderate, moderate-to-vigorous, and vigorous intensity activity ( $p < .01$ ). Minutes of moderate ( $43.5 \pm 14.6$  vs.  $34.8 \pm 16.1$  min), moderate-to-vigorous ( $49.2 \pm 17.8$  vs.  $36.9 \pm 17.9$  min), and vigorous ( $5.5 \pm 4.0$  vs.  $2.1 \pm 2.5$  min) activity were significantly higher for the 15-sec epoch setting than for the 60-sec epoch setting, with moderate to large effect sizes.

**CONCLUSION:** Statistically significant epoch effects are present when measuring middle school students physical activity of moderate intensity or greater. These findings indicate that use of a longer epoch produces fewer minutes of moderate, moderate-to-vigorous, and vigorous physical activity and the use of shorter epochs may be necessary in order to reliably capture physical activity of middle school students.

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1880 Board #21 May 28 9:00 AM - 10:30 AM

**Tracking Children's Physical Activity: An 8 Year Longitudinal Follow-up Using Accelerometry And Dxa**

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(No relationships reported)

**PURPOSE:** Physical activity (PA) tracking studies can determine when children settle into activity patterns and how attributes may influence the stability of activity. This study examined the tracking of physical activity over an 8-year period in relation to adiposity and maturity.

**METHODS:** Participants were children from the Iowa Bone Development Study. PA was measured at ages 5, 8, 11, and 13 via accelerometry (Actigraph). Children wore the accelerometer for 3 to 5 days and a summary variable of moderate through vigorous activity (MVPA) was constructed using the Freedson equation. % fat was measured using dual-energy x-ray absorptiometry (Hologic 2000 at ages 5, 8 and Hologic 4500 at ages 11, 13). Maturity offset was predicted using the Mirwald equations. 270 children (140 girls and 130 boys) with all data available at ages 5 and 13 were included in the data analysis.

**RESULTS:** Spearman rank-order correlation coefficients between baseline (age 5) and follow-up MVPA and % fat ranged from 0.20 to 0.42 ( $p < 0.05$  all associations). Generalized estimating equations (GEE) were used to examine the stability of MVPA across all years after controlling for the influence of % fat and maturity. The adjusted GEE estimate for MVPA was 0.32 for boys (95% CI = 0.22, 0.43) and 0.36 for girls (95% CI = 0.23, 0.49). % fat was significant in this model ( $p < 0.05$ ); maturity was not. Based on GEE, logistic regression analysis was used to examine if "at risk" children could be predicted. The least active quartile for MVPA was set as "at risk." The unadjusted odds ratios (OR) were 3.51 (95% CI = 1.87, 6.58) for boys and 3.69 (95% CI = 1.97, 6.90) for girls. After adjustment for % fat, the OR were 3.74 (95% CI = 2.00, 6.99) and 3.75 (95% CI = 2.01, 7.00) in boys and girls, respectively. The OR for boys with higher than average % fat at age 5 was 5.18 (95% CI = 2.28, 11.73).

**CONCLUSIONS:** MVPA is moderately stable throughout childhood and predictive of later MVPA regardless of changes in adiposity. Young overweight and inactive boys are more likely to remain inactive throughout childhood when compared to peers. Since habitual activity patterns in young children tend to continue to adolescence, early intervention strategies appear warranted.

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**C-26 Free Communication/Poster - Acute Exercise**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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1881 Board #22 May 28 8:00 AM - 9:30 AM

**Implications Of Acute Exercise And Inspiratory Hypoxia For Systemic NO Bioavailability**

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(No relationships reported)

Systemic vascular nitric oxide (NO) bioavailability is known to play a key role in regulation of vascular tone at rest in Normoxic (N) and Hypoxic (H) conditions (Maher et al. Circulation 2008. 117 (5) 594-7). However, the effect of altered oxygen delivery as a function of exercise and inspiratory hypoxia and subsequent implications for NO metabolites remains unknown.

**PURPOSE:** The present study examined the effects of physical exercise and H on NO metabolites in the systemic circulation. Specifically, we hypothesized that exercise would result in a net loss of NO metabolites which would be compounded in hypoxia due to a) PO<sub>2</sub> mediated re-apportionment and/or b) oxidative inactivation.

**METHODS:** Fourteen healthy males aged 24 (mean)  $\pm$  5 (SD) years performed two incremental tests to volitional exhaustion in N (21%O<sub>2</sub>) and H (~12%O<sub>2</sub>). Maximal oxygen consumption (VO<sub>2max</sub>) was measured off line using the Douglas bag method and arterial haemoglobin oxygen saturation (SaO<sub>2</sub>) via pulse oximetry. Blood samples were taken from an antecubital vein before and immediately after exercise for determination of PO<sub>2</sub> and plasma concentrations of nitrite (NO<sub>2</sub>), nitrate (NO<sub>3</sub>) and S-nitrosothiols (RSNO) via ozone-based chemiluminescence using modified tri-iodide/vanadium reagents. Data were analyzed with a two-way repeated measures ANOVA and *post-hoc* Bonferroni-corrected paired samples *t*-tests and relationships between variables by a Pearson Product Moment correlation coefficient.

**RESULTS:** H decreased SaO<sub>2</sub> (N:  $96 \pm 1$  vs H:  $77 \pm 4\%$ ,  $P < 0.05$ ) and subsequently VO<sub>2max</sub> (N:  $3.92 \pm 0.30$  vs H:  $3.00 \pm 0.17$  L/min,  $P < 0.05$ ).

Total NO did not change as a result of exercise and hypoxia (N:  $-0.4 \pm 6.3$  vs H:  $-1.2 \pm 7.7 \mu\text{mol}$ ). The exercise-induced reduction in NO (N:  $-137 \pm 93$  norm vs. H:  $-78 \pm 99$  nmol) was mirrored by an exercise-induced increase in RSNO (N:  $+11 \pm 31$  vs. H:  $+21 \pm 16$  nmol ( $P < 0.05$ ). A more marked reduction in NO was observed during N exercise ( $P = 0.07$ ).

**CONCLUSION:** These findings demonstrate an exercise induced re-apportionment of NO across the metabolite pool (from nitrite to RSNO) that may help conserve vascular  $\text{O}_2$  delivery which is especially important in H. Alternatively the reduction in nitrite and tendency towards a decrease total NO may reflect oxidative inactivation.

**1882 Board #23 May 28 8:00 AM - 9:30 AM**  
**Acute Effects Of Whole Body Vibration During Passive Standing On Arterial Stiffness**

Masae Miyatani<sup>1</sup>, Kei Masani<sup>1</sup>, J Totosy de Zepetnek<sup>2</sup>, Milad Alizadeh-Meghrizi<sup>1</sup>, Milos R. Popovic<sup>1</sup>, C Catharine Craven<sup>1</sup>. <sup>1</sup>Toronto Rehabilitation Institute, Toronto, ON, Canada. <sup>2</sup>University of Waterloo, Waterloo, ON, Canada. (Sponsor: Izumi Tabata, FACSM)  
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 (No relationships reported)

Patients with spinal cord injury (SCI) are prone to coronary artery disease (CAD) resulting in high CAD related morbidity and mortality. Increased arterial stiffness is a well-established CAD risk factor among able-bodied individuals. Whole body vibration (WBV) with static squat exercise acutely decreases arterial stiffness among able-bodied individuals. People with SCI can passively stand with the assistance a standing frame. WBV may be beneficial as an alternate to exercise for decreasing arterial stiffness among people with SCI.

**PURPOSE:** To investigate the acute effects of WBV during passive standing on arterial stiffness in able-bodied individuals.

**METHODS:** Seven healthy men (Age:  $27 \pm 7$  yrs; Height:  $177.8 \pm 8.9$  cm; Body weight:  $77.8 \pm 8.7$  kg) performed WBV during passive standing in the standing frame (Easystand 5000). The WBV session consisted of 10 sets of 60 s-vibration (frequency, 45Hz; amplitude, 1.2mm) with inter-set resting periods of 60 s each. Arterial stiffness (pulse wave velocity in cm/sec) was measured from the common carotid to the femoral artery (c-f PWV) and from the femoral to posterior tibial artery (f-a PWV). Blood pressure (BP) and heart rate (HR) were measured pre and 2min post WBV.

**RESULTS:** BP and HR did not change from baseline after WBV. f-a PWV significantly decreased after the WBV ( $940 \pm 88$  cm/sec vs.  $926 \pm 88$  cm/sec,  $p < 0.05$ ). The group mean of c-f PWV decreased ( $1067 \pm 973$  cm/sec vs.  $973 \pm 273$  cm/sec,  $p = 0.174$ ), although it was not statistically significant.

**CONCLUSIONS:** WBV during passive standing acutely decreased arterial stiffness, especially in the leg in able-bodied individuals. These results suggest that WBV with passive standing may be feasible as an alternate for exercise in people with SCI for decreasing arterial stiffness.

**1883 Board #24 May 28 8:00 AM - 9:30 AM**  
**A Cool Down Period After A Bout Of Dynamic Exercise Does Not Attenuate PEH In Treadmill Trained Rats**

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Post-exercise hypotension (PEH) is a well established phenomenon that occurs in a variety of exercise settings in humans and animals. PEH is characterized by increased vascular conductance and decreased cardiac output, which does not appear to be due to sympathetic withdrawal. It has been proposed that elimination of the muscle pump may contribute to PEH.

**PURPOSE:** Our aim was to determine if the fall in blood pressure after a bout of treadmill exercise could be attenuated or eliminated by continued low intensity walking. Thus, the purpose of the study was to test the hypothesis that continued low intensity exercise, a "cool down period", following a bout of dynamic exercise would attenuate the magnitude of PEH.

**METHODS:** Eight male Sprague-Dawley rats ( $350 \pm 7$  g) were previously trained 5 days/wk, for 2-4 wks on a motor-driven treadmill. Under isoflurane anesthesia the right carotid artery was catheterized. After two days recovery, blood pressure and heart rate were measured before, during and after a 20 min bout of running on a rodent treadmill at 20 m/min, 20% incline. On consecutive days, at the conclusion of the exercise bout, each rat either stopped exercise completely (no cool down, NCD) or continued walking at 5 m/min for 10 min before stopping (cool down, CD), as determined by random assignment.

**RESULTS:** Similar to previous reports, during the NCD protocol, blood pressure fell below the initial resting baseline ( $112 \pm 3$  mmHg) in all animals reaching its nadir between 20 and 30 min post-exercise (20 min,  $104 \pm 2$  mmHg; 25 min,  $104 \pm 2$  mmHg; 30 min,  $104 \pm 3$  mmHg;  $p < 0.05$ ). PEH was not affected during the CD protocol, as blood pressure fell below baseline ( $109 \pm 2$  mmHg) to its nadir (30 min,  $102 \pm 3$  mmHg; 35 min,  $103 \pm 3$  mmHg; 40 min,  $103 \pm 3$  mmHg;  $p < 0.05$ ). The time to maximum fall in blood pressure was delayed by the duration of the cool down period (to 30 min). Blood pressure remained elevated 10 min post-run during CD ( $112 \pm 3$  mmHg), while falling precipitously during the NCD ( $105 \pm 3$  mmHg;  $p = 0.028$ ).

**CONCLUSIONS:** These results suggest that, although a cool down period delays the immediate fall in blood pressure post-exercise, it does not attenuate the ultimate magnitude of PEH. These data suggest that at the conclusion of a protracted exercise bout, a period of low intensity exercise may diminish the potential for post-exercise syncope.

**1884 Board #25 May 28 8:00 AM - 9:30 AM**  
**Does Advanced Cardiac Impedance Technology Accurately Measure Cardiac Output During Submaximal Steady State Exercise?**

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 ( C.E. Broeder, PhysioFlow Corporation, Contracted Research.)

**PURPOSE:** This study determined if advanced cardiac impedance technology (ACI) could accurately measure cardiac output during steady-state cycling exercise compared to values calculated using the direct Fick equation developed by Stringer et al (1997). **METHOD:**  $\text{VO}_2$  max was determined on both a treadmill (Mean =  $3.96 \pm 1.2$  liters/min) and cycle ergometer (Mean =  $3.42 \pm 1.2$  liters/min) in 15 subjects (Age:  $34.3 \pm 9.4$  yrs). Steady-state exercise wattage was set at 25%, 50%, and 75% of peak watts achieved. Subjects exercised 8 mins at each stage. The last 4 mins were used to determine the ACI values for cardiac output (Q), heart rate, stroke volume, EDV, SBP, DBP, and systemic vascular resistance. Both the submaximal and maximal exercise trials were performed in duplicate to assure accurate data collection. No significant differences were observed in test-retest trials. Thus, the mean of duplicate trials was used for all data analyses.

**RESULTS:** There was no significant difference between the cardiac output determined by the Stringer equation and the ACI measured Q value. The percent differences across exercise intensity's for Q were 4.2%, -1.5%, and -6.7% for the 25%, 50%, and 75% of max watts, respectively. Linear regression analyses indicated r-squared = 0.99, SEE = 0.20 liters,  $p = .001$ . For all trials combined, the mean percent difference between the stringer cardiac output and the ACI cardiac output was 0.5%.

STAGE INTENSITY	VO2	% OF VO2 MAX	A-V DO2	STRINGER Q	ACI Q	% DIFFERENCE
25% MAX WATTS	1.37	40.1	0.097258	14.1	13.5	4.2%

50% MAX WATTS	2.17	63.5	0.120650	18.0	18.3	-1.5%
75% MAX WATTS	3.02	88.3	0.145504	20.8	22.2	-6.7%
MEAN OF ALL TRIALS	2.19	63.9	0.121138	18.1	17.97	0.5%

**CONCLUSION:** In conclusion, these data indicate that the ACI system used in this study was highly accurate in determining a person's Q during steady state exercise ranging between 40.1% and 88.3% of VO<sub>2</sub> max. Future studies need to determine if similar accuracy can be achieved using other forms of exercise, i.e., treadmill.

#### 1885 Board #26 May 28 8:00 AM - 9:30 AM

##### Acute Exercise Reverses Dysfunction Of Endothelial Progenitor Cells In Chronic Heart Failure.

Emeline M. Van Craenenbroeck, Paul Beckers, Vicky Y. Hoymans, Nadine Possemiers, Kurt Wuyts, Johan Roeykens, Christiaan J. Vrints, Viviane M. Conraads. *Antwerp University Hospital, Edegem, Belgium.*

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(No relationships reported)

**PURPOSE:** Exercise training partially restores endothelial function and exercise capacity in chronic heart failure (CHF) patients. Training-induced mobilization of endothelial progenitor cells (EPC) and their associated regenerative capacity might explain these observed benefits. We studied the number and function of EPC at baseline and after a cardio-pulmonary exercise test (CPET).

**METHODS:** Endothelial function was assessed by flow mediated dilation (FMD) of the brachial artery in 41 sedentary CHF patients (pts). Twenty two pts were classified as mild CHF (62 ± 3 yrs, NT-proBNP < 800 pg/ml, LVEF 32 ± 1%, FMD 5.3 ± 0.5%, mean ± SEM) and 19 as severe CHF (63 ± 3 yrs, NT-proBNP > 800 pg/ml, LVEF 23 ± 2%, FMD 6.4 ± 0.6%). Circulating CD34<sup>+</sup> and CD34<sup>+</sup>/KDR<sup>+</sup> cells (EPC) were determined by flow cytometry before and 10 minutes after CPET. Migration of UEA+/acLDL+ EPC towards VEGF and SDF-1α was assessed at day 7 of culture. Thirteen age-matched healthy subjects (56 ± 2 yrs, FMD 7.1 ± 0.4%) served as controls.

**RESULTS:** Numbers of CD34<sup>+</sup> cells were decreased in both mild (0.329 ± 0.07 of lymphocytes) and severe CHF pts (0.336 ± 0.05%) compared to healthy controls (0.599 ± 0.09%) and correlated positively with VO<sub>2</sub> peak and maximal workload (all p<0.05). Numbers of CD34<sup>+</sup>/KDR<sup>+</sup> cells were not significantly different between groups. Migratory capacity of EPC was significantly decreased in mild CHF pts (35.5 ± 3.1%) and severe CHF pts (33.1 ± 3.8%) compared to healthy subjects (63.7 ± 5.7%, p<0.05) and correlated with VO<sub>2</sub> peak (r=0.682, p=0.021). Following exercise, migratory capacity improved acutely in mild CHF pts (35.5 ± 3.1% vs. 46.2 ± 3.5%, p=0.005) and severe CHF pts (33.1 ± 3.8% vs. 50.1 ± 3.8%, p=0.003), whereas a significant improvement was absent in healthy subjects (63.7 ± 5.6% vs. 52.4 ± 4.9%, p>0.05). A single exercise bout had no effect on circulating EPC numbers.

**CONCLUSION:** CHF patients exhibit reduced EPC numbers and function which is correlated to disease severity and exercise capacity. Acute exercise improves migratory activity of EPC, whereas their number remains unaltered. The increase is larger in advanced disease stages. The latter suggests that the exercise-induced stimulus for endothelial restoration is larger in clinically more affected patients.

Supported by a grant from the Fund for Scientific Research, Vlaanderen

#### 1886 Board #27 May 28 8:00 AM - 9:30 AM

##### Sex Differences In Carotid Baroreflex Control Of Heart Rate At Rest And During Dynamic Exercise In Humans

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(No relationships reported)

Previous studies in animals have demonstrated that the arterial baroreflex control of heart rate (HR) was greater in female compared to male rodents. In contrast, equivocal results have been reported in humans with several studies reporting that young women, in fact, exhibit a reduced cardiac baroreflex sensitivity compared to young men. In addition, to date, no studies have examined differences in the baroreflex control of HR during exercise in young men and women.

**PURPOSE:** To determine if the carotid baroreflex control of HR differs between young men and women at rest or during dynamic exercise.

**METHODS:** Beat-to-beat HR and blood pressure were measured in nine young women (22±1 yr) and men (22±1 yr) at rest and during steady-state leg cycling at 50% HR reserve. All women were studied during the early follicular phase of the menstrual cycle (days 2-5). Five second pulses of neck suction (NS, -60 Torr) and neck pressure (NP, +40 Torr) were applied to selectively load and unload the carotid baroreceptors, respectively. In addition, HR variability analyses were employed to investigate time and frequency domain indices of parasympathetic and sympathetic control of HR.

**RESULTS:** At rest and during exercise, HR responses to NS were significantly greater in women than men (rest, D -16±3 women vs. D -8±1 men bpm, P=0.002; exercise, D -17±3 women vs. D -6±1 men bpm, P=0.004), whereas responses to NP were similar between groups (rest, D +7±1 women vs. D +5±1 men bpm, P=0.222; exercise, D +4±1 women vs. D +2±1 men bpm, P=0.096). In addition, there were no differences in HR variability measurements between women and men both at rest and during exercise.

**CONCLUSION:** Carotid baroreflex mediated HR responses to a hypertensive challenge are greater in young women both at rest and during exercise. In contrast, the ability of the carotid-cardiac baroreflex to respond to a hypotensive challenge is similar between young women and men. Overall, these preliminary data suggest that sex differences in cardiac baroreflex responses are selective to hypertensive challenges both at rest and during exercise.

#### 1887 Board #28 May 28 8:00 AM - 9:30 AM

##### Carotid Baroreflex Control Of Arterial Blood Pressure At Rest And During Dynamic Exercise In Young And Older Men

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The arterial baroreflex is of fundamental importance for evoking and maintaining the normal cardiovascular adjustments to exercise. Previous studies have reported that exercise-induced blood pressure responses are exaggerated in older individuals; however, whether alterations in arterial baroreflex function contribute to the greater pressor response during exercise in older subjects remains unclear.

**PURPOSE:** To begin to investigate how healthy aging influences the carotid baroreflex regulation of blood pressure during dynamic exercise.

**METHODS:** Mean arterial pressure (MAP) and heart rate (HR) were continuously recorded at rest and during leg cycling performed at 50% HR reserve in 8 young (23±1 yr) and 6 older middle-aged (61±1 yr) healthy men. Five second pulses of neck pressure (NP, +40 Torr) and neck suction (NS, -60 Torr) were applied to selectively unload and load

the carotid baroreceptors, respectively.

**RESULTS:** At rest, MAP responses to NP tended to be lower in older subjects ( $D+5\pm 1$  older vs.  $D+8\pm 1$  young mmHg;  $P=0.056$ ), whereas responses to NS were significantly greater compared to younger subjects ( $D-15\pm 2$  older vs.  $D-8\pm 2$  young mmHg). Group responses to NP were unchanged by exercise (rest vs. exercise;  $P=0.919$ ) such that the tendency for a reduced response in the older men persisted during leg cycling. In contrast, the MAP responses to NS were attenuated in the older group during exercise but not in the younger group. Thus, the age-group differences to a hypertensive challenge were eliminated during exercise.

**CONCLUSIONS:** These preliminary data suggest that healthy aging alters the carotid baroreflex control of blood pressure both at rest and during dynamic exercise. Further studies are needed to determine how these alterations in arterial baroreflex regulation may influence the pressor response to exercise.

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**1888 Board #29 May 28 8:00 AM - 9:30 AM**  
**Effect Of 30-second All-out Exercise On Selected Haemorheological And Platelet Markers In Healthy Subjects**

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(No relationships reported)

Strenuous physical exercise promotes a prothrombotic state and may cause acute myocardial infarction. In a previous study we demonstrated that high-intensity all out exercise like the 30-second Wingate Anaerobic test (WAnT) can lead to activation of blood coagulation and fibrinolysis in healthy subjects. An effect on selected haemorheological markers like fibrinogen (Fib) and platelet count as well as the plasma level of the platelet activation marker soluble p-selectin (sP-sel) is less well investigated.

**PURPOSE:** To analyze the acute effect of a WAnT on indicators of metabolic stress, haemoconcentration and haemorheological and platelet markers.

**METHODS:** Thirteen healthy male leisure time athletes (mean  $\pm$  SD; age  $28.8 \pm 7.2$  yrs, height  $1.84 \pm 0.06$  m, body mass  $82.7 \pm 9.0$  kg) performed a 30-second WAnT. Before and immediately after the WAnT as well as 9 and 30 min into a passive recovery period venous blood was taken for the analysis of plasma lactate concentration (PLA) and pH, total protein (TP) and hematocrit (HCT), FIB, platelet count and sP-sel.

**RESULTS:** Pre-test values of all measures were well within the reference range for healthy subjects. Maxima of PLA ( $17.7 \pm 2.0$  mmol  $l^{-1}$ ), TP ( $6.84 \pm 0.27$  g  $dl^{-1}$ ) and HCT ( $49.0 \pm 2.0$  %) and the minimum of pH ( $7.17 \pm 0.04$ ) were found at 1 or 9 min post WAnT (all  $p < 0.0083$ ). Also Fib ( $278.8 \pm 45.8$  mg  $dl^{-1}$ ) and sP-sel ( $89.9 \pm 26.0$  ng  $ml^{-1}$ ) showed maxima at 1 or 9 min (all  $p < 0.0083$ ), whilst an increase in platelets ( $310 \pm 10 \cdot 10^9 l^{-1}$ ) was not found before 9 min ( $p < 0.0083$ ). Only sP-sel returned to pre-test levels at 30 min. Interrelationships between Fib and TP ( $r = 0.45$ ,  $p < 0.001$ ) and sP-sel and pH ( $r = -0.35$ ,  $p < 0.05$ ), respectively were found.

**CONCLUSION:** The results seem to indicate that the WAnT induced metabolic acidosis contributes to the increase in sP-sel whilst the metabolic osmotic effect attributes to the response of Fib.

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**1889 Board #30 May 28 8:00 AM - 9:30 AM**  
**Circulating Endothelial Progenitor Cells Exhibit Exercise Induced Variation**

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A. Van Berendoncks Presenting

(No relationships reported)

**PURPOSE:** Physical training has important peripheral vascular effects. Endothelial progenitor cells (EPC) play an regenerative role at the level of the endothelium. We determined a time-curve of circulating EPC before/after a maximal exercise test (ET) in healthy subjects (HS) and in patients (pts) with chronic heart failure (CHF). The influence of exercise on the diurnal variation of EPC, characterized by an evening peak, was assessed.

**METHODS:** Eight subjects (4 HS,  $20 \pm 0.9$  yrs, Watt max  $265 \pm 10$ ; 4 CHF pts,  $70 \pm 5$  yrs, left ventricular ejection fraction  $20 \pm 5$  %, Watt max  $53 \pm 10$ ) underwent ET. Venous blood was taken before, within 10 min, after cessation of ET, after 30', 60', 2 - 4 - 8 - 12 - 24hrs, 2 - 4 days. Circulating CD34<sup>+</sup>/KDR<sup>+</sup> EPC were quantified in whole blood by flow cytometry.

**RESULTS:** Results are shown in the figures (mean  $\pm$  SEM). ET acutely increased total leucocyte count in both groups (HS:  $p = 0.1$ ; CHF:  $p = 0.01$ ). A second, delayed leucocytosis, was documented in HS, but not in CHF pts. EPC increased acutely following ET in HS, stayed elevated for 1hr, whereas in CHF pts this increase was absent after 1hr. EPC remained elevated the next morning in both groups, although still lower in CHF pts. Normal diurnal variation was suppressed post-ET in both groups.

**CONCLUSION:** Acute exercise induces an increase in leucocyte and EPC numbers, which is smaller and less prolonged in CHF suggesting a general exhaustion of progenitor cells in the bone marrow. Moreover, the present results have consequences for the standardization of blood sampling in future EPC studies. In order to avoid intra-individual variability, recent physical exercise at the time of blood sampling should be taken into account.

Supported by the Fund for Scientific Research (FWO) Vlaanderen

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**1890 Board #31 May 28 8:00 AM - 9:30 AM**  
**Dramatic Post-exercise Hypotension And Postural Hypotension After Ultramarathon Running**

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(No relationships reported)

Post-exercise hypotension (PEH) has been well-documented and considered as a health promotion benefit of aerobic exercises; however, dramatic PEH and postural hypotension which caused falling and head injury have been reported after ultramarathon (UM) race.

**PURPOSE:** To investigate the relationships among exercise duration, PEH and postural hypotension in UM runners.

**METHODS:** Thirty two experienced UM runners were recruited, 19 subjects participating in 12 hours UM (12UM) and 13 subjects participating in 24 hours UM (24UM). The distance covered during 12 hours and 24 hours were also reported as the physical workload. The resting sitting and standing blood pressures measured before and immediate after the UM were recorded and the PEH was calculated afterward. The postural hypotension index (PHI), blood pressure difference between sitting and standing were also measured before and after the race.

**RESULTS:** The systolic blood pressure (SBP) and diastolic blood pressure (DBP) significantly decreased after both 12UM (DSBP:  $-30.63 \pm 16.37$  mmHg; DDBP:  $-17.79 \pm 11.74$  mmHg,  $p < 0.05$ ) and 24UM (DSBP:  $-25.85 \pm 8.51$  mmHg; DDBP:  $-11.85 \pm 10.46$  mmHg,  $p < 0.05$ ). The prevalence of SBP  $< 100$  mmHg which representing the person would be about to faint are 50% in both groups after the competition. Asymptomatic postural hypotension defined as a fall in SBP of greater than 20 mmHg from the sitting to the erect position without syncopal symptoms was present in 5 runners (15.6%) before the race and in 9 runners (28.1%) afterward. The degree of postural variation in SBP was unrelated to the changes in body weight or running distance.

**CONCLUSION:** Dramatic PEH and postural hypotension with individual differences after UM was noted, and the prevalence of PEH and postural hypotension after the 24UM



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## C-27 Free Communication/Poster - **Body Composition - Bio Impedance**

MAY 28, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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**1891 Board #32 May 28 9:00 AM - 10:30 AM**  
**Validation Of A Bioelectrical Impedance Analysis Equation Predicting Body Composition Using Conductor Length Instead Of Height.**

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(No relationships reported)

Bioelectrical impedance analysis (BIA) is widely used in predicting body composition. Impedance of an electrical current that passes through the body is related to the composition of the body but also to the length of the conductor, conventionally estimated using height.

**PURPOSE:** To compare a BIA equation predicting fat-free mass (FFM) that utilized actual conductor length (Parsons) with a conventional BIA equation (NHANES), using hydrodensitometry as the reference method.

**METHODS:** Thirty-nine male and 53 female subjects were studied. BIA was performed using a four-terminal impedance plethysmograph. The Parsons equation, validated using an independent sample of 91 subjects, is  $FFM = 0.607 (CL2/R) + 0.265(BW) + 0.184(Xc) + 1.82(G) - 14.7$ , where: CL2 = Conductor Length Squared (cm), R = Resistance (ohms), BW = Body Weight (kg), Xc = Reactance (ohms), and G = Gender (Males = 1, Females = 0).

**RESULTS:** For both sexes, FFM predicted by both Parsons and NHANES equations were equally and highly correlated with FFM measured using hydrodensitometry ( $r = 0.88$  to  $0.91$ ). For males, both equations had equal precision in predicting FFM ( $R^2$  (Parsons) =  $0.711$ ,  $R^2$  (NHANES) =  $0.718$ ). However, for females, FFM predicted with the Parsons equation had a much higher precision than FFM predicted with the NHANES equation ( $R^2$  (Parsons) =  $0.771$  and  $R^2$  (NHANES) =  $0.578$ , respectively).

**CONCLUSION:** These results suggest that using conductor length in BIA equations may result in more precise predictions of FFM for females.

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**1892 Board #33 May 28 9:00 AM - 10:30 AM**  
**Validity Of Single-frequency Bioelectrical Impedance Method To Assess Changes In Body Composition During Exercise Training**

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(No relationships reported)

**PURPOSE:** To investigate the validity of single-frequency bioelectrical impedance method (BI; Muscle-alpha, Phision) to assess body composition changes during a 12-week aerobic exercise program in comparison with dual-energy X-ray absorptiometry (DXA; QDR 4500, Hologic).

**METHODS:** Eighteen obese men (age:  $49.1 \pm 11.3$  years, body mass index:  $28.7 \pm 1.8$  kg/m<sup>2</sup>) participated in this study. They enrolled in a 90-min supervised exercise program mainly consisting of aerobic exercise (60-80% of heart rate reserve) on a regular basis of 3 d/wk for 12 weeks. Percentage of fat mass (%fat), fat mass (FM) and fat-free mass (FFM) were measured before and after the program using BI and DXA.

**RESULTS:** With  $-2.7 \pm 2.4$  kg of weight reduction during the program, %fat and FM significantly decreased ( $P < 0.05$ ), but FFM remained unchanged when assessed by BI and DXA. Significant differences ( $P < 0.05$ ) were observed between BI and DXA at baseline for %fat (28.2% vs. 25.4%), FM (23.5 kg vs. 21.3 kg) and FFM (59.7 kg vs. 62.6 kg). Further, significant differences ( $P < 0.05$ ) were observed after the program for %fat (25.2% vs. 23.3%), FM (20.4 kg vs. 19.0 kg) and FFM (60.2 kg vs. 62.3 kg) and change in FM ( $-3.1$  kg vs.  $-2.3$  kg). At each time point, %fat, FM and FFM measured by BI were significantly lower ( $P < 0.05$ ) than those by DXA. The correlation coefficients between BI and DXA were similar at baseline and after the program, while rather low for the change in %fat ( $r = 0.63, 0.69$ , and  $0.33$ , respectively), FM ( $r = 0.81, 0.86$ , and  $0.59$ , respectively) and FFM ( $r = 0.98, 0.98$ , and  $0.15$ , respectively). A Bland-Altman analysis revealed no significant bias (change%fat:  $r = -0.21$ , standard error of estimate: SEE =  $1.36$ ,  $P = 0.40$ ; changeFM:  $r = -0.09$ , SEE =  $1.54$ ,  $P = 0.72$ ; changeFFM:  $r = -0.35$ , SEE =  $0.96$ ,  $P = 0.16$ ).

**CONCLUSIONS:** BI and DXA are able to track changes in %fat and FM similarly during an aerobic exercise program in obese men. Additionally, there are no significant differences in %fat and FM between the two methods, suggesting that BI can be used in a clinical setting.

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**1893 Board #34 May 28 9:00 AM - 10:30 AM**  
**The Effect Of Submaximal Exercise And Hydration Status On Bioelectrical Impedance Analysis**

Kimberly A. Smith, Anne E. Hays, Jeff Lynn, Marty Prokop, Ciara Pomerico, Jeremy Miller, Whitney Nardoza, April Pinkney. *Slippery Rock University, Slippery Rock, PA.* (Sponsor: Patricia A. Pierce, FACSM)

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(No relationships reported)

**PURPOSE:** The purpose of this investigation was to determine the effect of moderate exercise with or without mild dehydration on BIA%FAT.

**METHODS:** Thirty-nine male ( $n=13$ ) and female ( $n=26$ ) subjects (age= $19.3 \pm 0.9$ yr, body fat= $19.1 \pm 8.5\%$ ) underwent testing on two days. On day one, the Dehydration Session (DS), subjects' weight and BIA%FAT were recorded. Subjects then ran 30 min on a treadmill at an intensity of 60-85% HR<sub>max</sub>. After the exercise session, weight and BIA%FAT were re-measured and the amount of weight lost in sweat was recorded in kilograms. A subset of the population ( $n=9$ ) remained in the lab at rest for one hour without eating, drinking, or urinating. Weight and BIA%FAT were recorded every 15 min to determine the lasting effect of exercise on BIA%FAT. On day two, the Euhydration Session (ES), subjects repeated the DS procedure with the exception that subjects drank water equal to the amount of sweat lost during the DS.

**RESULTS:** During the DS, subjects lost a significant amount of water weight ( $-1.25$ kg;  $p<0.01$ ) and BIA%FAT ( $-1.27\%$ ;  $p<0.01$ ). During the ES, subjects maintained body weight through hydration ( $-0.02$ kg;  $p>0.05$ ), but BIA%FAT significantly decreased ( $-0.86\%$ ;  $p<0.01$ ). From 15-60 min post exercise, BIA%FAT significantly increased for both the DS and ES as subjects remained at rest in the lab. After 60 min of seated rest, the DS BIA%FAT remained significantly lower than pre-exercise BIA%FAT ( $p<0.05$ ). Contrary to the DS, BIA%FAT returned to pre-exercise levels in the ES.

**CONCLUSIONS:** BIA%FAT decreased after a 30 min bout of submaximal treadmill exercise regardless of water consumption. This decrease in BIA%FAT is not solely hydration or weight dependent. There was a tendency for BIA%FAT to increase in the hour post exercise in both DS and ES trials even though no water was consumed during this time. The maintenance of hydration during the ES allowed BIA%FAT to return to baseline after 60 min of seated rest, contrary to the DS.



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**1894 Board #35 May 28 9:00 AM - 10:30 AM**  
**Accuracy Of Bioelectrical Impedance Analysis Instruments For The Measurement Of Body Composition In Collegiate Baseball Players**

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(No relationships reported)

**PURPOSE:** Fitness assessments of athletes usually include a measure of body composition. The purpose of this study was to examine whether five different Bioelectrical Impedance Analysis (BIA) instruments varied in their estimates of body composition. The five instruments were the Tanita BF-350, Tanita BF-522, Omron HBF-500, Omron HBF-306, and Omron HBF-300.

**METHODS:** Criterion body composition was measured using DEXA (Lunar Prodigy Advance). In addition, body composition was estimated using skinfolds (SKF). Subjects of the study were 35 college baseball players. Mean (+ SD) subject characteristics were age 20.17 (+1.36) yrs, height 1.82 (+0.06) m, weight 88.45 (+9.50) kg, and body mass index (BMI) 26.69 (+2.20) Kg/m<sup>2</sup>.

**RESULTS:** The percent body fat results were as follows: the Tanita BF-350 = 14.67 + 3.77, the Tanita BF-522 = 14.92 + 3.85, the Omron HBF-500 = 22.47 + 4.51, the Omron HBF-306 = 14.84 + 3.23, the Omron HBF-300 = 15.70 + 4.27, SKF = 18.74 + 6.45, and the DEXA = 20.31 + 7.28. Data were analyzed using repeated measures analysis of variance (ANOVA) and post-hoc paired sample t-tests. A significant F (F = 567.485, p < .001) was found for the 7 different measures of body composition. Post-hoc tests showed statistically significant differences between the DEXA and all the other estimates of body composition.

**CONCLUSIONS:** Although the SKF underestimated body composition and the Omron HBF-500 overestimated body composition the results of this study suggest that for college baseball players the Omron HBF-500 and SKF may provide a valid assessment of body composition in non-laboratory settings. However, the other four BIA instruments all significantly underestimated percent body fat.

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**1895 Board #36 May 28 9:00 AM - 10:30 AM**  
**The Ability Of Bioelectrical Impedance To Track Body Composition Changes During A Physical Activity Intervention**

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(No relationships reported)

Body composition is an important component of an individual's health and fitness profile.

**PURPOSE:** The purpose of this study was to assess the ability of bioelectrical impedance (BIA) to accurately track body composition changes during a physical activity intervention in previously sedentary, overweight men and women.

**METHODS:** Fourteen men (46+7 y) (mean+SD) and 22 women (age, 47+5 y) with a body mass index >25 kg m<sup>-2</sup> participated in a 36-week walking intervention (with a goal of 10,000 steps per day). Body composition was measured by air displacement plethysmography (ADP) and BIA at baseline, after 20 weeks and after 36 weeks.

**RESULTS:** Over the 36-week intervention, the women lost 1.6+4.8 kg of body mass while the men lost 3.9+4.2 kg. Compared to ADP, the decline in percent body fat was significantly underestimated by BIA in women, but not in men.

Percent body fat and fat mass measured at baseline, 20 weeks, and 36 weeks			
Men	Baseline	20 Weeks	36 Weeks
ADP (% body fat)	34.5+6.5	32.6+6.7*	31.7+7.2*
BIA (% body fat)	33.1+6.3	31.6+6.3*	30.8+6.9*
ADP (fat mass, kg)	37.7+13.6	34.8+13.6*	33.8+13.9*
BIA (fat mass, kg)	36.3+13.6	33.7+12.8*	32.9+14.1*
Women			
ADP (% body fat)	48.1+5.3	46.2+5.7*	46.6+5.3
BIA (% body fat)	45.1+4.0	45.6+3.8	45.4+3.7
ADP (fat mass, kg)	46.1+12.2	43.6+11.1*	44.0+11.1
BIA (fat mass, kg)	43.3+11.4	43.1+10.7	42.8+10.3

\* Indicates a significant difference from baseline (P<0.05)

At each time point, BIA estimated % body fat to be significantly lower in both men and women when compared to ADP (P<0.05).

**CONCLUSION:** BIA appears to be a suitable method for detecting body composition changes in men. However, BIA did not accurately detect body composition changes in women and therefore, an alternative body composition assessment method should be considered for this population.

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**1896 Board #37 May 28 9:00 AM - 10:30 AM**  
**The Effect Of Acute Fluid Consumption On Segmental Bioelectrical Impedance Analysis**

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(No relationships reported)

**PURPOSE:** To examine the effect of acute fluid consumption on impedance (IMP) and percent body fat (%BF) determined by segmental bioelectrical impedance analysis (SBIA).

**METHODS:** Seventy-six healthy, recreationally active adults (41 women; 35 men) volunteered to participate in this study (age = 21.0 ± 1.6 y; body mass index = 25.0 ± 3.2 kg/m<sup>2</sup>). Subjects had their body composition assessed by SBIA (Tanita model: BC-418) on three separate occasions. After an initial baseline body composition measurement, subjects consumed water (H<sub>2</sub>O: 20 oz.), a carbohydrate/electrolyte drink (CHOE: 20 oz., 35 grams of carbohydrate; 270 mg sodium; 75 mg potassium), or received nothing, which served as the control (CON). Subjects were reassessed 20, 40 and 60 min following (POST) the baseline measure in each treatment condition.

**RESULTS:** Following fluid consumption (H<sub>2</sub>O and CHOE), IMP, %BF and body mass were significantly different at 20 min (mean difference: H<sub>2</sub>O = 12.9W, 1.0%, 0.5 kg; CHOE = 13.6W, 1.2%, 0.6 kg), 40 min (H<sub>2</sub>O = 15.2W, 1.1%, 0.5 kg; CHOE = 12.2W, 1.1%, 0.5 kg) and 60 min (H<sub>2</sub>O = 14.0W, 1.0%, 0.3 kg; CHOE = 13.0W, 1.0%, 0.3 kg)

POST when compared to baseline values ( $P<0.001$ ). Fluid type had no effect on the magnitude of change POST. During the CON trial, IMP and %BF were significantly greater at 40 min (mean difference = 7.4W; 0.3%) and 60 min (10.9W; 0.5%) POST when compared to baseline ( $P<0.003$ ).

**CONCLUSION:** Fluid consumption significantly increased SBIA-determined IMP and body mass resulting in the overestimation of %BF (~1.0%). As such, when precision is critical, fluid restriction prior to SBIA assessment is recommended in order to avoid temporary alterations in hydration state that may influence body composition measures.

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**1897 Board #38 May 28 9:00 AM - 10:30 AM**

**Acute Fluid Ingestion Impacts Leg-to-leg Bioelectrical Impedance Analysis In Children**

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(No relationships reported)

**PURPOSE:** To examine the effect of acute fluid consumption on body composition measures determined by leg-to-leg bioelectrical impedance analysis (LBIA) in children.

**METHODS:** Forty-five children (20 girls; 25 boys) between 7 and 16 years of age had their percent body fat (%BF) assessed by LBIA (Tanita model: TBA-300A) on two separate occasions: a control (CON) and fluid trial. During the fluid trial, subjects were randomly assigned into either a water (H<sub>2</sub>O; 11 girls; 13 boys) or Gatorade® (CHOE; 9 girls; 12 boys) group. After a baseline body composition measurement, subjects consumed either 12 oz. (355 ml) of H<sub>2</sub>O, CHOE, or received nothing, which served as the CON. Subjects were reassessed 20, 40 and 60 min following post fluid consumption in each treatment group and in the CON group.

**RESULTS:** Following fluid consumption (H<sub>2</sub>O and CHOE), impedance (IMP) was significantly greater ( $P<0.05$ ) at 20 min (H<sub>2</sub>O =  $544.1 \pm 70.2W$ ; CHOE =  $565.8 \pm 70.7W$ ) when compared to baseline values (H<sub>2</sub>O =  $538.5 \pm 67.2W$ ; CHOE =  $558.2 \pm 66.9W$ ). Body mass was significantly greater ( $P<0.05$ ) at 20 min ( $45.6 \pm 15.4kg$ ), 40 min ( $45.6 \pm 15.4kg$ ) and 60 min ( $45.4 \pm 15.4kg$ ) POST CHOE consumption, when compared to baseline values ( $45.2 \pm 15.3kg$ ). Following the consumption of H<sub>2</sub>O, %BF was significantly greater ( $P<0.05$ ) at 20 min, 40 min and 60 min POST (mean difference: 0.8%; 0.7%; 0.6%, respectively) when compared to baseline values. When subjects consumed CHOE, %BF was significantly greater ( $P<0.05$ ) at 20 min (mean difference: = 0.9%) and 60 min (mean difference = 0.4%) POST when compared to baseline values. During the CON trial there were no significant changes in %BF over time, whereas IMP was significantly greater ( $P<0.05$ ) at 40 min ( $555.5 \pm 68.6W$ ) and 60 min ( $556.4 \pm 67.4W$ ) POST when compared to baseline values ( $551.1 \pm 67.0W$ ). Body mass at 60 min (mean difference = 0.2kg) was significantly greater ( $P<0.05$ ) when compared to the baseline CON value.

**CONCLUSIONS:** The ingestion of 12 oz. of fluid significantly increased LBIA-determined %BF values in children. Therefore, when precision is critical, we recommend adhering to the fluid restriction guideline prior to the LBIA measurement to avoid fluid-induced alterations in the child's %BF estimate.

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**1898 Board #39 May 28 9:00 AM - 10:30 AM**

**Validation Of Bioelectrical Impedance Analyzers As A Measure Of Percent Body Fat.**

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(No relationships reported)

**PURPOSE:** To determine the reliability and validity of the Tanita® and Omron® bioelectrical impedance analyzers (BIA) to estimate percent body fat. Each analyzer operated under two settings, standard and athletic, which were meant to be used for sedentary or active individuals respectively.

**METHODS:** Thirty-nine male (n=13) and female (n=26) subjects (age=19.3±0.9yr, body fat=19.1±8.5%) underwent testing on two separate occasions. Underwater weighing (UWW) was used as the criterion measure to determine percent body fat. Subjects' height and weight were measured and four BIA measurements were conducted (Tanita standard, Tanita athletic, Omron standard, and Omron athletic). Subjects then sat for 30 minutes and weight and BIA were re-analyzed to determine test-retest reliability.

**RESULTS:** Each of the four BIA measurements produced similar results before and after 30min of sitting ( $r = .997-.998$ ;  $p<0.01$ ) establishing excellent test-retest reliability. There was a significant difference between percent body fat derived by UWW and percent body fat estimated by the Tanita athletic mode ( $p<0.05$ ). There were no significant differences between the remaining BIA-estimated percent body fat measurements and UWW ( $p>0.05$ ).

**CONCLUSION:** Tanita and Omron bioelectrical impedance analyzers were reliable, and with a given standard error, can be used to estimate percent body fat when used prior to exercise and when all pre-test assumptions are met. However, the Tanita athletic mode significantly underestimated percent body fat in this sample of SRU students.

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**1899 Board #40 May 28 9:00 AM - 10:30 AM**

**Tracking Changes In Body Fat Using Commercially Available Bia Devices Compared To A Four-Compartment Model**

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(No relationships reported)

Over the past few years the number of bioelectrical impedance analysis (BIA) devices has grown significantly. Several of these devices are designed for consumer purchase with price tags of less than \$100. Many of these BIA devices are designed for predicting percent body fat (%fat); however, the validity of these devices has not been established.

**PURPOSE:** Validate %fat values estimated using commercially available scales compared to a four-compartment (4C) model.

**METHODS:** Three foot-to-foot scales, one hand-to-hand device, and one foot-to-hand scale were evaluated before and after a ten-week exercise intervention in overfat and obese individuals compared to a 4C model. The 4C model included body volume, bone mineral content, and total body water measured by underwater weighing, dual-energy X-ray absorptiometry, and deuterium oxide, respectively. Sixty overfat and obese men and women ( $27 \pm 8yr$ ,  $33.41 \pm 3.81\%$ fat) participated in the study.

**RESULTS:** Only the foot-to-hand BIA scale produced non-significant pre and post %fat estimations compared to the 4C model [constant error (CE)<1.44%fat]; however, the post- total error (TE) value was unacceptable (4.07%fat). Delta %fat values were more accurate than the pre and post-intervention values compared to the 4C model. Of all devices, one foot-to-foot device produced a significant CE value (-1.23%fat) in the exercise group (n=32) while no device produced a significant CE (CE < 1.19%fat) value in the control group (n=28). However, delta TE values ranged from 1.76 to 3.41%fat indicating a large variation between devices.

**CONCLUSIONS:** Pre, post, and delta values indicated that the most accurate BIA for predicting %fat was the foot-to-hand device. However, the 95% limits of agreement for the exercise group indicated individual overestimations upwards of 4.14%fat and underestimations as large as 3.07%fat. Therefore, commercial scales are not valid for a single estimation of %fat and are more accurate for tracking changes with individual errors  $\pm 3.6\%$ fat.

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**C-28 Free Communication/Poster - Caffeine and Creatine**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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1900    **Board #41    May 28    8:00 AM - 9:30 AM**

**Caffeine Does Not Alter Heart Rate-Derived Estimates Of Oxygen Uptake During Heavy Exercise**

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(No relationships reported)

Heart rate (HR)-derived estimation of oxygen uptake ( $\text{VO}_2$ ) during exercise is more accurate when the differences in reserves above and below gas exchange threshold (GET) are adjusted for. Caffeine's accelerating effect on resting HR may translate to exercising HR and therefore may invalidate HR-derived estimates of  $\text{VO}_2$  during exercise; however, no direct research supports such a claim.

**PURPOSE:** To evaluate the efficacy of HR-derived estimates of  $\text{VO}_2$  during heavy exercise in control (CTRL) and 6 mg·kg<sup>-1</sup> caffeinated (CAF) states.

**METHODS:** Nine men ( $\text{VO}_{2\text{max}}$ :  $57 \pm 5$  ml·kg<sup>-1</sup>·min<sup>-1</sup>, age:  $36 \pm 4$  y) completed a graded exercise test to determine power evoking the GET. Each subject returned on two separate occasions and in counterbalanced order and in double-blind fashion, ingested dextrose or CAF 1-hr prior to engaging a 20-min constant-load, pedaling bout. For each bout, subjects pedaled on their own bicycle mounted to a CompuTrainer at an intensity equivalent to the power evoking the GET. Actual and HR-estimated  $\text{VO}_2$  data were summed for the total 20-min exercise time (total  $\text{VO}_2$ ) then compared using Bland-Altman plots. Two-way ANOVA with repeated measures was used to compare actual-estimate and CTRL/CAF differences.

**RESULTS:** Total  $\text{VO}_2$  accumulated during CAF ( $70 \pm 8$  L) was higher than CTRL ( $67 \pm 8$  L) ( $F_{1,7} = 8.95$ ,  $p = 0.02$ ). There was no difference ( $F_{1,7} = 0.39$ ,  $p = 0.55$ ) in actual versus HR-derived total  $\text{VO}_2$  estimates in either CTRL or CAF states. Actual-estimate differences (Mean) and limits of agreement ( $\pm 2\text{SD}$ ) were low for CTRL ( $0.70 \pm 4.46$ ) and CAF ( $1.12 \pm 4.22$  L) states.

**CONCLUSION:** Moderate-dose CAF intake elevates  $\text{VO}_2$  but does not affect the accuracy of HR-derived estimates of  $\text{VO}_2$  during heavy exercise.

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1901    **Board #42    May 28    8:00 AM - 9:30 AM**

**Effects Of Caffeinated And Uncaffeinated Energy Drinks On Muscular Strength And Endurance**

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(No relationships reported)

Caffeine ingestion has been found to increase muscle activation and as a result strength. However, it is not known if caffeine when combined with carbohydrate, such as that in a commercial energy drink, would have a similar effect.

**PURPOSE:** To compare a caffeinated energy drink's effect on muscle activation and strength with that of placebo and an uncaffeinated energy drink.

**METHODS:** A convenience sample of 15 college students was used in a double-blind, repeated measures experimental design. Each subject performed 3 trials, ingesting either a caffeinated energy drink (Full Throttle, The Coca-Cola Company), an uncaffeinated version of the energy drink, or a placebo drink. The interpolated twitch procedure was used to assess maximum voluntary isometric contraction (MVIC) strength, electrically-evoked strength, and muscle activation during MVIC of the knee extensors both before and after drink ingestion, and after a fatiguing bout of 50 concentric contractions.

**RESULTS:** The mean change in MVIC strength from before to after drink ingestion was greater for the caffeinated ( $+5.0\%$ ;  $\text{SE}=1.7\%$ ) and uncaffeinated ( $+4.7\%$ ;  $\text{SE}=1.1\%$ ) energy drinks compared to placebo ( $-0.5\%$ ;  $\text{SE}=1.5\%$ ) ( $p=0.017$ ); there was no significant difference between the two energy drinks. There was no effect of drink type on the changes in electrically-evoked strength or muscle activation from before to after drink ingestion. In addition, there was no effect of drink type on the changes in any variable from before to after the fatiguing bout of contractions. The similar increase in MVIC strength from before to after drink ingestion seen with the two energy drinks is not easily explained. The caffeinated energy drink significantly increased the plasma glucose level over that for placebo whereas the uncaffeinated drink did not. Furthermore, the serum caffeine level was 14-fold greater with the caffeinated energy drink compared to the uncaffeinated drink.

**CONCLUSION:** Both caffeinated and uncaffeinated energy drinks can increase MVIC strength in the unfatigued state but the mechanism for the ergogenic effect is unclear.

Supported by a grant from The Coca-Cola Corporation

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1902    **Board #43    May 28    8:00 AM - 9:30 AM**

**Acute Effects Of A Caffeine-containing Thermogenic Supplement On Endurance Performance And Muscular Strength In Men**

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(No relationships reported)

**PURPOSE:** To determine the effects of a thermogenic nutritional supplement on muscular strength, endurance performance, and rating of perceived exertion during cycle ergometry in college-aged men.

**METHODS:** Twenty recreationally-trained men (mean  $\pm$  SD age =  $21.5 \pm 1.4$  years; stature =  $178.2 \pm 6.3$  cm; mass =  $76.5 \pm 9.9$  kg;  $\text{VO}_{2\text{PEAK}} = 3.05 \pm 0.59$  L/min<sup>-1</sup>) volunteered to participate in this randomized, double-blinded, placebo-controlled, cross-over study. All testing took place over a three-week period, with each of the 3 laboratory visits separated by 7 days ( $\pm 2$  hours). During visit 1, a graded exercise test was performed on a Lode Corival cycle ergometer (Lode, Groningen, Netherlands) until exhaustion (increase of 25 W every 2 min) to determine the maximum cycle ergometry power output (W) at the  $\text{VO}_{2\text{PEAK}}$  (Parvo Medics TrueOne® 2400 Metabolic Measurement System, Sandy, Utah). In addition, one-repetition maximum (1-RM) strength was assessed using the bench press (BP) and leg press (LP) exercises. During visits 2 and 3, the subjects were asked to consume a capsule containing either the active supplement (200 mg caffeine, 33.34 mg capsaicin, 5 mg bioperine, and 20 mg niacin) or the placebo (175 mg of calcium carbonate, 160 mg of microcrystalline cellulose, 5 mg of stearic acid, and 5 mg of magnesium stearate in an identical capsule) 30 min prior to the testing. Testing included a time-to-exhaustion (TTE) ride on a cycle ergometer at 80% of the previously-determined power output at  $\text{VO}_{2\text{PEAK}}$  followed by 1-RM LP and BP tests. Rating of perceived exertion (RPE) was also assessed throughout the TTE tests.

**RESULTS:** There were no differences ( $p > 0.05$ ) between the active and placebo trials for BP, LP, TTE, or RPE. However, for the BP and LP scores, the baseline values (visit 1) were less than the values recorded during visits 2 and 3 ( $p \leq 0.05$ ).

**CONCLUSIONS:** Our findings indicated that the active supplement containing caffeine, capsaicin, bioperine, and niacin did not alter muscular strength, cycling endurance, or RPE during the TTE test in college-aged men when compared to a placebo trial.

**ACKNOWLEDGEMENTS:** This study was funded by a grant from the General Nutrition Corporation, Pittsburgh, PA.

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1903    **Board #44    May 28    8:00 AM - 9:30 AM**

**Influence Of A CYP1A2 Polymorphism On The Ergogenic Effects Of Caffeine During Sprint Cycling**

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(No relationships reported)

**PURPOSE:** Cytochrome P450 is a liver enzyme which plays a key role in caffeine metabolism. A (C/A) single nucleotide polymorphism at intron 1 of the Cytochrome P450 gene influences caffeine metabolism, with individuals possessing the C variant having slower caffeine metabolism and subsequently higher plasma caffeine levels following caffeine ingestion. Thus, this genetic polymorphism could potentially explain variability in responses to caffeine supplementation. The purpose of this study was to determine if this specific CYP1A2 polymorphism influenced the ergogenic effect of caffeine supplementation during short-duration cycling.

**METHODS:** 24 male cyclists (24.9±7.5 yrs, 179.9±9.6 cm, 76.1±13.4 kg) performed two exercise tests to volitional exhaustion on an electrically braked cycle ergometer, at a workload corresponding to 150% of  $\dot{V}O_{2peak}$ . One hour prior to testing subjects ingested either 6 mg/kgBW of caffeine (CAF) or a placebo (PLA), administered in double-blind fashion. DNA was obtained from whole blood samples and genotyping was performed via polymerase chain reaction using allele-specific primers. Subjects were grouped as those homozygous for the A variant (n=11) and those possessing the C variant (n=13).

**RESULTS:** Caffeine significantly increased time to exhaustion ( $p<0.05$ ) in the overall group. There was a strong, but not significant ( $p=0.06$ ) tendency for subjects homozygous for the A variant to derive greater performance improvements from caffeine (33%; PLA=86.1±25.1 s, CAF=114.5±37.9 s) compared to subjects possessing the C variant (11%; PLA=86.9±31.0 s, CAF=96.6±25.4 s). Blood lactate levels were significantly increased by caffeine intake, both at rest (CAF=1.03±0.33 mmol/L; PLA=0.75±0.28 mmol/L) and post-exercise (CAF=7.59±1.04 mmol/L; PLA=7.13±1.02 mmol/L), independent of genotype. Peak HR was also significantly elevated in the caffeine trials (CAF=178±11 bpm; PLA=175±9 bpm), with no influence of genotype. Isometric MVC of the leg-extensors significantly decreased from pre-exercise (525.2±122.3 N) to post-exercise (490.8±116.2 N), with no influence of caffeine or genotype.

**CONCLUSIONS:** Subjects homozygous for the A variant may have a more pronounced ergogenic effect from caffeine during sprint cycling than individuals who possess the C variant.

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**1904 Board #45 May 28 8:00 AM - 9:30 AM**

**The Effects Of Creatine Supplementation On Thermoregulation And Isokinetic Muscular Performance Following Acute (3-day) Supplementation**

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(No relationships reported)

**PURPOSE:** The purpose of this investigation was to determine the effects of 3-d of creatine supplementation on thermoregulation and muscle force output.

**METHODS:** 14 males participated in two exercise bouts (thermoregulation and muscle force), following 3-d of creatine supplementation (0.3 g/kg total body weight) or placebo. For the thermoregulation session subjects ran for 60 min at 60-65% of  $\dot{V}O_{2max}$  in the heat (32.58 ± 0.91°C; 18.52 ± 4.79%). Immediately following the thermoregulation session muscular force output was measured isokinetically at velocities of 60, 180, and 300°/s. Pre- and post-test thermoregulatory measures included nude body weight (NBW), urine specific gravity (USG), total body water (TBW), extracellular water (ECW), intracellular water (ICW), serum creatine levels (SCR), and urinary creatinine levels (UCR). During the 60 min run core temperature ( $T_{re}$ ) was assessed in 5 min intervals. Peak torque was used to assess isokinetic muscular force output. The velocities and repetitions included 60°/s x 10 reps; 180°/s x 15 reps; and 300°/s x 30 reps. **RESULTS:**  $T_{re}$  increased over the 60 min run for both conditions. For TBW and ECW there were significant ( $p < .05$ ) treatment and time effects. TBW was significantly greater following creatine supplementation versus placebo, and pre-test TBW values were greater than post-test TBW values. ECW was greater following creatine supplementation versus placebo, and pre-test ECW values were significantly less than post-test ECW values. No significant difference ( $p > .05$ ) was found between conditions for ICW, NBW, USG, UCR, and SCR. However, pre-test scores for ICW, USG, UCR, and SCR were significantly less ( $p < .05$ ) at pre-test versus post-test. There were no significant differences ( $p > .05$ ) in peak torque values between conditions for each velocity. A significant ( $p < .05$ ) overall velocity effect was found for both flexion and extension. As velocity increased, mean peak torque values decreased. **CONCLUSIONS:** 3-d of creatine supplementation does not effect thermoregulation during submaximal exercise in the heat. The lack of difference in peak torque values suggests that 3-d of creatine supplementation is not enough to elicit an ergogenic effect for muscle force output following endurance activity.

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**1905 Board #46 May 28 8:00 AM - 9:30 AM**

**The Effect Of Two Different Creatine Formulations On Skeletal Muscle Creatine Retention**

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(No relationships reported)

Many creatine (CR) supplements contain dextrose, since early research suggested that a large insulin spike enhanced CR uptake into muscle. However, it has also been reported that CR uptake is primarily dependent upon sodium vs. insulin, which has led to the formulation of products that contain higher amounts of sodium and no dextrose; therefore, these products may also be Calorie free. Few studies have compared the efficacy of these 'sugar free' CR products to more traditional formulations that include dextrose.

**PURPOSE:** To compare the effects of two different CR formulations on total skeletal muscle CR retention (TCR) following loading and maintenance doses.

**METHODS:** 19 resistance trained men ( $X \text{ age} \pm \text{SEM} = 29 \pm 2 \text{ yr}$ ) randomly received one of two treatment conditions: (1) dextrose-free CR supplement containing 5g CR citrate and 250mg sodium (n=9; SOD) or (2) a CR supplement containing 5g CR monohydrate and 36g dextrose (n=10; DEX). Each treatment was dissolved in 16oz water and ingested 4 times per day for 5d (loading) followed by 5 g/d for 28d (maintenance). Body weight (BW) was measured using a calibrated physician's scale and muscle biopsies were obtained from the vastus lateralis using a fine needle aspiration technique at baseline (BL) and following the loading and maintenance doses for the determination of free CR (fCR) and phosphocreatine (PCR). The data were analyzed using 2x3 ANOVA ( $p<.05$ ).

**RESULTS:** All CR values are expressed as mmol/kg dw. There were no significant time x group interactions for BW, fCR, PCR, or TCR; however, there was a significant time effect for fCR ( $p = .003$ ). Scheffe' post hoc tests showed a significant increase in fCR at 5d (59.63 ± 5.8) and 28d (58.40 ± 5.23) when compared to BL (47.90 ± 5.23).

**CONCLUSION:** These findings suggest that SOD and DEX CR formulations are equally effective for increasing fCR in resistance trained men. The increase in fCR (25%) following 5d of loading is comparable to increases reported in previous studies, and remained elevated throughout the 28d maintenance period. Although 5d CR loading with DEX resulted in an extra 576 kcal/d, there were no significant differences between or within groups for BW. The mean increase in BW at 5d and 28d for all 19 subjects compared to BL was 1.34 kg and 2.11 kg, respectively.

Supported by a CU Research Initiative Grant and 8-Ball Nutrition, Omaha, NE

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**1906 Board #47 May 28 8:00 AM - 9:30 AM**

**Influence Of Creatine Supplementation On The Parameters Of The All-out Critical Power Test**

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(No relationships reported)

**PURPOSE:** We tested the hypotheses that a 5-day creatine loading intervention would result in no alteration in the power asymptote (the critical power, CP), but would significantly increase the curvature constant ( $W\dot{C}$ ; analogous to the total amount of work done above CP) using a novel all-out cycling test protocol to establish the parameters



of the power-duration relationship.

**METHODS:** Following institutional ethical approval, seven healthy males completed 3-min all-out critical power tests against fixed resistance on an electrically braked cycle ergometer after a 5-day dietary supplementation with 20 g per day of creatine monohydrate (CR) or the same dose of a glucose placebo (PL). The CP was estimated from the mean power output sustained over the final 30 s of the test and the W<sub>6</sub> was estimated as the power-time integral above the end-test power output. Differences between conditions were assessed by paired samples t-tests and statistical significance was accepted at  $P < 0.05$  level.

**RESULTS:** Creatine supplementation resulted in a significant increase in body mass (from  $80.4 \pm 9.2$  kg at baseline to  $81.5 \pm 9.5$  kg;  $P < 0.05$ ), whereas the body mass was not different after the placebo supplementation ( $80.3 \pm 9.3$  kg;  $P = 0.74$ ). There were no differences in the power profiles of the 3-min all-out tests following PL and CR supplementation (CP; PL:  $252 \pm 30$  vs. CR:  $255 \pm 28$  W,  $P = 0.14$ ; W<sub>6</sub>; PL:  $19.4 \pm 3.5$  vs. CR:  $19.2 \pm 3.4$  kJ,  $P = 0.77$ ; total work done; PL:  $64.8 \pm 4.9$  vs. CR:  $65.0 \pm 4.9$  kJ,  $P = 0.49$ ).

**CONCLUSIONS:** In contrast to earlier studies which established the parameters of the power-duration relationship using the conventional prediction trial protocol, the present study indicates that creatine loading does not alter either the CP or the W<sub>6</sub> as assessed using the novel 3-min all-out test and has no ergogenic effect on power output during prolonged all-out cycling.

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**1907 Board #48 May 28 8:00 AM - 9:30 AM**

**Three Weeks Creatine Monohydrate Supplementation Affects Testosterone And Dihydrotestosterone Conversion In Young Rugby Players**

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(No relationships reported)

Creatine supplementation influences muscle mass, however the mechanisms behind the ergogenic effects of creatine have not been elucidated. Testosterone can stimulate muscle growth by increasing protein synthesis and potentially re-utilizing amino acids from muscle protein breakdown. Testosterone can be converted into a more bioactive metabolite, Dihydrotestosterone (DHT) by 5- $\alpha$  reductase. DHT has recently been shown to be related to protein synthesis at the transcriptional level. Both T and DHT, as well as the conversion of T to DHT may be beneficial in muscle development and hypertrophy, and creatine supplementation may take effect through these androgens.

**PURPOSE:** To measure serum T and DHT and calculate the conversion rate after 21 days creatine supplementation administered in a double blind placebo controlled cross over study design with a 6 week washout period.

**METHODS:** 20 Caucasian males from a Rugby Institute situated near Stellenbosch University in South Africa took part in the study, (aged 18-19 yrs). Subjects were randomly assigned to two groups. Subjects underwent a 7 day loading period with creatine supplementation or placebo followed by 14 days maintenance dose (Cr or placebo). Creatine monohydrate was given with glucose (25g/day creatine and 25g/day of glucose) for loading dose and 5g/day creatine and 25g/day of glucose for maintenance dose. Placebo group received glucose only (50g/day glucose) for loading dose and 30g/day glucose for maintenance dose. Blood samples were taken at day 0, after 7 days supplementation and after the further 14 day maintenance period. T and DHT were measured using DSL Testosterone and Dihydrotestosterone radio immunoassay. Repeated measures ANOVA was used.

**RESULTS:** There was no difference in body mass prior to the experiment. Creatine supplementation appeared to significantly increase the rate of conversion of T to DHT after 7 days (36% increase;  $p < 0.0001$ ) and 21 days (22% increase;  $p < 0.01$ ) of creatine monohydrate supplementation. There was no change in % body fat in either group.

**CONCLUSIONS:** Creatine supplementation may act, at least in part, through the increased rate of conversion of T to DHT.

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**1908 Board #49 May 28 8:00 AM - 9:30 AM**

**Effect Of Caffeine Ingestion After Creatine Supplementation On High-intensity Cycling Sprint Performance**

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(No relationships reported)

Previous studies showed that ingestion of caffeine together with creatine may inhibit the effects of creatine on anaerobic exercise. Although some studies indicated that ingested caffeine after short-term creatine supplementation could increase maximal accumulated oxygen deficit, there was no evidence to prove whether this supplementary method could facilitate stop-and-go exercise performance.

**PURPOSE:** This study was to investigate the effects of caffeine ingestion after creatine supplementation on intermittent high-intensity cycling sprints performance.

**METHODS:** Twelve physically active men were administered in a double-blind, randomized, counterbalanced design to perform intermittent high-intensity sprints ( $6 \times 10$ -s; repeated at 60-s intervals, HIS) on a cycling ergometer with or without caffeine ingestion. After short-term creatine monohydrate supplementation ( $0.3 \text{ g} \cdot \text{kg}^{-1} \cdot \text{day}^{-1}$ , 5 days), subjects ingested  $6 \text{ mg} \cdot \text{kg}^{-1}$  caffeine or placebo (maltodextrin) 1 hour before HIS trials. Heart rate was monitored continuously throughout the tests, with rating of perceived exertion (RPE) recorded after each sprint. Earlobe blood samples were also drawn immediately after each sprint to evaluate lactate and glucose concentrations.

**RESULTS:** Compared with placebo, caffeine did not result in higher maximal power output ( $842.3 \pm 102.2$  vs.  $813.5 \pm 95.3$  watts,  $p > 0.05$ ). However, the relative peak power output in caffeine treatment was significantly higher than in placebo during the first sprint ( $11.7 \pm 0.7$  vs.  $11.3 \pm 0.7$  watts  $\cdot \text{kg}^{-1}$ ,  $p < 0.05$ ) and second sprint ( $11.5 \pm 0.7$  vs.  $10.8 \pm 0.7$  watts  $\cdot \text{kg}^{-1}$ ,  $p < 0.05$ ). Heart rates were significantly increased with caffeine treatment from the third sprint to the final sprint, and the blood lactate and glucose concentrations were also significantly elevated through the HIS trial. Furthermore, there were no significant effects of caffeine ingestion on the RPE scores.

**CONCLUSIONS:** The present study showed that caffeine ingestion after short-term creatine supplementation could improve intermittent high-intensity sprints performance, but might also induce higher metabolic stress.

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**1909 Board #50 May 28 8:00 AM - 9:30 AM**

**Overload Creatine Supplementation Effect On Volleyball Players Strength**

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(No relationships reported)

**PURPOSE:** To determine the effects of overload oral creatine supplementation during 7 days, on strength gain and delayed muscle fatigue of Volleyball players.

**METHODS:** Twenty four male Volleyball players, with an average age of 21.4 yrs ( $\pm 2.4$ ) took part in this study: 12 constituted the placebo group (PG) and ingested 20 g of manitol per day, and the others ingested 20 g of creatine monohydrate (CG) per day, distributed by four doses of 5 g each (in the morning, after lunch and before and immediately after the training). To measure strength levels, all the athletes performed a Squat Jump (SJ) and a Counter Movement Jump (CMJ) in the Ergo Jump (Globus Ergo Tester) at the beginning and in the end of the training session, both before the supplementation program started (pretest) and after 7 days (posttest). The groups' strength levels comparisons between pretest and posttest and between the beginning and the end of each training session were made using two-way ANOVA with repeated measures.

**RESULTS:** There were no differences in SJ performance between pretest and posttest either in PG ( $0.64 \pm 0.04$  vs.  $0.66 \pm 0.07$  at beginning, and  $0.64 \pm 0.05$  vs.  $0.65 \pm 0.04$  at the end of training session) or in CG ( $0.60 \pm 0.07$  vs.  $0.59 \pm 0.09$  at beginning, and  $0.59 \pm 0.07$  vs.  $0.61 \pm 0.06$  at the end of training session). Similarly, there were no differences in CMJ performance between pretest and posttest either in PG ( $0.65 \pm 0.04$  vs.  $0.67 \pm 0.03$  at beginning, and  $0.66 \pm 0.03$  vs.  $0.66 \pm 0.03$  at the end of the training session) or in CG



(0.61±0.07 vs. 0.60±0.08 at beginning, and 0.60±0.07 vs. 0.61±0.07 at the end of the training session).

**CONCLUSIONS:** The overload creatine supplementation failed to induce an increase in strength gain and delayed muscle fatigue of Volleyball players.

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**1910 Board #51 Abstract Withdrawn**

**1911 Board #52 May 28 8:00 AM - 9:30 AM**  
**Creatine Supplementation: Effects On Leg Power During Repeat Sprint Running In Collegiate Football Players**

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(No relationships reported)

American football is characterized by work:rest ratios of ~5 s of intense work with ~45 s recovery between plays. Although many research studies show that creatine loading is effective during repeat sprint activity on a cycle ergometer, the effectiveness of creatine loading has been less convincing during sprint running using sprint times as a performance measure. In studies that have shown no benefit during repeat sprint running tests, some have postulated that the increased body mass with creatine loading may compromise any metabolic benefit that may enhance sprint running performance.

**PURPOSE:** To determine the effects of creatine loading on repeat sprint running performance by measuring leg power on a loaded non-motorized treadmill during sprint running.

**METHODS:** On 2 occasions 7 d apart, 20 collegiate football players participating in an off season training program performed a repeat sprint test (RST) consisting of 2 sets of 5 maximal 5 s sprint runs on a non-motorized treadmill against a load equal to 15% body mass. Recovery between sprints was 45 s, while between sets of sprints was 10 min. Players were familiarized with the RST 2 times prior to the initial test. After the initial test, players were matched by average power produced during the RST and separated into 2 supplementation groups: creatine (Cr- 5 g x 4/d for 6 d) or placebo (PL- same dose of maltodextrin) in a double blind design. Percent body fat was determined before each test using 7 site skinfold method.

**RESULTS:** A significant increase in body mass following loading was observed in the Cr group (Pre, 90.8 ± 9.9 kg; Post 92.0 ± 9.8 kg, p=0.01), but not in PL (Pre, 93.4 ± 7.8 kg; Post 93.9 ± 7.7 kg, p=0.09). Body fat did not change Pre to Post for either group (Cr, p=0.64; PL, p=0.38). Neither group showed a significant pre vs. post difference in performance for peak power (Cr, p=0.67; PL, p=0.93), average power (Cr, p=0.89; PL, p=0.73), peak velocity (Cr, p=0.73; PL, p=0.52), average velocity (Cr, p=0.14; PL, p=0.45) or fatigue decrement for peak power (Cr, p=0.90; PL, p=0.25), average power (Cr, p=0.81; PL, p=0.26), peak velocity (Cr, p=0.49; PL, p=0.20) or average velocity (Cr, p=0.87; PL, p=0.86).

**CONCLUSIONS:** The results of this study indicate that sprint power and velocity during a RST similar to the work:rest ratios for football are not affected by 6 d of creatine loading.

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**1912 Board #53 May 28 8:00 AM - 9:30 AM**  
**Wingate Performance And Surface Emg Frequency Variables Are Not Affected By Creatine Or Creatine+caffeine Ingestion**

Jacobo O. Morales<sup>1</sup>, Felicia Greer<sup>1</sup>, Darpan I. Patel<sup>2</sup>, Tim R. Anderson<sup>1</sup>, Wade Gilbert<sup>1</sup>, Amanda Stetler<sup>1</sup>, John Monroe<sup>1</sup>. <sup>1</sup>California State University, Fresno, Fresno, CA. <sup>2</sup>Cedra Clinical Research LLC, San Antonio, TX.

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(No relationships reported)

The possible synergistic effects of creatine and caffeine on anaerobic exercise are controversial. It is unknown if these substances, when taken together, impact motor unit recruitment as determined from surface EMG.

**PURPOSE:** Examine if power output and EMG variables during high intensity cycling are affected following creatine and/or creatine+caffeine ingestion.

**METHODS:** 18 active college males (mean ±SD, age: 22.9 ± 2.4 yr; body mass: 87.03 ± 10.6 kg) performed the Wingate Test (WG) after 7 days of ingesting either placebo (cornstarch) or creatine (5 grams, 4x/d). On day 7, subjects ingested either placebo (dextrose) or caffeine (5 mg/kg body weight) 1 hr prior to testing. Treatments were: 1) Placebo (PL) - placebo loading + placebo; 2) Creatine (CR) - creatine loading + placebo; 3) Creatine + Caffeine (CRCaff) - creatine loading + caffeine. For all WG, peak power (PP), minimum power (MP) and the percent decline in power (Pd) were calculated. EMG records of the right vastus lateralis (VL) and gastrocnemius (GA) corresponding to the PP and MP periods were collected. The EMG signals' amplitude (IEMG), and their mean (MNPf) and median frequencies (MDPf) were calculated. A 2-Way Repeated Measures ANOVA (Treatment x Time) determined the effect of the treatments on all dependent measures across time.

**RESULTS:** There was a significant decline from PP to MP in all treatments (p<0.001). There was no treatment effect in the power output variables (PP: PL, 1101 ± 128W; CR, 1112 ± 155W; CRCaff, 1133 ± 133W) (MP: PL, 561 ± 70W; CR, 572 ± 61W; CRCaff, 546 ± 135W) (Pd: PL, 48 ± 6.2%; CR, 48 ± 6.3%; CRCaff, 51 ± 12%). For both muscles, MNPf and MDPf diminished significantly (p<0.001) across time and to a similar degree in all trials. The supplementation treatments had no effect on the corresponding IEMG scores of the VL and GA.

**CONCLUSIONS:** Creatine and/or creatine+caffeine supplementation do not affect power output during a WG test. These supplementation protocols do not impact neuromuscular drive as indicated by the similar IEMG scores between treatments. The frequency content of the EMG signal and thus, the nature of the recruited motor units before and after the expression of fatigue were not affected by the treatments. The lack of change in the muscles' IEMG along with the decline in power suggests a peripheral, as opposed to a neural mechanism of fatigue.

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**C-29 Free Communication/Poster - Cellular/Molecular and Renal**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**1913 Board #54 May 28 9:00 AM - 10:30 AM**  
**Prediction Of Maximal Rates Of Water Excretion With Excessive Water Consumption During Exercise.**

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(No relationships reported)

Excessive fluid consumption may expand plasma volume and lead to hyponatremia. Cases of water intoxication and hyponatremia have been reported during exercise. It has been suggested that the inability of the kidneys to excrete an excessive fluid load during exercise represents an abnormality of renal function. A fundamental principle is that the maximal urine volume is limited or determined by the amount of "free water" that reaches the collecting ducts. Changes in glomerular filtration or the filtered load and increases in renal tubular reabsorption of sodium and water will limit free water delivery to the collecting ducts.

**PURPOSE:** To use existing data to model renal function during moderate/heavy exercise to predict maximal rates of water excretion.

**METHODS:** Based upon human studies and micropuncture and renal denervation data in animals, rates of glomerular filtration, tubular reabsorption, as influenced during exercise, were used to calculate free water delivery to the collecting duct.

**RESULTS:** A glomerular filtration of 60 ml/min was used. Estimates of tubular reabsorption, driven by sympathetic neural activity, angiotensin II, and aldosterone, were predicted to return 90 % of the filtered water load back to the circulation. The resultant free water delivery to the collecting ducts was 6 ml/min. With a full suppression of ADH, 6 ml/min represents the maximal urine flow rate that can be achieved by normally functioning kidneys during exercise. If there is non-osmotic mediated release of ADH this maximal urine flow rate will be reduced below 6 ml/min.

**CONCLUSION:** In the absence of significant sweat losses, during heavy exercise the consumption of more than 6 ml/min of water will result in the dilution of plasma and possible hyponatremia.

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**1914 Board #55 May 28 9:00 AM - 10:30 AM**

**Modulation Of Renin, Angiotensin, Aldosterone And Arterial Distensibility Following Aerobic Exercise In Pre-hypertensive Individuals**

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(No relationships reported)

Hypertension is associated with increased arterial stiffness, which leads to ventricular remodeling and increased risk for cardiovascular disease. The renin-angiotensin-aldosterone system (RAAS) is a key regulator of blood pressure (BP) and plays a role in modulating vascular function. Yet, few studies have compared the hemodynamic and vascular effects of aerobic exercise (AE) with concomitant changes in the RAAS.

**PURPOSE:** The purpose of this study was to investigate the changes in resting hemodynamics (systolic and diastolic BP (SBP & DBP)), arterial distensibility (pulse wave velocity (PWV)) and modulations of the RAAS.

**METHODS:** Following 4 weeks of a control wait period we supervised 8 pre-to stage-1 unmedicated, obese hypertensives (5M and 3W, 54±2.8 yrs) for 4 weeks of moderate intensity (3x/week at 65%  $\dot{V}O_{2max}$ ) aerobic exercise training (AE). Fasted blood draws were taken at 0700 h at the start of the control, exercise and at the end of the exercise training periods. An ANOVA with repeated measures was used to make the pre-post comparisons with significance set at  $p < 0.05$ .

**RESULTS:** There were no significant changes during the 4 week control period in any variables, however AE significantly decreased SBP (pre vs post training: 137±1.6 vs 133.5±1.9 mmHg) and DBP (pre vs post training: 74.7 vs. 72.6 mmHg). AE decreased both central and peripheral PWV (pre vs post: 10.2±0.39 to 10±0.39m/s and 10.3±0.4 to 9.9±0.4m/s, respectively). While there were no significant changes in angiotensin and plasma renin activity, there were significant decreases in aldosterone (pre vs post training: 176±28 to 123±25 pg/mL).

**CONCLUSIONS:** These data suggest that the significant decrease in aldosterone following AE may lower BP by decreasing plasma volume in obese-hypertensive individuals, leading to decreases in pulse wave transit time.

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**1915 Board #56 May 28 9:00 AM - 10:30 AM**

**Epigallocatechin Gallate Attenuate Oxidized Low Density Lipoprotein-induced Endothelial Inflammation**

Kai-Ling Chen<sup>1</sup>, Shin-Da Lee<sup>1</sup>, Chia-Hua Kuo<sup>2</sup>, Kun-Ling Tsai<sup>1</sup>, Tsan-Hung Chiu<sup>3</sup>, Hsiu-Chung Ou<sup>1</sup>. <sup>1</sup>*China Medical University, Taichung, Taiwan.* <sup>2</sup>*Taipei Physical Education College, Taipei, Taiwan.* <sup>3</sup>*China Medical University Hospital, Taichung, Taiwan.* (Sponsor: John L. Ivy, FACSM)  
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(No relationships reported)

Background: Atherosclerosis is an inflammatory disease. Atherogenic lipoproteins cause inflammatory responses to the vascular wall in the early stage of atherogenesis. (-)-Epigallocatechin-3-gallate (EGCG), the main catechin in green tea, has been well known about its benefits in cardiovascular system and anti-oxidant effects. However, its protective effects against oxidized low density lipoprotein (oxLDL)-induced endothelial inflammation still unclear.

**PURPOSE:** In this study, we examined whether EGCG prevents inflammatory responses in endothelial cells caused by oxLDL and to explore the possible mechanism.

**METHODS:** Primary human umbilical vein endothelial cell cultures (HUVECs) incubated with oxLDL were used to explore the anti-inflammatory effects of EGCG. The expression of NF- $\kappa$ Bp65, phosphorylated p38 and cyclooxygenase -2 (COX-2) was measured by Enzyme-Link Immunosorbent Assay (ELISA), Western blot and immunocytochemistry. Adhesion molecule expression of intercellular adhesion molecule (ICAM), E-selectin and monocyte chemoattractant protein-1 (MCP-1) as well as several pro-inflammatory cytokines including interleukin-8 (IL-8), interleukin-6 (IL-6) and Endothelin-1 (ET1) were investigated by real-time PCR, ELISA and flow cytometry.

**RESULTS:** Our results showed that oxLDL-induced inflammatory response including activation of NF- $\kappa$ Bp65, phosphorylation of P38, expression of COX-2, adhesion molecule (ICAM, E-selectin and MCP-1) and pro-inflammatory cytokines (IL-6, IL8 and ET1) both in mRNA and protein levels. All these parameters were significantly rescued by pretreatment with EGCG.

**CONCLUSIONS:** We demonstrated that EGCG prevent oxLDL-induced inflammatory responses, implying that EGCG has a potential role in the prevention of atherosclerotic vascular disease.

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**1916 Board #57 May 28 9:00 AM - 10:30 AM**

**Solanum Lyratum Thumb Prevent Oxidized Low-density Lipoprotein-induced Endothelial Dysfunction**

Kun-Ling Tsai<sup>1</sup>, Shin-Da Lee<sup>1</sup>, Chia-Hua Kuo<sup>2</sup>, Tsan-Hung Chiu<sup>3</sup>, Wei-Wen Kuo<sup>1</sup>, Hsiu-Chung Ou<sup>1</sup>. <sup>1</sup>*China Medical University, Taichung, Taiwan.* <sup>2</sup>*Taipei Physical Education College, Taipei, Taiwan.* <sup>3</sup>*China Medical University Hospital, Taichung, Taiwan.* (Sponsor: John L. Ivy, FACSM)  
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(No relationships reported)

Background: *Solanum lyratum Thunberg* (SL), well known as “*Herba Solani Lyrati*”, is one of the traditional medicines in China. It has been widely used for regulating body immune function and against allergic diseases for generations. However, little is known about whether SL has a protective effect on endothelial dysfunction caused by oxidized low density lipoprotein (oxLDL).

**PURPOSE:** To determine the protective effects of SL on endothelial dysfunction mediated by oxLDL and to explore the underlying mechanism.

**METHODS:** Primary human umbilical vein endothelial cell cultures (HUVECs) treated with oxLDL were used to explore the protective effect of SL. 1,1-diphenyl-2-picryl-hydrazyl (DPPH) radical scavenging activity, HUVECs mediated oxidative modification of LDL, superoxide dismutase (SOD) and reactive oxygen species (ROS) generation were determined to evaluate the antioxidant effects of SL. Expression of adhesion molecules (MCP-1, CXCR6) as well as inflammatory cytokines (endothelin-1, IL-6 and IL-8) were measured by real-time polymerase chain reaction (PCR), Enzyme-Linked Immunosorbent Assay (ELISA) and flow cytometry. In addition, several apoptotic features, such as the accumulation of intracellular calcium and mitochondrial destabilization and the activation of caspase 3 were also investigated.

**RESULTS:** SL at a dose as low as 2.5  $\mu$ g/ml scavenged approximately 93% DPPH radical and inhibited HUVECs mediated oxidative modification of LDL in a dose-dependent manner. SL ameliorated the oxLDL-attenuated SOD activity that, subsequently, resulting in a decreased ROS generation. SL pretreatment inhibited the upregulation of adhesion molecules expression and inflammatory cytokine release caused by oxLDL. Furthermore, SL reduced the accumulation of oxLDL-induced intracellular calcium, decreased the disturbance of Bcl-2 family protein balance and subsequent mitochondrial membrane potential collapse, decreased the level of cytochrome c released into the cytosol and decreased the activation of caspase 3.

**CONCLUSIONS:** Our results suggest a possible mechanisms linking to ROS generation, expressions of adhesion molecules, inflammatory cytokines release and induction of

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**1917 Board #58 May 28 9:00 AM - 10:30 AM**

**Improved Apoptotic Gene Profile Of The Survived Remodeled Myocardium By Exercise Conducted Prior To Acute Infarction**

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(No relationships reported)

Long-term exercise training induces favorable morphological changes that play a major role in the prevention of Acute Myocardial Infarction (AMI). It is postulated that even short episodes of exercise bouts provide sufficient cardiac protection due to changes in the molecular and gene expression which may improve cardiac myocytes oxygen and energy supply, viability, and LV wall elasticity.

**PURPOSE:** To study the effect of short-term (3 weeks) exercise training, conducted prior to AMI on the molecular alterations related to cardiac healing during remodeling.

**METHODS:** SD male rats (n=188) underwent short-term (90 min, 5 days/wk, 3 weeks) of swimming exercise training, or remained sedentary (Ex/Sed). At the end of the training/ sedentary period, rats were subjected to AMI induced by surgical ligation of the left coronary artery and thereafter remained sedentary during the 4-week remodeling period (ExMI/SedMI), and thereafter sacrificed. At sacrifice, hearts were harvested, weighted, and the viable left ventricle underwent RNA extraction. Gene expression was obtained using gene-array (Affymetrix Rat 230 2.0®), scanned and analyzed by MAS5, which followed by Super-Paramagnetic Clustering (SPC), using Treeview and the Expander programs. Further verification of the selected mRNA gene expression was conducted using qRT-PCR.

**RESULTS:** Cluster analysis of 486 genes significantly changed ( $p < 0.05$ ) in ExMI vs. SedMI groups (Ex/Sed). Accordingly, viable myocardium of ExMI rats manifest gene expression to a lesser extent compared to SedMI animals during remodeling. This was accompanied with a reduced mRNA expression of pro-apoptotic (Gsk-3 $\beta$ ; Igfbp3; Ddit3;  $p \leq 0.05$ ) and increased anti-apoptotic related genes (Myc; Crebbp;  $p \leq 0.05$ ), reduced mRNA expression of fibrosis related genes (Timp; Bgn; Itga; Colla1; Colla2;  $p \leq 0.05$ ) and increase in the expression of oxidative metabolism related genes (Cpt1a; Cs; Fabp3; Had;  $p \leq 0.04$ ).

**CONCLUSION:** Short-term exercise training prior to acute myocardial infarction induces molecular alterations of the survived viable myocardium, resulting in myocyte preservation, and improved oxidative metabolism.

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**1918 Board #59 May 28 9:00 AM - 10:30 AM**

**The Effect Of Voluntary Exercise On Cardiac Remodeling In *Apc<sup>Min/+</sup>* Mice**

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(No relationships reported)

*ApcMin/+* mice experience intestinal adenomas and chronic inflammation that lead to cachexia and cardiac enlargement. Physical activity can maintain overall physical function, lower chronic inflammation and attenuate cardiac enlargement.

**PURPOSE:** To determine whether lifetime voluntary exercise attenuates cardiac enlargement and related changes in gene expression in *ApcMin/+* mice.

**METHODS:** C57BL/6 (*wt*) and *ApcMin/+* mice given access to running wheels or served as cage controls beginning at 4 wks of age and mice were sacrificed at 26 wks of age. Body weights, heart, gastrocnemius, mammary fat pads, and spleens wts were determined and hearts were frozen. Collagen 1a, TGF $\beta$ , myosin heavy chain (MHC)a, and MHCb were determined by RT-PCR. STAT3 activation was determined by western blot analysis.

**RESULTS:** Body wts were 10% lower in *ApcMin/+* than *wt* mice ( $21.5 \pm 5$  vs  $24.2 \pm 7$  g) ( $P \leq 0.05$ ) and were not altered by exercise. Gastrocnemius muscle wts were 37% lower in *ApcMin/+* than *wt* mice ( $68 \pm 5$  vs  $108 \pm 4$  mg) ( $P \leq 0.05$ ) but were not altered by exercise. Mammary fat pad wts were lower in *ApcMin/+* than *wt* mice ( $28 \pm 11$  vs  $262 \pm 49$  mg) ( $P \leq 0.05$ ), and were not altered by exercise. Heart wts were 25% heavier in *ApcMin/+* than *wt* mice ( $9.0 \pm 3$  vs  $7.6 \pm 3$  mg/mm) ( $P \leq 0.05$ ) but were not altered by exercise. Procollagen 1a gene expression was 300% greater in *ApcMin/+* than *wt* mice ( $3.6 \pm 9$  vs  $1 \pm 1$ ) ( $P \leq 0.05$ ), but exercise attenuated this expression by 48% in *ApcMin/+* mice ( $1.9 \pm 2$ ) ( $P \leq 0.05$ ). MHCa gene expression was not different between *ApcMin/+* and *wt* mice, nor was it altered by exercise. However, MHCb gene expression was attenuated by exercise in both *ApcMin/+* and *wt* mice ( $0.5 \pm 1$  vs  $1 \pm 1$ ) ( $P \leq 0.05$ ) but was not different between *ApcMin/+* and *wt* mice.

**CONCLUSIONS:** These results demonstrate that increased exercise altered cardiac extracellular matrix and myocyte gene expression. The exercise-induced changes altered the physiological function of the heart during cancer-cachexia that were independent of heart and body weight in *ApcMin/+* mice.

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**1919 Board #60 May 28 9:00 AM - 10:30 AM**

**Acute And Chronic Endurance Exercise Improve Endothelial Progenitor Cell Function And Reduce Expression Of Oxidative Stress-Related Genes.**

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(No relationships reported)

Endothelial progenitor cells (EPCs) are a recently-identified circulating cell type that participate in the maintenance and repair of the vascular endothelium. Oxidative stress impairs EPC function, but the effects of acute and chronic exercise on gene expression that regulates oxidative stress in EPCs have never been studied. The lectin-like oxidized LDL receptor 1 (LOX-1) and NADPH oxidase pathways contribute to oxidative stress and were investigated as target genes in this study.

**PURPOSE:** To test the hypothesis that chronic and acute endurance exercise increase EPC colony forming units (CFU-EC) and reduce the expression of genes involved in cellular oxidative stress.

**METHODS:** Young ( $26 \pm 2$  yr) active ( $n = 5$ ) and inactive ( $n = 3$ ) men were studied. CFU-EC were cultured from blood samples obtained before and after 30 min treadmill running at 75%  $\text{VO}_{2\text{max}}$ . LOX-1 and NADPH oxidase (subunits gp91<sup>phox</sup>, p47<sup>phox</sup>, and p67<sup>phox</sup>) mRNA levels were measured using semiquantitative RT-PCR after 5 days of culturing the EPCs.

**RESULTS:** CFU-EC did not differ between groups at baseline, but in active individuals CFU-EC increased after acute exercise by  $7.9 \pm 3.9$  colonies ( $p = 0.056$ ). CFU-EC in the inactive group did not change after acute exercise ( $-0.8 \pm 1.6$  colonies,  $p = 0.3$ ). gp91<sup>phox</sup> mRNA levels were lower in active than inactive participants at baseline (43% group difference,  $p = 0.02$ ) and decreased significantly after acute exercise in both groups (active:  $-34 \pm 11\%$ ,  $p = 0.02$ ; inactive,  $-32 \pm 7\%$ ,  $p = 0.04$ ). LOX-1 mRNA was not different between groups at baseline ( $p = 0.14$ ) but tended to decrease following acute exercise in the active group ( $-10 \pm 6\%$ ,  $p = 0.09$ ). There were no group or acute exercise-induced differences in p47<sup>phox</sup> or p67<sup>phox</sup> mRNA levels.

**CONCLUSION:** Endurance exercise training may enhance EPC function by reducing oxidative stress. An acute bout of exercise reduces expression of NADPH oxidase and possibly LOX-1. Importantly, these differences in gene expression were observed despite no group differences in CFU-EC at baseline and only the active group increased CFU-EC with acute exercise. Exercise may, therefore, have powerful effects on EPC function through mediating the intracellular environment.

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1920    **Board #61    May 28    9:00 AM - 10:30 AM**

**Exercise Training Preserves Running Capacity In Mice After Excision Of Cardiac *Serca2* Gene**

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(No relationships reported)

In experimental models of exercise and heart failure, aerobic performance is closely linked to cardiomyocyte contractility and to the function of sarco-endoplasmic reticulum  $\text{Ca}^{2+}$  ATPase (SERCA2). Cardiac specific disruption of the *Serca2* gene controlled by tamoxifen administration in vivo (KO) induces severe congestive heart failure within 7 weeks, while control mice with floxed *Serca2* alleles (FF) preserve cardiac function. Four weeks after tamoxifen treatment the level of *Serca2a* mRNA in cardiomyocytes is less than 5% in KO mice.

**PURPOSE:** Our working hypothesis was that *Serca* gene ablation reduces aerobic fitness and impairs adaptation to exercise training.

**METHODS:** To determine whether responses in KO mice differed from those in control, a four-week high intensity exercise training program started two weeks after gene excision. Training was done as interval running on a treadmill, 8 min at 85-90% of maximum oxygen uptake capacity ( $\text{VO}_{2\text{max}}$ ) interspersed with 2 min at 40-50%, 1 hour, 5 days per week. High-frequency echocardiography was performed, and  $\text{VO}_{2\text{max}}$  and maximum running speed (RS) were measured. Protein analyses were carried out on left ventricular myocardium (LV) and soleus muscle.

**RESULTS:**  $\text{VO}_{2\text{max}}$  and RS increased in SERCA2 FF mice during the training period. SERCA2 KO animals maintained their RS despite a 36% decrease in  $\text{VO}_{2\text{max}}$ . In sedentary KO mice, RS was reduced by 28% and  $\text{VO}_{2\text{max}}$  by 50%. Echocardiography showed a 32% left atrial dilation in both trained and sedentary KO groups, but no differences in LV dimensions. Change in stroke volume was nominally lower in trained compared to sedentary KO mice. Right ventricle and lung weights were increased and histology demonstrated pulmonary congestion and heart failure in SERCA2 KO mice, independent of training. LV citrate synthase activity, and NCX, phospholamban and *Serca2a* protein levels were unaffected by training. Capillary density in soleus muscle increased in both sedentary and trained KO mice compared to FF controls.

**CONCLUSIONS:** Running capacity is maintained by exercise training after cardiac *Serca2* gene excision despite a significant decrease in  $\text{VO}_{2\text{max}}$ . Maintained LV stroke volume and neovascularisation in skeletal muscle seem to partly explain the maintained running capacity.

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1921    **Board #62    May 28    9:00 AM - 10:30 AM**

**Exercise Training Corrects Control Of Diastolic Calcium In Hearts From Myocardial Infarction Heart Failure Rats**

Ole J. Kemi<sup>1</sup>, Niall MacQuaide<sup>1</sup>, Morten A. Hoydal<sup>2</sup>, Per M. Haram<sup>3</sup>, Øyvind Ellingsen<sup>2</sup>, Godfrey L. Smith<sup>1</sup>, Ulrik Wisloff<sup>2</sup>. <sup>1</sup>*University of Glasgow, Glasgow, United Kingdom.* <sup>2</sup>*Norwegian University of Science and Technology, Trondheim, Norway.* <sup>3</sup>*University of Tromsø, Tromsø, Norway.*

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(No relationships reported)

Arrhythmias cause ~50% of deaths in heart failure (HF), but no satisfactory treatment exists. An underlying scenario is the impaired control of cardiomyocyte intracellular diastolic  $\text{Ca}^{2+}$ . Exercise training corrects abnormal cyclic  $\text{Ca}^{2+}$  handling in HF, but control of diastolic  $\text{Ca}^{2+}$  remains unstudied.

**PURPOSE:** To study the effect of exercise training on the generation and propagation of spontaneous diastolic  $\text{Ca}^{2+}$  waves in failing left ventricle cardiomyocytes.

**METHODS:** We induced myocardial infarctions (MI) and HF by coronary artery ligation in Sprague-Dawley rats. MI was evidenced by echocardiography, indicating that 40±5% of the LV was infarcted, whereas HF was evidenced by increased LV end-diastolic pressures and decreased contraction-relaxation rates and exercise work capacity. Diastolic  $\text{Ca}^{2+}$  was imaged by laser scanning confocal microscopy.

**SUMMARY OF RESULTS:** Pathological remodeling was evidenced by increased LV cardiomyocyte lengths and widths. Spontaneous  $\text{Ca}^{2+}$  waves were measured by confocal linescanning after 488nm excitation and recording emission at 505-530nm in intact Fluo3-loaded cardiomyocytes (2uM) at 37°C, at  $[\text{Ca}^{2+}]$  1.2mM and 5.0mM. These studies showed that spontaneous wave frequency was higher at 5.0mM than 1.2mM  $\text{Ca}^{2+}$ . Post-MI HF cardiomyocytes had twice the wave frequency compared to sham-operated controls. Regular exercise training post-MI improved exercise capacity and induced reverse remodeling. Exercise training reduced the frequency of spontaneous waves at both  $\text{Ca}^{2+}$  1.2mM and 5.0mM, although it did not completely normalize spontaneous  $\text{Ca}^{2+}$  waves. Exercise training also increased the ratio between aborted and complete waves at  $\text{Ca}^{2+}$  1.2mM, but not  $\text{Ca}^{2+}$  5.0mM. Finally, we repeated these studies in the presence of the nitric oxide synthase inhibitor L-NAME, to study the contribution of nitric oxide. This did not have any effects.

**CONCLUSION:** This study suggests that exercise training partly improves the control of diastolic  $\text{Ca}^{2+}$  by reducing the frequency by which spontaneous  $\text{Ca}^{2+}$  waves are generated and by improving the ability of the cardiomyocyte to eliminate a spontaneous wave after its generation, but before its propagation. This therefore also suggests a mechanism by which exercise training may reduce the incidence of cardiac arrhythmias in post-MI HF.

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1922    **Board #63    May 28    9:00 AM - 10:30 AM**

**Endurance Training On Jak/stat Activation In The Left Ventricle Of Rat**

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(No relationships reported)

The activation of Janus Kinase(JAK)/ signal transducers and activators of transcription(STAT) pathway has been reported to induce cardiac hypertrophy in genetically hypertensive and experimental post-myocardial infarction rats, as well as in isolated ventricular myocytes subject to mechanical stretch. Our previous study showed that acute exercise induced JAK/STAT pathway activation; however, no reports have documented the activation of JAK/STAT pathway in the myocardium of exercise-induced cardiac hypertrophy.

**PURPOSE:** To evaluate endurance training on JAK/STAT3 pathway and Suppressor of cytokine signaling (SOCS) expression in myocardium in order to understand the mechanism of JAK/STAT3 pathway in exercise induced cardiac hypertrophy.

**METHODS:** Male Sprague-Dawley rats(220±5g) were randomly divided into sedentary and exercise groups, rats in exercise group were submitted to grade treadmill training for 10 weeks, then sacrificed at 0hour and 24 hours after last exercise respectively. phosphorylated (p) - STAT3, STAT3, JAK1, JAK3 and SOCS1, SOCS2,SOCS6 expression in left ventricle determined with either western blot or immunohistochemistry.

**RESULTS:** The heart/body weight ratio of exercised rats significantly higher in comparison with the sedentary rats ( $p<0.05$ ); the percentage of JAK1 positive cells significantly increased immediately after the last running in exercised rats( $p<0.01$ ); however, the percentage of JAK3 positive cells showed no change either immediately or 24 hours after last exercise ( $p>0.05$ ); p-STAT3/STAT3 ratio increased immediately after last exercise ( $p<0.05$ ); while the percentage of SOCS1 and SOCS2 positive cells increased remarkably both immediately ( $p<0.01$ ,  $p<0.05$ ) and 24 hours ( $p<0.05$ ) after last exercise, while SOCS6 expression showed no changes in exercised groups compared with the sedentary group( $p>0.05$ ).

**CONCLUSIONS:** Exercise training that induced activation of JAK/STAT3 pathway might be related to the exercise-induced cardiac hypertrophy, the different responses of JAK1 and JAK3 might indicate the different functions of JAKs in exercised heart and the expression changes of SOCS1 and SOCS2 might be involved in regulating JAK/STAT3 signal pathway in exercised-induced cardiac hypertrophy.

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**C-30 Free Communication/Poster - Children and Adolescents**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**1923 Board #64 May 28 9:00 AM - 10:30 AM****Effects Of Grade Classification On High School Football Players' 40 Yard Dash Times**Emily C. Thevis, Brian J. Campbell, Bradley Burkhalter, Torie Guidry, Michael A. Schultz. *University of Louisiana at Lafayette, Lafayette, LA.*

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(No relationships reported)

Traditionally, 40-yd. dash (40YD) time is used to assess the speed of football players. Times are typically recorded without protective gear worn in a game. Studies have shown a significant increase in the time a player runs the 40YD in full equipment. However, there are many variables that may affect individual high school player's time change when timed in the 40YD with and without football equipment including pad weight, position, or workout regimen. Another serious consideration is player classification in school. As players mature through high school via age and strength training, player functional strength would seem to increase.

**PURPOSE:** To determine if grade classification of high school athletes affects difference in 40YD times with and without equipment on (DT).

**METHODS:** The 40 yard dash times of 69 high school football players were recorded using computerized timing software and a high-speed camera (30 frames/sec). Two trials were performed for each condition: wearing shorts and a T-shirt with no equipment (NEP) and wearing full game equipment (EP). The faster time for each condition was used in data collection. Difference in times EP and NEP was calculated and the times of the freshman (FR) and seniors (SR) were extracted for analysis. An independent samples T-test was used to determine if FR or SR were affected differently by equipment weight, based on their difference in 40YD times (DT).

**RESULTS:** There is a significant increase in DT for FR ( $0.1975 \pm 0.06406s$ ) compared to SR ( $0.1422 \pm 0.0253s$ ) ( $p \leq .05$ ).

**CONCLUSIONS:** The results suggest that senior football players are better suited to handle the weight of football equipment when running the 40YD. Although both SR and FR players had an increase in time for the 40YD EP, SR times were less affected by the additional weight. This may be due to the higher maturity level and longer involvement in a strength training program of seniors. If coaches utilize traditional 40YD methods without equipment, FR players should be expected to translate less of that speed onto the field than upperclassmen.

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**1924 Board #65 May 28 9:00 AM - 10:30 AM****A Comparison Of Physical Activity Levels Between Children With And Without A Congenital Heart Defect.**Lauren A. Ewalt<sup>1</sup>, Ann M. Swartz<sup>1</sup>, Scott J. Strath<sup>1</sup>, Michael J. Danduran<sup>2</sup>, Victoria A. Moerchen<sup>1</sup>, Jerome Carson Smith<sup>1</sup>. <sup>1</sup>University of Wisconsin-Milwaukee, Milwaukee, WI. <sup>2</sup>Children's Hospital of Wisconsin, Milwaukee, WI.

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(No relationships reported)

**PURPOSE:** To describe and compare daily physical activity (PA) levels of children with and without a congenital heart defect (CHD). Secondly, to compare groups for time spent in moderate intensity PA (MPA), vigorous intensity (VPA), sedentary behavior, and physical education (PE), sport, and recess.

**METHODS:** Twenty-one children with mild to moderate CHD (16 females,  $10.6 \pm 3.4$  y) were matched for gender and age group (6-11 y, 12-15 y, 16-19 y) with 21 children without CHD (16 females,  $10.8 \pm 3.2$  y). Participants wore an accelerometer (Actigraph 7164, Fort Walton Beach, FL) and completed a PA log for seven consecutive days. Moderate intensity PA was defined as 4.0-6.9 METs and VPA was defined as greater than or equal to 7 METs (Wickel & Eisenmann, 2007). Sedentary behavior was defined by any accelerometer activity count being less than or equal to 50 counts/30 sec. The amount of time spent in the three structured physical activities (PE, sport, and recess) were self-reported on the PA log. Paired sample t-tests were utilized to compare daily PA levels, total time spent in MPA (min/day), VPA (min/day), sedentary behavior (min/day), and PE (min/week), recess (min/week), and sport (min/week) between the two study groups.

**RESULTS:** There were no statistical differences in total PA level ( $p=0.297$ ), time spent in MPA ( $p=0.250$ ), VPA ( $p=0.220$ ), sedentary behavior ( $p=0.712$ ), physical education ( $p=0.978$ ), and recess ( $p=0.217$ ) between children with and without CHD. However, children with CHD spent significantly less time participating in sport than children without CHD (CHD:  $51.6 \pm 91.8$  min/week; Non-CHD:  $185.8 \pm 216.7$  min/week,  $p=0.025$ ).

**CONCLUSIONS:** Although children with CHD had similar overall PA levels as children without CHD, they spent over two less hours per week participating in sport. An additional study with a larger sample size and qualitative methods to determine exposure to sport among children with CHD would address not only activity but also participation among this at-risk population.

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**1925 Board #66 May 28 9:00 AM - 10:30 AM****Assessing Physical Activity In Girls Using Accelerometry - 60s Versus 10s Sampling Intervals**Matthew Yao, Panagiota Klentrou, Lauren Corbett, Izabella Ludwa, Bareket Falk. *Brock University, St. Catharines, ON, Canada.*

(No relationships reported)

Children exhibit physical activity patterns mainly comprised of sporadic and intermittent bouts, each lasting under 15s in duration. Despite this fact, most studies utilize a 60s accelerometry sampling interval to objectively quantify physical activity in youths. This relatively long sampling interval may underestimate children's true physical activity behaviour.

**PURPOSE:** To assess the difference in intensity, duration and number of continuous bouts of physical activity in children and adolescents when using accelerometry intervals of 60s vs. 10s.

**METHODS:** A total of 106 girls and adolescents (mean =  $13.0 \pm 2.6$  yrs old) wore ActiGraph GT1M accelerometers for all waking hours (except while bathing, swimming, etc.) over seven days. Accelerometers were set at 10s epochs and the raw data was subsequently re-integrated into 60s epochs. From data of both epoch lengths, daily bouts of moderate (MPA; 3-5.9 METs), vigorous (VPA; 6-8.9 METs) and very vigorous (VVPA;  $\geq 9$  METs) activities were quantified using a Visual Basic data reduction program. The number of continuous 5 min, 10 min and 20 min bouts at each intensity was also calculated.

**RESULTS:** There was no difference in total MPA minutes between the 10s and 60s analysis. Total VPA, and VVPA were 80.4%, and 61.5% greater in the 10s sampling than in the 60s integrated sampling, respectively ( $p < 0.01$ ). When examining continuous bouts of activity, the 10s analysis generally resulted in more continuous bouts compared with the 60s analysis, especially when examining 5 min bouts of MPA (19.1%), 20 min bouts of VPA (14.6%), and of VVPA (0.9%) ( $p < 0.01$ ).

**CONCLUSION:** The commonly used 60s accelerometry sampling interval underestimates the amount of physical activity that children and adolescents engage in, especially at the higher intensity levels. Thus, a sampling interval of 10s or less is warranted to better assess physical activity levels of different intensities in children and adolescents.

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**1926 Board #67 May 28 9:00 AM - 10:30 AM****Physical Activity And Overweight In Low Socioeconomic Status, Elementary And Middle School Students**



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Previous research estimates that 32% of US children and adolescents are classified as overweight (Ogden, 2008). In addition, nearly 70% participate in physical activity for  $\geq 60$  min on  $\geq 5$  days/wk (Pate, 2002). However, minimal research has focused on physical activity levels and overweight status in low socioeconomic status (SES) children.

**PURPOSE:** The purpose of this study was to examine physical activity participation and overweight status in low SES elementary and middle school students.

**METHODS:** Students ( $n=124$ ; 52% female, 83% African American) in grades 3-8 attending a low SES urban charter school (97% free/reduced lunch) participated in a fitness assessment and physical activity survey during the winter 2008 semester. BMI ( $\text{kg}/\text{m}^2$ ) was calculated from measured height and weight. Centers for Disease Control and Prevention BMI-for-age and sex growth charts were used to classify youth as overweight ( $>85$ th percentile). Students self reported physical activity and were classified as being physically active if they performed 60 minutes of physical activity on  $\geq 5$  days per week. Chi-square analysis was used to assess gender, racial, and grade differences in overweight and physical activity.

**RESULTS:** Only 39% of children participated in physical activity for  $\geq 60$  min on  $\geq 5$  days/wk and 47% were classified as overweight. Females (27%) were less likely than males (52%) to be physically active ( $p=0.015$ ). Furthermore, females (58%) were more likely than males (34%) to be overweight ( $p=0.011$ ). Race and grade level were not significantly related to physical activity levels or overweight status.

**DISCUSSION:** The prevalence of overweight and physical inactivity is alarmingly high in low SES children. Females were more likely to be overweight and less likely to participate in physical activity. These results suggest that physical activity interventions should target girls at an early age in low SES populations.

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1927 Board #68 May 28 9:00 AM - 10:30 AM

**After-school Fitness Performance Is Not Altered Following Physical Education Lessons In Adolescent Athletes**

Avery D. Faigenbaum, FACSM<sup>1</sup>, James E. McFarland<sup>2</sup>, Erin Buchanan<sup>1</sup>, Nicholas A. Ratamess<sup>1</sup>, Jie Kang<sup>1</sup>, Jay R. Hoffman, FACSM<sup>1</sup>. <sup>1</sup>The College of New Jersey, Ewing, NJ. <sup>2</sup>Hillsborough High School, Hillsborough, NJ.  
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(No relationships reported)

Physical education (PE) provides a unique opportunity for school-age youth to establish healthy habits, although some young athletes are exempt from PE and others do not participate due to a concern regarding the lingering effects of fatigue on after-school fitness performance.

**PURPOSE:** To examine the effects of different PE lessons on after-school fitness performance in young athletes.

**METHODS:** On nonconsecutive days, 20 high school athletes (14-18 yrs) participated in 3 different 43 min PE lessons which consisted of walk/jog aerobic exercise (AE), multi-set resistance training with progressive loads (RT), or basketball skill training (BS). Fitness performance was assessed after-school following each lesson and after a control day without PE. Subjects had  $2.8 \pm 1.1$  hr to recover from PE before fitness testing.

**RESULTS:** There were no significant differences in sit and reach flexibility ( $34.1 \pm 6.5$ ,  $34.7 \pm 1.3$ ,  $33.5 \pm 7.2$ ,  $33.6 \pm 7.3$  cm), vertical jump ( $46.3 \pm 14.7$ ,  $46.2 \pm 13.6$ ,  $46.4 \pm 13.4$ ,  $45.6 \pm 14.2$  cm), long jump ( $175.0 \pm 36.4$ ,  $174.2 \pm 36.3$ ,  $172.7 \pm 35.8$ ,  $171.9 \pm 34.7$  cm), seated medicine ball toss ( $348.9 \pm 121.8$ ,  $342.0 \pm 120.6$ ,  $353.9 \pm 123.6$ ,  $348.4 \pm 129.1$  cm), pro-agility shuttle run ( $5.8 \pm 0.5$ ,  $5.7 \pm 0.53$ ,  $5.8 \pm 0.52$ ,  $5.8 \pm 0.5$  sec), 20 m sprint ( $3.7 \pm 0.4$ ,  $3.7 \pm 0.4$ ,  $3.7 \pm 0.3$ ,  $3.7 \pm 0.3$  sec), and 200 m sprint ( $36.3 \pm 4.7$ ,  $35.1 \pm 4.0$ ,  $35.9 \pm 5.9$ ,  $35.4 \pm 5.4$  sec) between groups following AE, RT, BS or the control day, respectively.

**CONCLUSION:** These findings suggest that a moderate intensity exercise lesson or skill-based PE class will not have an adverse effect on after-school fitness performance in adolescent athletes.

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1928 Board #69 May 28 9:00 AM - 10:30 AM

**Physical Fitness: A Discriminant Analysis In The Determination Of Childhood Obesity**

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The improvement in physical fitness (PF) via exercise participation and training is an important part of prevention programs in childhood obesity; however, its assessment is seldom reported as part of the screening procedure.

**PURPOSE:** We investigated the discriminate potential of PF together with selected screening variables of anthropometric measurements of body weight, height, body mass index, BMI-SDS (standard deviation score), percentile (of BMI-SDS) and blood plasma measurements of total cholesterol, triglycerides, low density lipoprotein, high density lipoprotein, blood glucose, insulin, leptin and adiponectin in 10-12 yrs old normal weight (NW) and overweight (OW) children.

**METHODS:** Twenty-six NW and 25 OW children participated in a physical fitness test battery (PFTB-PR), in a graded cycle spirometry test ( $1 \text{ W} \cdot \text{kg}^{-1} \text{ BW}$ ,  $10 \text{ W} \cdot \text{min}^{-1}$ ), and 5.5 ml venous blood collection in fasting state. The discriminate potential of PF was analyzed with discriminant analysis (DA, direct entry method) after a multivariate analysis of variance (MANOVA) was completed. DA was conducted separately for anthropometric variables, PF, and blood measurements. A loading of  $a \geq 0.6$  was used to select the most discriminate variables of each construct. Thereafter, the DA was conducted with all remaining variables (percentile; PFTB-PR, maximal workload,  $P_{\text{max}}$ , peak oxygen uptake,  $\text{VO}_{2\text{peak}}$ ; leptin).

**RESULTS:** NW ( $11.5 \pm 0.8$  yrs,  $41.8 \pm 8.8$  kg,  $17.9 \pm 2.1$  BMI) differed significantly from OW ( $11.3 \pm 1.0$  yrs,  $70.4 \pm 18.8$  kg,  $29.1 \pm 5.1$  BMI) in most of the variables after MANOVA testing. DA revealed that in addition to percentile ( $a=0.80$ ),  $P_{\text{max}}$  ( $a=-0.78$ ),  $\text{VO}_{2\text{peak}}$  ( $a=-0.76$ ), PFTB-PR ( $a=-0.74$ ), and leptin ( $a=0.64$ ) separated very well the NW from OW. Only one OW subject was classified as NW, whereas 100% of NW children were classified correctly. The group separation by the discriminant function (non-standardized)  $d = -2.2 + (\text{percentile} \times 0.66) - (\text{PFTB-PR} \times 0.03) - (\text{VO}_{2\text{peak}} \times 0.001) - (P_{\text{max}} \times 0.41) + (\text{leptin} \times 0.02)$  was significant as measured by Wilks'  $\lambda = .14$  with  $\chi^2(5, N=51) = 90.50$  at  $p = .0001$ .

**CONCLUSION:** The discriminant analysis revealed that PF variables are strong and useful indicators to separate between normal-weight and overweight 10-12 year old children, and should be included in screening procedures.

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1929 Board #70 May 28 9:00 AM - 10:30 AM

**Energy Expenditure In Children During Rock Climbing Activity**

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The activity of rock climbing has been implemented in some school physical education programs however there have been no published studies on the physiological demands and energy costs of climbing in children.

**PURPOSE:** The purpose of this study was to measure energy expenditure in children during climbing activities typical of school-based programs.

**METHODS:** Twenty-nine children (18 male, 11 female; mean age = 10.9±1.7 yr) participated in the study. All subjects had some recreational climbing experience. Prior to participation, each subject and his/her parent read and signed informed consent. Subjects were familiarized with the climbing terrain and instrumentation employed prior to data collection. A commercially available climbing structure (ht = 2.44 m; circumference = 8.20 m) fit with modular hand and foot holds provided continuous climbing terrain. The specific pattern of hand and foot hold placement was designed to ensure that the exertion level was submaximal during the trials of this study. Subjects were instructed to climb at a comfortable pace. Following an initial 5-min rest each child climbed one sustained 5-min bout followed by a 5-min rest for a total of 10 min (SUS). This period was immediately followed by five 1-min climbing + 1-min rest intervals for a second total of 10 min (INT). Expired air was analyzed continuously via a portable system (Viasys/Jaeger Oxycon Mobile). Energy expenditure (EE) in kcal was determined from the expired air data via the Weir method for averaged 10-second intervals throughout climbing and rest periods.

**RESULTS:** Total EE (climbing + rest) was significantly higher for INT than for SUS (39.3±13.1 vs 34.3±11.3 kcal;  $p<.01$ ). Elevated EE did not return to resting level between the 1-min intervals of climbing in INT. The mean total EE for the full 20-min protocol (SUS + INT) was 73.7±24.2 kcal. Total EE was significantly correlated with body mass;  $r=0.86$ . Mean average and peak metabolic equivalents (METs), calculated from oxygen consumption, were 6.4±1.3 and 9.1±2.1 METs respectively over the full 20-min protocol.

**CONCLUSIONS:** The rock climbing tasks employed in this study produced EE and MET levels similar to what have been reported in children for stair climbing, pickup basketball games, soccer, and easy jogging.

*Supported by NMU Faculty Grant 554789*

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**1930 Board #71 May 28 9:00 AM - 10:30 AM**

**Validation Of The Progressive Aerobic Cardiovascular Endurance Run Test For Children 7-13 Years Old**

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*(No relationships reported)*

The measurement of physical fitness in children has continuously been a topic of interest to physical educators, health agencies, exercise physiologists and coaches. A test often used in physical education classes is the PACER test, a progressive, multistage maximal exercise test that closely resembles a graded, speed-incremented treadmill test used in the laboratory to directly measure maximal oxygen consumption ( $O_{2max}$ ). The PACER test has been shown to be a valid predictor of  $O_{2max}$  when conducted on adolescents and adults; however, the results have not been substantiated in children.

**PURPOSE:** The purpose of this study was to investigate the validity of the PACER test for use with children between the ages of 7 and 13 years old.

**METHODS:** Twenty subjects volunteered to complete a PACER test and a  $O_{2max}$  test within a 2 wk period. During the PACER test, the subjects completed as many laps as possible within a 20-m distance. Heart rate (HR) and ratings of perceived exertion (RPE) were measured and recorded. The  $O_{2max}$  test was performed on a treadmill, in which oxygen consumption, RPE, and HR were monitored and recorded. Pearson's correlation coefficient was used to determine the relationship between the number of laps completed from the PACER test and measured  $O_{2max}$ . Independent t tests were used to determine significant differences between males and females, and younger and older age groups. To determine significant difference between measured relative  $O_{2max}$  and estimated  $O_{2max}$ , a dependent t test was used.

**RESULTS:** The number of laps completed correlated significantly ( $r = 0.71$ ;  $P < 0.05$ ) with  $O_{2max}$ . There was a significant difference in relative  $O_{2max}$  (49.1±6.4 vs. 41.7±5.9 ml·kg<sup>-1</sup>·min<sup>-1</sup>,  $P<0.05$ ) and number of laps completed (55.7±20.1 vs. 36.0±11.3,  $P<0.05$ ) during the PACER test between males and females. A significant difference was also found in absolute  $O_{2max}$  (1.28±0.2 vs. 1.99±0.4 L·min<sup>-1</sup>,  $P<0.05$ ) between the younger and older individuals. Additionally, the paired t test indicated a significant difference ( $P<0.05$ ) between measured  $O_{2max}$  and predicted  $O_{2max}$ .

**CONCLUSION:** Based on these results and this population, it may be concluded that the PACER test is a valid test of cardiorespiratory endurance for children 7-13 years old. However, a better equation is needed to predict  $O_{2max}$ .

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**1931 Board #72 May 28 9:00 AM - 10:30 AM**

**Muscle Phosphocreatine Kinetics In Children And Adults During High-intensity Exercise**

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*(No relationships reported)*

**PURPOSE:** To compare the age and sex differences in the kinetic response of muscle PCr during high-intensity exercise in children and adults.

**METHODS:** Eleven adults (6 men 25 ± 5 y and 5 women 23 ± 3 y) and 11 children (6 boys 13 ± 0.2 y and 5 girls 13 ± 1.3 y) exercised using their right leg on a quadriceps ergometer within a 1.5 Tesla MR scanner. Following habituation, each participant completed an incremental test to exhaustion. After a minimum 48 hours recovery, participants completed two to four constant work rate bouts on separate days. Exercise bouts consisted of 2 min rest and 7 min exercise, at an intensity equivalent to 20 % of the difference between the workload at the intracellular P<sub>i</sub>/PCr threshold and the maximal workload. <sup>31</sup>P spectra were collected every 6 s using a 6 cm surface coil positioned beneath the right quadriceps muscle. The breakdown of muscle PCr at the onset of exercise was modelled using a single-exponential function until the onset of the PCr slow component (SC). This point was identified using an iterative fitting window - where the time constant diverged from a plateau, a PCr SC was deemed to emerge. Data are reported as mean ± standard deviation and 95 % confidence intervals (CI) are presented. A two by two factorial ANOVA was utilised to determine group differences.

**RESULTS:** No significant interaction effect was found for the fundamental time constant (boys: 31 ± 10, CI 5; girls: 31 ± 10, CI 6; men: 44 ± 20, CI 6; women: 29 ± 14 s, CI 6 s;  $P=0.26$ ), or the fundamental amplitude (boys: -39 ± 10; girls: -42 ± 9; men: -36 ± 9; women: -48 ± 9 %;  $P=0.23$ ), or the SC PCr (as a % of the difference between the fundamental amplitude and end exercise PCr) which was similar across groups (boys: 6 ± 1; girls: 13 ± 8; men: 8 ± 5; women: 8 ± 6 %  $P=0.15$ ). The end-exercise PCr revealed a significant sex difference ( $P=0.03$ ) but no significant age or interaction effect (boys: 55 ± 10; girls: 46 ± 14; men: 56 ± 11; women: 44 ± 8 %). There was no significant difference between age ( $P=0.22$ ) or sex ( $P=0.13$ ) for the PCr cost of contraction at end-exercise (boys: 1.7 ± 0.5; girls: 1.3 ± 0.5; men: 1.4 ± 0.4; women: 1.2 ± 0.2 mM·W<sup>-1</sup>  $P=0.13$ ).

**CONCLUSION:** The kinetics of muscle PCr during high intensity exercise are similar in 13 y old children and adults, suggesting the phosphate-linked control of oxidative metabolism, at least during high-intensity exercise, is adult like by this age.

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**1932 Board #73 May 28 9:00 AM - 10:30 AM**

**Substrate Utilization And Hormonal Response During Treadmill Exercise In Females At Different Maturity Stages**

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*(No relationships reported)*

It has been suggested that metabolic and hormonal responses to exercise may be age or maturity dependant; however, existing data is not conclusive.

**PURPOSE:** To determine differences in substrate utilization and hormonal responses to exercise in females at different maturity stages.

**METHODS:** Thirty healthy active females were divided into 3 groups based on maturity stage: pre-menarcheal (PMen)(Tanner I-II) (age 10.1 ± 1.4 yr), menarcheal (Men)

(Tanner III-IV) (age  $13.2 \pm 0.6$  yr), and adults (Ad) (age  $23.3 \pm 4.5$  yr). After a 12 hr fast subjects completed a 40 min treadmill protocol at 60% of their  $\text{VO}_{2\text{max}}$ . Blood samples were obtained at rest, min 20, and min 40 of the exercise protocol for glucose, lactate, FFA, insulin, human growth hormone (HGH), epinephrine (Epi), and norepinephrine (NE) analyses. ANOVA with repeated measures was used to compare differences between the groups and across time.

**RESULTS:** RER was higher in Men at min 20 and 40 of exercise. From rest to min 40, Men and Ad glucose increased from 84.6 to 94.3 mg/dl and 76.3 to 88.7 mg/dl, respectively. Resting glucose was higher in PMen (90.4 mg/dl). Only Men lactate increased from rest to min 20 (0.77 to 1.58 mmol/L,  $P < 0.05$ ). Only Ad increased FFA from rest (0.2 mEq/L) to min 20 (0.41 mEq/L) and 40 (0.56 mEq/L). Insulin did not change during exercise, but Ad had a lower resting insulin compared to PMen and Men (4.5, 8.2 and 10 uU/dl, respectively). All groups increased HGH from rest to min 20 (increased 16, 19.6 and 8.9 ng/ml in PMen, Men and Ad, respectively), but only PMen and Men had higher values at min 40. Resting NE was higher in PMen (399 pg/ml) than in Ad (164 pg/ml). At min 20 NE was higher only in Men (744 pg/ml), and was higher compared to Ad (394 pg/ml). Epi and NE were higher at min 40 in Men and Ad.

**CONCLUSIONS:** These results suggest that among females there are maturity dependent differences in substrate utilization and hormonal responses to exercise at 60% of  $\text{VO}_{2\text{max}}$ .

*Supported by UPR-FIPI and UPR-FHC*

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**1933 Board #74 May 28 9:00 AM - 10:30 AM**

**Skeletal Age With The Fels And Tw3 Methods In The Assessment Of Biological Maturation Among Adolescent Soccer Players**

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**PURPOSE:** Skeletal age [SA] is an indicator of biological maturity status that is useful from childhood through adolescence in contrast to those limited to the pubertal years (secondary sex characteristics, age at peak height velocity). Skeletal age varies, however, with method of assessment. The present study compares the SA of adolescent soccer players 13-15 years of age assessed with the Tanner-Whitehouse and Fels methods.

**METHODS:** The sample included 72 Portuguese youth soccer players 13.3-15.3 years with at least two years experience in the sport. Chronological age (CA) was the difference between date of examination and date of birth as recorded on official birth certificates. Posterior-anterior hand-wrist radiographs of the left hand were taken on all players. SA was assessed with the Fels (Roche *et al.*, 1988) and Tanner-Whitehouse radius-ulna-short bone (TW3, Tanner *et al.*, 2001) methods. Players were classified as late, average (on time) or early on the basis of the difference between SA and CA: Late - SA behind CA by more than 1.0 year, Average - SA within plus/minus 1.0 year of CA, Early - SA in advance of CA by more than 1.0 year. In addition to descriptive statistics, concordance between maturity groups based on the two methods was tested with the Kappa statistic.

**RESULTS:** Chronological ages ranged from 13.3 to 15.3 years, while SAs ranged from 12.01-17.67 years with the Fels method and from 11.05-16.42 years with the TW3 method. Variation in SA was almost three times the variation in CA. Classification of players by maturity status varied with method of SA assessment: TW3 - Late 17%, On time 57%, Early 26%; Fels - Late 5%, On time 63%, Early 32%. Concordance between methods was 81% (Kappa=0.65±0.08,  $p < 0.001$ ).

**CONCLUSIONS:** Skeletal ages based on the Fels and TW3 methods are not equivalent and reflect in part real inter-individual differences and methodological differences. Although variation in skeletal maturity status within a two year competitive age group is considerable, there is reasonable concordance between classifications of players as late, on time and early in maturity status.

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**1934 Board #75 May 28 9:00 AM - 10:30 AM**

**Comparison Of Different Stage Lengths For Physical Working Capacity Tests**

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(No relationships reported)

In recent investigations, researchers have used either a 2-min or 3-min protocol for physical working capacity (PWC) assessment as a measure of aerobic fitness in children and adolescents.

**PURPOSE:** The purpose of this study was twofold: 1) compare different PWC tests in youth using 2-, 3-, and 6-minute stage lengths, and 2) examine the relationship between  $\text{PWC}_{170}$  and peak oxygen consumption ( $\text{VO}_{2\text{peak}}$ ).

**METHODS:** Seventeen youth (9 girls, 8 boys) aged 11-16 years ( $13.3 \pm 2.0$  yrs) participated in this study. Each participant visited the laboratory on two separate occasions within two weeks and performed three PWC tests (2-, 3-, 6-min stages) on a cycle ergometer. The first visit comprised of anthropometric measurements and one or two of the PWC tests; the second visit involved the remaining PWC test(s). The order of PWC tests was randomized and counterbalanced, with tests separated by 30 minutes of rest. On the day that two PWC tests were performed, participants continued the second test until exhaustion to assess  $\text{VO}_{2\text{peak}}$ . During each PWC test, heart rate (HR) was recorded every 30-sec and within the last 10-sec of each stage. Each PWC test consisted of at least two, but usually three, stages of increasing loads with the goal of reaching a  $\text{HR} \geq 165 \text{ b} \cdot \text{min}^{-1}$ . A fourth stage was completed if participants did not achieve  $165 \text{ b} \cdot \text{min}^{-1}$  within three stages. Individual regression lines were created to predict workload at  $\text{HR} = 170 \text{ b} \cdot \text{min}^{-1}$  for each test. Repeated measures ANOVA was used to compare  $\text{PWC}_{170}$  values. Pearson correlation was used to assess the relationships between  $\text{VO}_{2\text{peak}}$  and the different  $\text{PWC}_{170}$  stage lengths.

**RESULTS:** There were significant differences in  $\text{PWC}_{170}$  values among stage lengths ( $F(2,14)=9.3$ ,  $p < 0.0001$ ). Post-hoc analyses showed differences between the 2- and 6-minute stage lengths ( $111.3 + 27.1$  vs.  $92.5 + 22.2$  watts;  $p < 0.05$ ) and 3- and 6-minute stage lengths ( $104.2 + 30.0$  vs.  $92.5 + 22.2$  watts;  $p < 0.05$ ). Correlations between  $\text{VO}_{2\text{peak}}$  and the different stage lengths were  $r = 0.28$ ,  $0.39$ , and  $0.37$  ( $p > 0.05$ ) for 2-, 3-, and 6-min stages, respectively.

**CONCLUSION:** The lack of difference between the 2- and 3-min stage lengths may indicate that either is acceptable for determination of  $\text{PWC}_{170}$ . However,  $\text{PWC}_{170}$  (determined by different stage lengths) showed poor associations with  $\text{VO}_{2\text{peak}}$ .

Research was funded by the Spencer Foundation.

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**1935 Board #76 May 28 9:00 AM - 10:30 AM**

**Substrate Use In Obese And Lean Prepubescent Children.**

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(No relationships reported)

**Purpose-**To examine differences in substrate oxidation between non-trained, healthy, lean and overweight children exercising at the same absolute and relative submaximal intensities on a treadmill. **Methods-** Forty three lean ( $n=17$ ) and overweight ( $n=26$ ), prepubescent (8-11yr) children walked on a treadmill at a speed of 2.5 mph for five minutes and then at a speed to produce a HR of 140bpm for 5 minutes. Directly after the second 5-min stage they completed a graded exercise test. Oxygen consumption and fat oxidation was determined using indirect calorimetry. Body composition was determined using dual energy X-ray absorptiometry (DEXA). **Results-** Maximal oxygen consumption of the overweight group (OG) ( $1.81 \text{ L} \cdot \text{min}^{-1}$ ) was higher than the lean group (LG) ( $1.53 \text{ L} \cdot \text{min}^{-1}$ ;  $p=.009$ ). Sub maximal  $\text{VO}_2$  at 2.5 mph in the OG ( $0.75 \pm 0.14 \text{ L} \cdot \text{min}^{-1}$ ) was higher than in the LG ( $0.54 \pm 0.09 \text{ L} \cdot \text{min}^{-1}$ ;  $p < 0.05$ ) while the respiratory exchange ratios (RER) were the same in both groups. This higher  $\text{VO}_2$  was consistent with a higher absolute rate of carbohydrate oxidation in the OG ( $2.18 \pm 0.084 \text{ kcal/min}$ ) than LG ( $1.35 \pm 0.6 \text{ kcal/min}$ ;  $p < 0.05$ ). There was no significant difference in absolute rate of fat oxidation between the groups when exercising at the same absolute intensity ( $p=0.121$ ). When accounting for fat-free mass (FFM), the overweight group oxidize a

significantly greater amount of CHO ( $0.0675 \pm 0.023$  kcal/kg FFM than the LG ( $0.0498 \pm 0.02$  kcal/kg FFM) while the fat oxidized per kg FFM was the same in both groups ( $p=.562$ ). The relative sub-maximal  $\text{VO}_2$  (HR of 140 bpm) in the OG was higher than the lean group ( $p=.001$ ). The absolute rate of CHO oxidation was still higher in the OG than the LG ( $p=.03$ ) but in FFM the CHO oxidation was the same in both groups ( $p=.55$ ). Both groups oxidized fat similarly in absolute terms ( $p=.323$ ) and relative to FFM ( $p=.765$ ). Conclusion - Even though overweight children have significantly greater sub maximal oxygen consumption and a greater amount of lean mass compared to lean children, they are no more effective at utilizing fat during sub max exercise; however, in absolute terms, overweight children oxidize carbohydrates at a higher rate than their lean counterparts.

**1936 Board #77 May 28 9:00 AM - 10:30 AM**  
**Active Transportation, BMI And Sports Participation Among Adolescent Girls**

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**PURPOSE:** The aim of this study was to assess the relationship between commuting to and from school (active vs. passive), BMI and physical activity participation (organized vs. non-organized) out side school in a sample of adolescent girls.

**METHODS:** This is an epidemiologic descriptive study. The sample comprised 266 girls aged 13-17 years-old. Questionnaires were used to describe travel mode to school and to estimate sports participation. Socioeconomic position was established by parental occupation and educational level. BMI was also analyzed. Girls were grouped into active (AT) or passive (PT) travelers depending on their travel mode.

**RESULTS:** Obese girls reported to significantly be PT. AT girls reported to be more engaged in non-organized sports than their PT counterparts. Logistic regression analysis showed that the likelihood of AT increased by around 50% with increasing non-organized sports participation ( $\text{OR} = 0.50$ ;  $p \leq 0.01$ ) and decreased BMI ( $\text{OR} = 0.56$ ;  $p \leq 0.05$ ), which means that girls with higher BMI (overweight/obese group) are likely to be less active commuters.

**CONCLUSIONS:** Active transportation must be taking into account as a mean to increase level of physical activity.

**1937 Board #78 May 28 9:00 AM - 10:30 AM**  
**Evaluation Of Sleep Habits Among Obese Children After Multidisciplinary Program Of Exercise And Health Education**

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Several studies have associated short duration of sleep with increased obesity in children and adolescents (daily recommended between 5 and 10 years of age is 10 hours or more and for more than 10 years of age at least 9 hours). The duration of sleep is a potential modifiable risk factor with clinical implications especially for treatment of obesity.

**PURPOSE:** Evaluate the effects of a unique multidisciplinary program of exercise and health education on the quality and quantity of sleep in children and adolescents.

**METHODS:** Twelve boys and fourteen girls ( $12.9 \pm 2.9$  yrs), participated in the study. The intervention consisted of a unique program of physical activity, including a variety of games that were enjoyable, maintained interest, and motivated subjects to adhere. Activity sessions were offered one time per week, two hours each session, for twelve months. In addition, a health education program was offered to the subjects one time each month, one hour per session. Sleep habits was evaluated by self reported questionnaire completed by the subjects each day for 15 days. Obesity was measured by BMI. Results of sleep habits were evaluated by a t-test of mean differences from the beginning to the end of the program.

**RESULTS:**

Table 1. Evaluation of sleep habits in obese children according to age				
	Between 5 and 10 years		> 10 years	
	T 0	T + 1	T 0	T + 1
Time of going to bed (hour)	$22.42 \pm 0.8$	$22.09 \pm 0.9^*$	$23.35 \pm 1.1$	$22.71 \pm 1.2^*$
Wake-up time (hour)	$8.16 \pm 0.9$	$8.36 \pm 1.1^{**}$	$7.71 \pm 0.9$	$7.85 \pm 0.9$
Total time of sleep (hour)	$9.72 \pm 0.8$	$10.28 \pm 0.9^*$	$8.27 \pm 1.1$	$9.08 \pm 1.2^{**}$
Quality of sleep	$71.52 \pm 14.2$	$73.64 \pm 14.3^{**}$	$55.64 \pm 15.1$	$57.43 \pm 16.7^*$

\*  $p < 0.001$  ; \*\*  $p < 0.05$

Results (Table 1) showed that quality and quantity of sleep improved in the subjects of the two age groups ( $p < 0.05$ ). It was observed at the same time that obesity was significantly reduced from 30.9 to 29.8,  $p < 0.05$ .

**CONCLUSIONS:** From the study results it was concluded that a multidisciplinary program of exercise and health education in obese children reduced BMI and improved quality and quantity of sleep, and achieved recommendations for duration of sleep to minimize health problems associated with sleep disorders.

**1938 Board #79 May 28 9:00 AM - 10:30 AM**  
**Academic Performance Among Obese Children And Adolescents After Multidisciplinary Program Of Exercise And Health Education**

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The prevalence of obesity in youth continues to increase and is associated with numerous physical health as well as cognitive and psycho-social maladaptive behaviors. For

example, Li et al (2008) documented the association between overweight and decreased cognitive function among children.

**PURPOSE:** Evaluate changes of academic performance following one year of a multidisciplinary program of exercise and health education.

**METHODS:** Twelve boys and fourteen girls (12.9 ± 2.9 yrs), participated in the study. The intervention consisted of a unique program of physical activity, including a variety of games that were enjoyable, maintained interest, and motivated subjects to adhere. Activity sessions were offered one time per week, two hours each session, for twelve months. In addition, a health education program was offered one time each month, one hour per session. Academic performance was evaluated by interview and a review of the academic records of each subject. Obesity was measured by BMI. Results of academic performance were evaluated by a t-test of mean differences from the beginning to the end of the program.

**RESULTS:** Findings of the study suggest a significant improvement ( $p < 0.001$ ) in academic performance in three of the four evaluations (self-esteem, self evaluation of academic performance, ability to work alone) in children and adolescents (Table 1). It was observed at the same time that obesity was significantly reduced from 30.9 to 29.8,  $p < 0.05$ .

Tableau 1. Evaluation of academic performance in obese children			
	T 0	T + 1	
Changes in class standing	96.67 ± 18.7	98.12 ± 22.9	NS
Self esteem	6.59 ± 2.3	9.59 ± 1.5	< 0.001
Self evaluation of academic performance	9.39 ± 3.8	12.39 ± 3.3	< 0.001
Ability to work alone	9.17 ± 3.7	12.39 ± 2.7	< 0.001

NS : Non significant

**CONCLUSIONS:** It was concluded that a multidisciplinary program of exercise and health education in obese children and adolescents reduced BMI and improved academic performance, self esteem, self evaluation of academic performance, and ability to work alone.

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**1939 Board #80 May 28 9:00 AM - 10:30 AM**  
**Predictors Of Swimming Critical Velocity In Juvenile Talented Swimmers**

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The Critical Velocity (CV) - the maximal velocity sustainable for a long period of time without exhaustion - is considered to be a relevant performance determinant factor in swimming, and particularly related to the aerobic markers of swimming ability. Moreover, aerobic training and performance capacity are traditional concerns of swimming coaches. Thus, it seems relevant to determine which are the parameters, from those traditionally included in follow-up programs of young swimming talents, that are able to better explain the variance of CV.

**PURPOSE:** To assess the parameters from training background, strength, flexibility, hydrodynamics and hydrostatics, that better predicts CV.

**METHODS:** 100 juvenile swimmers of the Portuguese National Swimming Team - 52 males (15.8±0.4 yrs) and 48 females (13.8±0.4 yrs) were involved in a talent follow-up project that aimed to monitor the evolution of 33 variables from the above listed domains of characterization parameters. CV was assessed as the slope of a regression line computed between the maximum intensity 200 and 800 m front crawl swimming distance and the corresponding time. Multiple regression analysis was used to study the factors associated with CV.

**RESULTS:** The multiple regression models identified that the CV could be predicted, for an  $r = .69$  ( $p < .001$ ), by the following equation:  $CV = 0.741 - 0.06 (\% \text{ body fat}) + 0.009 (\text{bi-acromiale breadth}) + 0.009 (\text{"water" training time}) + 0.01 (\text{gliding})$ . Together, these variables accounted for 48% of the variance in the CV performance. This estimated model predicted an average score of 1.20±0.05 m/s, while the true average score was of 1.26±0.07 (corresponding to 1min 23.3s±3.6s and 1min 19.3s±3.7s, respectively, at the 100 m). Results pointed out that the main predictors of CV are anthropometric, training background and gliding variables, commonly associated with aerobic training and hydrodynamics. As a consequence, it may be sustained that CV, as a marker of aerobic performance ability, is both influenced by the amount of training and hydrodynamics.

**CONCLUSIONS:** It is considered that the combination of "water" training time, bi-acromiale breadth and gliding (positive effect), and % of body fat (inverse effect), can be used as good predictor of the swimmer's performance at intensities corresponding to aerobic training regimens.

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**1940 Board #81 May 28 9:00 AM - 10:30 AM**  
**The Effects Of A Personalized Aerobic Exercise Program In Obese Adolescents: An Early Adherence Study**

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Regular physical activity increases levels of fitness and decreases risks for both cardiovascular disease and diabetes. Establishing and maintaining daily physical activity is particularly important for adolescents as they are experiencing a 34% overweight prevalence rate. Current physical activity recommendations for youth include 60 minutes of at least moderate activity every day. It is unknown if personalizing an aerobic exercise program specifically targeted to obese youth will improve their physical activity adherence.

**PURPOSE:** The purpose of this investigation is to describe early adherence to a 16-week personalized aerobic exercise program for sedentary, obese adolescents and to examine associations between adherence and perceived barriers.

**METHODS:** We are reporting activity adherence assessed via accelerometry for the initial 40 days of the study. Body composition was assessed via bioelectrical impedance analysis using the Quantum X<sup>®</sup>. Cardiovascular fitness was measured by  $VO_{2peak}$  during progressive cycle ergometry.

**RESULTS:** The sample consisted of 10 (4 males, age 14.5 ± 1.7 yrs.; 6 females, age 14.8 ± 1.9 yrs.) obese adolescents with BMI > 99<sup>th</sup> percentile (8 Hispanic, 2 Non-Hispanic). Average accelerometer wear time was 13.5 hours/day. On average, youth spent 78.7% of the day in sedentary activity, 13.1% in light activity, 7.3% in moderate activity and 0.9% in vigorous activity. Thirty-two percent of the time obese youth achieved the recommended 60 min·d<sup>-1</sup> of moderate to vigorous physical activity (MVPA). Daily duration of MVPA appeared close to current recommendations, although was quite variable (mean 53.6 ± SD 35.4 min·d<sup>-1</sup>). Adolescents' perceptions of barriers to exercise were negatively associated with participation of at least 60 min·d<sup>-1</sup> of MVPA

( $r = -.697$ ,  $P = 0.03$ , point-biserial correlation).

**CONCLUSIONS:** Adolescents met the recommended level of daily MVPA for approximately one-third of the initial 40 days of the personalized intervention. Perceived barriers to exercise could be influencing their consistent adherence to the recommended frequency of 7 days per week.

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**1941 Board #82 May 28 9:00 AM - 10:30 AM**  
**Effect Of Maturation On Anthropometrical And Fitness Variables In 14 Year-Old Boys**

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Maturity can discriminate performance in individuals of similar age and because of this the use of maturity levels should be used to detect differences in fitness and body composition in youngsters.

**PURPOSE:** To examine the differences in anthropometrical and fitness variables between different maturational stages in 14 year-old boys.

**METHODS:** The sample was composed by 38 boys in the maturity level three (ML-3) and by 68 boys in the maturity level four (ML-4), in the age of 14 years old. The measurements of sexual maturation were made according to the procedures suggested by FAULKNER (1996), fat percentage was calculated by the equation of BOILEAU et al. (1985), blood pressure (BP) was collected by the procedures suggested by ACSM (2003), sit-and-reach test and hand grip test were performed according to JOHNSON and NELSON (1986) and  $\text{VO}_2$  max was estimated using the 20-m Shuttle Run test developed by LÉGER et al (1986). Mann-Whitney U test was used to examine the difference between the means of anthropometric and fitness variables due to maturational levels.

**RESULTS:** Chronological age was similar for ML-3 and ML-4 ( $14.4 \pm 0.2$  and  $14.4 \pm 0.2$  years). However, differences were found for body weight ( $50.7 \pm 10.8$  and  $58.3 \pm 11.3$  Kg), height ( $161.3 \pm 9.4$  and  $168.3 \pm 7.7$  cm), lean body mass ( $41.0 \pm 6.9$  and  $46.3 \pm 7.1$  Kg), grip strength of right hand ( $32.2 \pm 6.2$  and  $38.0 \pm 6.8$  Kg) and grip strength of left hand ( $30.2 \pm 6.2$  and  $35.2 \pm 6.9$  Kg),  $p < 0.05$ . No differences were found for BMI ( $19.3 \pm 3.2$  and  $20.5 \pm 3.7$  Kg/m<sup>2</sup>), fat percentage ( $18.1 \pm 6.7$  and  $19.5 \pm 7.4$  %), fat mass ( $9.6 \pm 5.3$  and  $11.9 \pm 6.3$  Kg), flexibility ( $22.3 \pm 6.9$  and  $22.8 \pm 7.1$  cm), predicted  $\text{VO}_2$  max ( $43.4 \pm 6.6$  and  $44.1 \pm 5.6$  ml/kg/min), systolic BP ( $110.0 \pm 15.5$  and  $114.0 \pm 13.6$  mmHg) and diastolic BP ( $66.4 \pm 10.0$  and  $69.0 \pm 9.9$  mmHg).

**CONCLUSIONS:** The self-assessment of the male reproductive tract development was useful to detect differences in anthropometric, body composition (lean body mass) and fitness (muscular power) variables in pubertary men.

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**1942 Board #83 May 28 9:00 AM - 10:30 AM**  
**Short Duration Jumping Increases Lean Tissue And Reduces Fat In Adolescent Boys But Not Girls**

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The dramatic rise in prevalence of chronic diseases, such as obesity, cardiovascular disease, and musculoskeletal conditions, is matched by a clear reduction in levels of physical activity among children and adolescents. There is an urgent need to implement preventative strategies during childhood that are community-based, widespread, and effectively target body systems most at risk in later life.

**PURPOSE:** To determine the effect of a regular, school-based, short duration, high intensity jumping regime on muscle, bone, and fat tissue in healthy adolescent boys and girls.

**METHODS:** We replaced regular warm up activities with jumping in the twice-weekly PE classes of early high school students for 8 months to observe the effect on lean and fat tissue. A total of 99 adolescents (46 boys, 53 girls;  $13.8 \pm 0.4$  years) volunteered to participate. Intervention group subjects performed ten minutes of high intensity jumping activity, while control subjects performed their regular PE warm-up (i.e. jogging and stretching). Anthropometrics, Tanner staging, peak height velocity, and whole body bone mineral content (BMC), lean tissue, and fat mass (DXA-derived) were measured at baseline and follow-up. Physical activity was determined by questionnaire.

**RESULTS:** There were no differences in any measured variable between control and intervention groups at baseline. No group differences were detected for 8-month change in anthropometric or maturity measures for boys or girls. Analysis of 8-month change in grouped data revealed that jumpers increased whole body BMC ( $p = 0.001$ ) and lean tissue mass ( $p = 0.001$ ) significantly more than controls. Sex-specific analysis, however, showed that intervention boys gained more whole body BMC ( $p = 0.001$ ) and lean tissue mass ( $p = 0.001$ ) and lost more fat mass ( $p = 0.03$ ) than controls, while intervention girls improved only whole body BMC ( $p = 0.003$ ) over controls.

**CONCLUSIONS:** Short duration, high intensity jumping activity during adolescence appears to improve bone, lean tissue, and fat in a sex-specific manner. We found that boys gained more lean tissue and bone mass and lost more fat mass, while girls gained more bone mass with no differences in lean or fat tissue.

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**1943 Board #84 May 28 9:00 AM - 10:30 AM**  
**Agreement Between Body Mass Index and Percent Body Fat In Determining Clinical Cutpoints For Youth**

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**PURPOSE:** A major uncertainty in clinical and epidemiological research relates to the level of uniformity between the clinical cutpoints used in conjunction with body mass index (BMI), waist circumference (WC), and percent body fat (%BF). The purpose of this study was to examine the diagnostic performance of BMI and WC in relation to an estimate of %BF in children and adolescents.

**METHODS:** Clinical data on youth (5-18 years old) were obtained from 3 cross-sectional waves (1999-2000, 2001-2002, 2003-2004) of the National Health and Nutrition Examination Survey ( $n = 8,228$ ). Percent fat was derived from the skinfold thicknesses, stature and body mass were used to calculate BMI, and WC was also measured. Receiver operator characteristic (ROC) analysis was employed to determine optimal cutpoints between the various adiposity indices using previously recommended BMI, WC, and %BF cutoff values. Sex- and ethnicity-specific %BF percentiles were also created and used to explore diagnostic agreement among the aforementioned indices.

**RESULTS:** The optimal %BF values associated with an overweight BMI in boys ranged from 14%-23% across the age range in all ethnicities. The corresponding values for girls were slightly higher and covered a larger range (16%-33%). For both sexes, the 85<sup>th</sup> BMI percentile corresponded with slightly lower %BF values for black youth. However, at the 95<sup>th</sup> BMI percentile, the values for boys were almost identical ranging from 17%-28% fat. In girls, the %BF values were lower for blacks than for white or Mexican American girls.

**CONCLUSIONS:** The findings of this study suggest that a single-value %BF cutoff (such as the 25% or 30% thresholds currently used in FITNESSGRAM) is not appropriate for use across the pediatric age range. Instead, using %BF percentiles may improve diagnostic agreement with the current BMI thresholds of overweight and obesity, especially for females. Further, the results indicate that BMI and %BF association is modified by ethnicity. The optimal cutoffs are provided for each adiposity index, based on the sum of sensitivity and specificity.

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**1944 Board #85 May 28 9:00 AM - 10:30 AM**  
**Lean Mass As A Predictor Of Bone Mineral Density In Prepubertal Children**

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The relative contribution of lean tissue and fat mass as predictors of bone mineral density (BMD) varies across the adult lifespan, especially during midlife and old age. The relative influences of fat and lean mass on BMD in prepubertal children remains inadequately characterized. Relations between body composition and bone status may be influenced by the obesity epidemic, low physical activity rates and suboptimal nutritional practices in children with the latter behaviors potentially impacting attainment of peak bone mass and subsequent risk for osteoporosis later in life.

**PURPOSE:** To determine if fat or lean mass explains the greatest variance in BMD in prepubertal children, and if the contribution of the respective body composition components is impacted by sex.

**METHODS:** Whole body (WB), lumbar spine (LS), femoral neck (FN) and hip (HIP) BMD, and total fat and lean mass were determined by dual energy X-ray absorptiometry (DXA) in 96 prepubertal children [9.2±1.3 y; males (n=49) and females (n=47)].

**RESULTS:** Mean WB BMD was 0.83±0.08 g/cm<sup>2</sup> (WB Z-score=0.19). Fat (12.3±7.9 kg) and lean mass (28.9±6.7 kg) both correlated with WB BMD (r=0.45, r=0.77, respectively) and regional BMD (r range=0.36 to 0.67; all p<0.01). However, the relationships between fat and all BMD measures were eliminated after controlling for lean mass (all p>0.05). Alternatively, when accounting for the influence of fat mass, the relationship between lean mass and BMD persisted (r range=0.53 to 0.72, all p<0.01). Using linear regression, fat mass was not an independent predictor at any site whereas lean mass was an independent predictor of WB, LS, FN, and HIP BMD (all p<0.01), explaining 60%, 44%, 41% and 39% of the variance, respectively. Sex was also an independent predictor of LS BMD explaining 11% of the variance with females having greater LS BMD; however, sex was not a predictor at the WB or FN and HIP sites.

**CONCLUSIONS:** Although fat and lean mass both influence BMD in prepubertal children, lean mass is the most significant independent predictor of BMD. These results encourage health behaviors that enhance lean mass, specifically physical activity, to optimize bone mineral accrual prior to adulthood.

Supported by University of Illinois Research Board and NIH HD05532

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**1945 Board #86 May 28 9:00 AM - 10:30 AM**

**Aerobic Fitness And Adiposity In Overweight And Non Overweight Eight Year Old Children**

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Obesity poses a substantial health risk to children across the world. Excess body fat is associated with increased morbidity and mortality in adults. Globally, the medical community is encouraging children to engage in more aerobic exercise as part of a healthier lifestyle.

**PURPOSE:** The objective of the present study was to determine the relationship between aerobic (cardio-respiratory) fitness and body fat percentage in both non-overweight and overweight 8-year-old school children. Our study was based on the hypothesis that high aerobic fitness would be associated with lower levels of total and central adiposity.

**METHODS:** A cross-sectional study was conducted in a random sample of 10 elementary schools. The study participants were a 245 healthy second-grade elementary school children aged 8.9 ± 0.4 yrs (125 boys, 120 girls), all of whom were recruited in the OLIMP study (Obesity and Physical Activity among Serbian School Children).

Anthropometric data (height, body mass, waist circumference, five skin-fold thickness measurements) were collected and body fat percentage was calculated. Body mass index (BMI) sex- and age-specific cut-off points were used to define overweight and obesity. Children were placed in two groups: overweight/obese and non-overweight. Aerobic fitness was assessed with the multi-stage shuttle run fitness test. Subjects were grouped into high (upper two quintiles) and low (lower two quintiles) aerobic fitness based on age and sex distributions.

**RESULTS:** Body mass index, waist circumference, five skin-fold thicknesses and total body fat were lower in overweight and obese children with high aerobic fitness in comparison with youths at the same BMI category with low fitness level (p < 0.01). The beneficial effect of high aerobic fitness was also present in non-overweight children (p < 0.01). Finally, aerobic fitness was moderately inversely correlated with total body fat in the whole group of subjects (r = - 0.48, p < 0.01). Indicators of local and total adiposity were lower in overweight and obese children with high aerobic fitness.

**CONCLUSIONS:** Increasing aerobic fitness correlates with lower rates of obesity in 8-year-old children. Further studies may help illuminate whether these decreased levels of obesity translate into decreased morbidity and mortality.

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**1946 Board #87 May 28 9:00 AM - 10:30 AM**

**Levels Of Physical Fitness As Predictors Of Overweight And Obesity In Rural Youth**

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(No relationships reported)

There has been a worldwide increase in the prevalence of obesity in children and adolescents with a subsequent increase in the prevalence of obesity-associated morbidities. Several studies have suggested a decrease in physical fitness among young people.

**PURPOSE:** The purpose of the present study was to determine the risk of a young person to present a high or very high percentage of body fat (%BF) high, when his/her level of physical fitness is below the healthy fitness zone (HFZ).

**METHODS:** The sample of this study consisted of 91% of a school population from a rural area of Madeira Island, Portugal, totalling 790 children and adolescents of both genders, aged between 10 and 17 years of age. Percentage body fat (%BF) was estimated by measuring skinfolds and Slaughter et al. (1988) equations, classified in categories according to Lohman (1987). Physical fitness was assessed with the Fitnessgram test battery (Cooper Institute for Aerobics Research, 2002).

**RESULTS:** Of the 5 fitness tests, all of them except for the seat-and-reach test, were found predictors of a high or very high %BF when the scores were below the HFZ. The risk was higher for the Pacer test (OR=3.65, CI 95%: 2.50 - 5.35), followed by push-ups test (OR=1.62, CI95%: 1.11-2.37), and the curl-ups test (OR=1.61, CI 95%: 1.08-2.39).

**CONCLUSIONS:** The subjects falling below the HFZ have a higher risk of high or very high %BF when compared with their peers classified in or above the HFZ. The risk was higher for the Pacer, curl-ups and push-ups tests.

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**1947 Board #88 May 28 9:00 AM - 10:30 AM**

**Relationships Between Body Composition Variables And Lower Limb Morphology In Children**

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Pain and lesions during the practice of sports and exercise are often attributed to the lower limbs morphology. Childhood and adolescence may a critical period to consolidate a good morphology. Nevertheless, the knowledge about the relationships between lower limbs morphology alterations and body composition in youth and children is lacking. It has been hypothesized that the overload resulting from overweight during growth is associated with some morphologic alterations (mainly in the knee and feet).

**PURPOSE:** To explore the relationships between anthropometric variables, percent of fat mass (%FM) and skeletal muscle mass, and leg and foot morphotypes.

**METHODS:** One hundred fifty children aged 12-18 years (75 boys and 75 girls) were assessed. %FM was estimated using Slaughter's equation with skinfolds. Morphological characteristics were assessed with goniometers. Ischiotibial shortening was assessed by lumbovertical (LV), EPR and the fingers-foot distance (FFD). Genu varum, genu valgum and foot morphotype were measured using a mechanical podometer. Pearson's correlation coefficient was used to test the association between variables. Significance was set at  $p < 0.05$  level.

**RESULTS:** A significant correlation between genu varum and height was observed ( $r = -0.23$ ,  $p = 0.004$ ). Genu valgum morphotype was positively associated with weight ( $r = 0.5$ ,  $p < 0.001$ ), BMI ( $r = 0.59$ ,  $p < 0.0001$ ) and %FM ( $r = 0.54$ ,  $p < 0.001$ ). Height was negatively associated with hamstring flexibility: EPR ( $r = -0.23$ ,  $p = 0.03$ ), LV ( $r = -0.24$ ,  $p = 0.002$ ), and FFD ( $r = -0.21$ ,  $p = 0.008$ ). Significant positive relationships were found between flat foot and body weight ( $r = 0.34$ ,  $p = 0.001$ ), BMI ( $r = 0.36$ ,  $p = 0.0001$ ) and %FM ( $r = 0.23$ ,  $p = 0.004$ ), while bare foot was not significantly associated with any of the anthropometric variables analyzed.

**CONCLUSIONS:** This was the first study to show that BMI, %FM and weight were negatively correlated with genu valgum morphotype and flat foot. Moreover, height was associated with genu varum and hamstring muscle shortening. The novel contribution of the current findings is that they have shown that childhood obesity is a risk for morphological alterations, indicating an interaction between physiological and biomechanical variables. The mechanisms upon which these interactions are established require further research.

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**1948 Board #89 May 28 9:00 AM - 10:30 AM**  
**Effectiveness Of A Summer Training Program On Sprint Acceleration Of High School Athletes**

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Sprint acceleration is a key factor in an athlete's success to out-accelerate and out-run an opponent. There are many types of conditioning programs that athletes can use to improve their overall speed. A good conditioning program should focus on the acceleration phase of the sprint as well as the entire distance.

**PURPOSE:** To investigate the effectiveness of a seven-week training program on the 9.144 m (10 yard) sprint acceleration performance of high school students who were enrolled in a summer sports enhancement camp.

**METHODS:** Eighteen high school athletes, ten male (56%) and eight female (44%), between the ages of 15 and 18, who were involved in a high school sport participated in a four day a week, seven week, non-sport specific summer sports enhancement camp. Students and their parents signed informed consent forms to participate in the study. To determine the student's initial acceleration, all athletes completed a ten-minute warm-up consisting of a jog, dynamic stretching, form running, and static stretching. Upon warm-up completion, the athletes were instructed in the proper technique needed to use the electronic timing system and contact switch used to measure their 9.144 m sprint time. Each athlete was given two attempts at sprinting through the timing system with the faster of the two attempts recorded. Students then participated in the summer sports enhancement camp for 7 weeks. When the camp was completed, post-testing occurred using the same method as the pre-test.

**RESULTS:** A paired sample T-test revealed no significant differences between pre-test sprint acceleration times and post-test sprint acceleration times with ( $p = 0.52$ ). After the implementation of the four-day-a-week training program over seven weeks, 55.6% (10) of the participants showed a slower sprint acceleration time, 38.9% (7) showed an improvement in sprint acceleration times, and 5.6% (1) of the participants showed no change in sprint acceleration time.

**CONCLUSION:** The results of this study indicated that the implementation of the summer training program did not have an affect on the improvement of sprint acceleration times of the high school athletes involved.

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**1949 Board #90 May 28 9:00 AM - 10:30 AM**  
**Validity Of The 20-m Msrt As A Predictor Of Vo2peak In Lisbon Elementary School Children**

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(No relationships reported)

Several studies have validated the 20-m multistage shuttle-run test (MSRT) in children by measuring the  $VO_{2peak}$  value in the laboratory and relating this to the number of laps completed.

**PURPOSE:** The aim of this study was to examine the validity of the FITNESSGRAM's MSRT software reports as a predictor of  $VO_{2peak}$  in Lisbon healthy school children, by measuring the  $VO_{2peak}$  during the actual 20-m shuttle run performance.

**METHODS:** Ninety subjects, 45 boys and 45 girls aged 8-10 years, performed the MSRT and their  $VO_{2peak}$  was determined in field using a portable gas analyzer (K4b<sup>2</sup>, Cosmed, Rome, Italy). Height and weight were measured with standard anthropometric methods, percentage of fat (%Fat) was estimated from skinfold thickness, and the number of completed laps during the shuttle run was recorded and estimated  $VO_{2peak}$  values were derived via established FITNESSGRAM's equation. The determined peak  $VO_2$  value was considered the highest attained value during the last minute of the test.

**RESULTS:** The mean determined  $VO_{2peak}$  value of  $49.6 \pm 9.0$  ml.kg<sup>-1</sup>.min<sup>-1</sup> ( $53.3 \pm 9.2$  ml.kg<sup>-1</sup>.min<sup>-1</sup> in boys and  $45.9 \pm 7.3$  ml.kg<sup>-1</sup>.min<sup>-1</sup> in girls) was compared to the mean estimated  $VO_{2peak}$  value of  $47.8 \pm 2.7$  ml.kg<sup>-1</sup>.min<sup>-1</sup> ( $48.9 \pm 2.7$  ml.kg<sup>-1</sup>.min<sup>-1</sup> in boys and  $46.7 \pm 2.2$  ml.kg<sup>-1</sup>.min<sup>-1</sup> in girls) and this difference was significant ( $P = 0.02$ ). The  $r$  was 0.72 and 22.2% of the difference scores fell outside 9 ml.kg<sup>-1</sup>.min<sup>-1</sup> of the measured  $VO_{2peak}$  SD. The mean difference was higher in boys ( $4.4 \pm 7.5$  ml.kg<sup>-1</sup>.min<sup>-1</sup>,  $P < 0.001$ ) than in girls ( $-0.7 \pm 6.2$  ml.kg<sup>-1</sup>.min<sup>-1</sup>,  $P = 0.445$ ).

**CONCLUSION:** These results suggest that the FITNESSGRAM's MSRT software reports underestimate the  $VO_{2peak}$  values determined by the K4b<sup>2</sup> in boys, but are suitable for girls.

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**1950 Board #91 May 28 9:00 AM - 10:30 AM**  
**Gender Differences In Functional Movement Screen And Y-balance Test Scores In Middle School Aged Children**

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Poor static and dynamic postures have been related to musculoskeletal injury. These postures can cause poor arthrokinematics, which in time may lead to pain and disability. Recent research has suggested that better functional movement and dynamic balance are associated with reduced injury rates. However, there are no published reports in this area on middle school aged children and whether gender differences exist in this age group.

**PURPOSE:** To examine gender differences in functional movement quality and dynamic balance, as measured by the Y-Balance testing protocol, in middle school aged children.

**METHODS:** Two physical education classes of middle school aged students (13 boys and 19 girls) were recruited for the study. Informed consent was obtained from the students and the students' parents. All students participated in dynamic balance testing using the anterior, posteromedial, and posterolateral reach directions of the Star Excursion Balance Test as measured by the Y-Balance testing device. Scores on anterior, posteromedial, posterolateral, and composite reach distances were normalized to leg length. In addition to Y-Balance testing, all students participated in the Functional Movement Screen. The Functional Movement Screen consisted of 7 tests: squat, lunge, hurdle step, push up, shoulder mobility, active straight leg raise, and rotary stability test. Independent samples t-tests were used to examine differences between boys and girls for the Y-Balance Test scores while Mann-Whitney U tests were used to examine differences in the functional movement tests due to the rank-order nature of the data.

**RESULTS:** Girls performed better on the squat, lunge, straight leg raise, and shoulder mobility compared to boys ( $p < 0.05$ ). There were no statistically significant differences between girls and boys for the hurdle step, push up, rotary stability or any of the Y-Balance Test reach scores ( $p > 0.05$ ).

**CONCLUSION:** Girls and boys of middle school age may exhibit different qualities of functional movements. Studies focused on improving functional movements in middle school aged children should consider these findings when developing interventions aimed at improving functional movements.

*Supported by the Welborn Baptist Foundation, Inc.*

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**1951 Board #92 May 28 9:00 AM - 10:30 AM**  
**Longitudinal Modeling Of Physical Activity, Body Fatness And Blood Pressure During Childhood**

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Our understanding of the inter-relationships among habitual, free-living physical activity and body fatness and resting blood pressure (BP) in children are based mainly upon cross-sectional studies. However, such studies cannot distinguish the effects of normal growth and maturation from the effects of physical activity on physical traits. To distinguish the independent effects of physical activity in the growing child, individual growth trajectories must be identified using longitudinal data.

**PURPOSE:** The purpose of this study was to investigate the independent effects of a) physical activity on fat mass and BP development and b) fat mass on BP development; whilst accounting for the confounding effects of growth.

**METHODS:** Subject were 173 (86 girls and 87 boys) children participating in a mixed-longitudinal study. Age at entry was 4 to 8 years of age. Stature, body mass, body fatness, resting BP and moderate-to-vigorous physical activity (MVPA) were assessed annually for 3 to 4 years. Data were analyzed using multi-level random effects models.

**RESULTS:** BP increased with chronological age, and MVPA decreased in the older age groups. In girls but not boys, when the confounders of age and stature were controlled, it was found that MVPA had a significant time-dependant effect on fat mass accrual ( $-0.03 \pm 0.01$  g;  $p < 0.05$ ). The difference in mean arterial pressure between the normal weight and obese at each age was  $7 \pm 1$  mm Hg. There was no significant influence of MVPA on BP development in boys or girls, even when removing fat mass as a confounder.

**CONCLUSIONS:** Habitual MVPA had a small influence on the growth of fat mass in girls but not resting BP once age and stature were accounted. In turn, fat mass influenced BP development in both sexes; however, the differences in fat mass and BP are already apparent at age 4 years. Thus, further investigation into the influence of prenatal and early growth and the role of physical activity and other environmental factors during this period is warranted.

*Supported by American Heart Association grant # 0665500Z.*

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**1952 Board #93 May 28 9:00 AM - 10:30 AM**  
**Effects Of A Sports Performance Training Program On Adolescent Athletes.**

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(No relationships reported)

It is well established that resistance training can be safe and effective for children and adolescents. In addition, improvements in sports performance can be further developed through plyometric training and general instruction of fundamental movements.

**PURPOSE:** The purpose of this study was to determine the effects of a training intervention that combined strength, plyometric, and speed and agility training on sports performance in adolescents.

**METHODS:** Twelve middle and high school girls and boys (aged  $14.7 \pm 1.7$  years) participated in a seven week youth sports performance training (YSPT) intervention. The YSPT program met three days a week on non-consecutive days for ninety minutes. At baseline and after training all participants performed a static and countermovement vertical jump, push-ups, pro agility run, overhead medicine ball toss, and 40 yard dash. These skills were assessed for quality of the skill using a 1-5 Likert scale. Weight, height, sitting height, and years of experience playing sports and strength training were recorded.

**RESULTS:** While vertical jump, overhead medicine ball toss, and the 40 yard dash all improved, the paired samples t-test revealed significant improvements only in push-ups ( $29.5 \pm 18.6$ ,  $38.8 \pm 15.8$ ,  $P = 0.0$ ) and pro agility ( $5.2 \pm 0.4$ ,  $5.1 \pm 0.3$  sec,  $P = 0.024$ ) from baseline to after training. The Wilcoxon test demonstrated significant improvements in the quality of the skill only for pro agility. Pearson correlations performed between age and change in performance showed moderate relationships in vertical jump, overhead medicine ball toss, and 40 yard dash.

**CONCLUSIONS:** These findings suggest that a short-term youth training program that focuses on sports performance may have a positive effect on upper body muscular strength and endurance and agility in adolescents. While this study supports positive adaptations to training in adolescents, it also suggests researchers should continue to investigate the effects of learning a skill on performance in this age group.

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**C-31 Free Communication/Poster - Dynamical Systems**

MAY 28, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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**1953 Board #94 May 28 8:00 AM - 9:30 AM**  
**A Passive Dynamic Model For Simulation Of Interpersonal Synchronization During Side By Side Walking**

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(No relationships reported)

Unintentional synchronization of stepping occurs frequently during side by side walking, yet little is known regarding the physiological mechanisms that underlie this coupling.

Our preliminary data suggest that this behavior varies among subject pairs, due in large part to differences in the leg length of each individual. Because an individual's leg length is a potential determinant of their preferred walking speed, analysis of a simple walking model may lend insight to this phenomenon.

**PURPOSE:** To examine the relationship between leg length and over-ground velocity in a passive dynamic walking model as a first step toward a model of gait entrainment, and to compare results to empirical data.

**METHODS:** A simplified model of bipedal locomotion based on an inverted double pendulum was utilized to simulate human gait. An additional term was introduced to simulate hip actuation via spring, acting on the angle between the walker's legs to allow for control of cadence. Simulations were performed for 100 steps, and leg length (L) was progressively increased for each case. At each value for L, the spring stiffness (K) was altered to maintain a consistent cadence. Simulation results were compared with data obtained from 27 pairs of subjects of varying leg lengths walking on side by side treadmills.

**RESULTS:** Synchronization of cadence was successfully achieved in the model by varying K for values of L up to 130%. Beyond this level, hip actuation alone was not sufficient to achieve synchronization. In addition, over-ground velocity was not maintained at a consistent level across changes in K and L. For small increases in L, simulations indicated that K required for synchronization increased in a curvilinear fashion, suggesting that increased effort is required for synchronization in partners with differing leg lengths. This idea was supported in the laboratory, where subjects that exhibited synchronization had significantly smaller differences in leg length ( $3.7 \pm 2.1$  cm vs  $7.3 \pm 5.2$  cm,  $p=0.02$ ).

**CONCLUSIONS:** These results suggest that interpersonal synchronization may require additional effort and may present an increasingly complex dynamical problem for the CNS as the difference in subject leg length is increased. Further investigation and development of this model will be necessary to fully understand this behavior.

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**1954      Board #95      May 28      8:00 AM - 9:30 AM**  
**Optimizing Movement Performance Through Understanding: An Application Of Dynamic Systems**

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(No relationships reported)

Dynamic systems theory suggests that a system in transition is in the process of developing new movement patterns. More precisely, as attractors lose stability the behavior of interest becomes more varied and less reliable. This loss of stability can be captured as an increase in the standard deviation or patterning of the behavior of interest and may reflect an increase in the systems adaptability.

**PURPOSE:** To provide evidence that increasing the cognitive understanding of systemic function facilitates the development of adaptability (i.e. increased variability of behavior) in older women who have had a knee joint replaced.

**METHODS:** A mixed method approach was used to provide evidence of performance change with a cognitive systemic training intervention. Four women from 59 to 72 years old who had had a knee replacement within the last year served as participants. Subjects were placed into 2 groups (n=2). Group 1 (experimental) took part in 10 training sessions over a 5-week period. Sessions utilized a systems approach to facilitate an optimization of movement through an expanded understanding of movement. Group 2 (control) took part in only 2 data collection sessions separated by 5 weeks. This group took place in no additional activity. Quantitative measures were collected for both groups prior to and following the 10 training sessions.

**RESULTS:** Group 1 showed increases in stride and step time, stride length, and stride velocity compared to Group 2. The standard deviation for Group 1 showed a 12-fold difference in gait time and a 4-fold difference in gait length compared to Group 2. Additionally, characteristic measures: Group 1 had a change of ROM during stride for hip, knee and ankle as compared to no change in Group 2.

**CONCLUSIONS:** These results support the systems perspective that the development of new patterning may be reflected through directional change, increased variance, and characteristic modification. The data indicates that the development of movement behavior occurred, thus suggesting that patients who have undergone knee replacement may benefit from a cognitive systemic training intervention.

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**1955      Board #96      May 28      8:00 AM - 9:30 AM**  
**Instrumentation And Calibration Of Track And Field Starting Blocks For The Measurement Of Kinetic Data**

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(No relationships reported)

**INTRODUCTION:** Several studies have been performed to measure kinetic properties of the sprint start in track and field. Many of these studies have been conducted in labs using starting blocks mounted over force platforms to measure reaction force (RF) in the blocks. However, a lab without a force plate would need to spend \$20,000 to \$30,000 for the purchase and installation of such hardware and software. This solution also leaves the sprinter in the restricted atmosphere of the lab, unless a specialized track surface with mounts for a force plate are available. More recently, instrumented starting blocks have become commercially available but cost upwards of \$20,000, and for many research labs the limited utility of a set of instrumented blocks does not justify the cost.

**PURPOSE:** To provide a cost-effective solution for collecting force data from a set of starting blocks while keeping the surrounding environment comparable to a competition setting.

**METHODS:** To simplify this introductory project, only one side of a standard Olympic style track and field starting block (wedge) was customized to measure RF. To do so, a plate was fabricated to sandwich four uniaxial load cells (Transducer Techniques MLP-500) to the starting wedge. Uniaxial load cells were used to keep costs lower but have the limitation of only providing RF perpendicular to the surface of the wedge. The cost of hardware for this specific application was less than \$3,200. The device was then calibrated using a least squares technique.

**RESULTS:** After using a least squares calibration to produce regression coefficients for the four load cells in the system, the customized plate was loaded with known weights in the range of 30 to 100lbs. The regression predicted the known weights with less than 1% error. A shear force component may be added with one additional load cell mounted perpendicular to the face of the wedge. A fully functional set of blocks (two wedges capable of measuring perpendicular and shear force under each foot with modular amplifiers for each load cell) would be expected to cost approximately \$7,000.

**CONCLUSION:** It is possible to construct a cost-effective, working set of instrumented starting blocks that accurately (<1% error) measures forces.

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**C-32      Free Communication/Poster - Fat Metabolism**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**1956      Board #97      May 28      8:00 AM - 9:30 AM**  
**Reactive Oxygen Species As Signaling Molecules Of Contraction-mediated Metabolic Responses In Skeletal Muscle**  
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Reactive oxygen species (ROS) are expected to be enhanced during exercise to an extent that could affect cell viability. However, changes on redox balance is important for many cellular processes including metabolism.

**PURPOSE:** This study evaluated the effects of changes on intracellular balance redox on contraction-mediated metabolic responses muscle cells.

**METHODS:** Muscle steam cells were isolated from rats. The cells were treated with N-Acetylcysteine (NAC) (800 $\mu$ M) or induced to contractions by electrostimulation during 30 min. ROS; translocation and mRNA of glucose transporter 4 (GLUT-4); uptake of 2-deoxyglucose (2-DG); oxidation of palmitate; activities and mRNA of hexokinase (HK), phosphofructokinase (PFK), citrate synthase (CS) and carnitine palmitoyl transferase 1 (CPT-1) were evaluated.

**RESULTS:** NAC removed the H<sub>2</sub>O<sub>2</sub> produced in baseline (75 $\pm$ 8 vs 40 $\pm$ 3U, p<0.05) and during muscle contractions (122 $\pm$ 6 vs 59 $\pm$ 6U, p<0.05). In baseline, the antioxidant decreased mRNA of GLUT-4 (100 $\pm$ 6 vs 57 $\pm$ 3UA, p<0.05) and PFK-1 (0.16 $\pm$ 0.1 vs 0.13 $\pm$ 0.08UA, p<0.05), increasing the expression of CPT-1 (100 $\pm$ 6 vs 192 $\pm$ 3UA, p<0.05) and CS (98 $\pm$ 4 vs 160 $\pm$ 11 UA, p<0.05). Whereas the oxidation of palmitate (0.07 $\pm$ 0.01 vs 0.093 $\pm$ 0.014  $\mu$ mol, p<0.05) and CS activity (0.8 $\pm$ 0.08 vs 1.9 $\pm$ 0.1 nmol/min, p<0.05) were increased. The removal of intracellular H<sub>2</sub>O<sub>2</sub> during muscle contractions decreased the translocation of GLUT-4 (137 $\pm$ 13 vs 102 $\pm$ 5UA, p<0.05), uptake of 2-DG (0.266 $\pm$ 0.01 vs 0.177 $\pm$ 0.02  $\mu$ mol/mg, p<0.05) and activity of PFK-1 (0.20 $\pm$ 0.033 vs 0.15 $\pm$ 0.02 nmol/min, p<0.05). H<sub>2</sub>O<sub>2</sub> increased glucose uptake (0.1 $\pm$ 0.01 vs 0.6 $\pm$ 0.01  $\mu$ mol/mg, p<0.05), and the activities of HK (0.18 $\pm$ 0.02 vs. 0.145 $\pm$ 0.01 nmol/min, p<0.05) and PFK-1 (1.7 $\pm$ 0.2 vs 1.04 $\pm$ 0.1 nmol/min, p<0.05) compared to control. Muscle contraction increased activity of CS (0.18 $\pm$ 0.02 vs 0.145 $\pm$ 0.01 nmol/min/mg, p<0.05) and oxidation of palmitate (0.065 $\pm$ 0.007 vs 0.11 $\pm$ 0.01  $\mu$ mol/mg, p<0.05).

**CONCLUSIONS:** the contraction-induced H<sub>2</sub>O<sub>2</sub> is associated with glucose uptake, activation of glycolytic enzymes and expression of genes related to glucose metabolism. In contrast, at low intracellular level of H<sub>2</sub>O<sub>2</sub> there was an increasing in activity and mRNA of CPT-1, suggesting that ROS regulates the metabolism of glucose and fatty acids in skeletal muscle cells. Support: FAPESP/CNPq.

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**1957 Board #98 May 28 8:00 AM - 9:30 AM**  
**The Effects Of Gradual Intensity Decrement Running On Fat Metabolism**

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Exercise is essential for a sound weight control program. However, what mode of exercise is optimal to metabolize fat is not clear.

**PURPOSE:** To investigate the effects of gradual intensity decrement running on fat metabolism and energy expenditure.

**METHODS:** Twelve healthy males served as subjects (age 25.2  $\pm$  2.4 yrs; height 176.9  $\pm$  6.6 cm; weight 70.2  $\pm$  9.0 kg; body fat 17.6  $\pm$  5.2 %; VO<sub>2</sub>max 48.2  $\pm$  5.3 ml/kg/min). The ACSM policy regarding human subjects and informed consent was followed. Subjects performed the same duration (60 min, each 10-min period represented one stage) treadmill running with constant intensity exercise (CIE, 5% below AT VO<sub>2</sub>) and with gradual intensity decrement exercise (GDE, 5% below AT VO<sub>2</sub> with a decrease of 5% every 20 min). A repeated-measures design (seven days apart) was used, and the testing order was counterbalanced. A MetaMax 3B was used to measure VO<sub>2</sub> and RER. SPSS software (13.0) was used for data analysis and the significance level was set at p<.05.

**RESULTS:** CIE was significantly higher than GDE at the 3<sup>rd</sup>, 5<sup>th</sup>, and 6<sup>th</sup> stages of the energy expenditure (122.8  $\pm$  26.9 vs. 114.1  $\pm$  24.3 kcal; 124.1  $\pm$  23.5 vs. 103.0  $\pm$  23.8 kcal; 124.9  $\pm$  23.6 vs. 102.8  $\pm$  25.3 kcal). CIE was also significantly higher than GDE for total energy expenditure (1600.1  $\pm$  323.7 vs. 1283.3  $\pm$  228.0 kcal). The RER of GDE was significantly lower than CIE at the 5<sup>th</sup> and 6<sup>th</sup> stages (0.80  $\pm$  0.06 vs. 0.83  $\pm$  0.06; 0.79  $\pm$  0.06 vs. 0.83  $\pm$  0.06). There was no significant difference in the amount of fat burned for both modes of exercise (374.3  $\pm$  149.0 vs. 380.9  $\pm$  113.8 kcal). Although the ratio of fat utilization showed no significant difference, GDE was slightly higher than CIE during the last 3 stages of exercise. On the rating of perceived exertion (RPE), GDE was significantly lower than CIE at the 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> stages (10.6  $\pm$  1.4 vs. 12.0  $\pm$  1.9; 10.8  $\pm$  1.9 vs. 12.3  $\pm$  2.2; 10.4  $\pm$  2.2 vs. 12.7  $\pm$  2.4; 10.3  $\pm$  2.4 vs. 13.0  $\pm$  2.6).

**CONCLUSIONS:** Although CIE burns more calories than GDE, fat metabolism was not significantly higher than GDE. However, due to the intensity decrease during exercise, GDE would make people feel that exercise was easier, and this may lengthen exercise duration. Therefore, GDE may be a better mode of exercise for weight control.

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**1958 Board #99 May 28 8:00 AM - 9:30 AM**  
**High-Fat Diet Based on Brazilian Diet Profile Induces Obesity and Hyperglycemia in Wistar Rats.**

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(No relationships reported)

Obesity has been reported as a worldwide epidemic, independently of economic, social conditions. The cause of increased mortality and morbidity associated with obesity has been focused by many studies

**PURPOSE:** The aim of this study was to develop a high fat diet based on the dietary intake of Brazilian obese women able to induce obesity in healthy female rats.

**METHODS:** The diet was formulated with lard as fat source (38.7% of calories), casein as protein source (17.1% of calories) and starch as carbohydrate source (44.2% of calories). Female Wistar rats were fed either with high fat diet (FD) or with the control diet (CD) for 40, 60 and 120 days

**RESULTS:** After 40 days eating the high fat diet, rats presented the same body weight in both groups; however, the rats fed with a high fat diet presented higher brown adipose tissue mass compared with the control rats, and also, more fat in their carcass (CD 78.88 $\pm$ 14.24; FD 112.41 $\pm$ 21.98). Evidences of fat accumulation were more exacerbated when diet was held for 60 and 120 days. We could also identify impairment in glucose tolerance, hyperinsulinemia (29.7%) and hyperglycemia (9.3%) after the intake of the high fat diet. The rats that fed on the high fat diet for 60 days presented impaired Glut 4 (CD 0.7356 $\pm$ 0.0501 vs. FD 0.6086 $\pm$ 0.0571) and insulin receptor (CD 0.9689 $\pm$ 0.1458 vs. FD 0.3046 $\pm$ 0.0842) gene expression.

**CONCLUSIONS:** The high fat diet developed in this study was efficient in inducing obesity and glucose intolerance in healthy female Wistar rats.

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**1959 Board #100 May 28 8:00 AM - 9:30 AM**  
**Fat Distribution In The 'Fat-fit' As Determined By Magnetic Resonance Imaging And Magnetic Resonance Spectroscopy**

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Background: Obesity does not predispose to chronic disease in fit men.

**PURPOSE:** To investigate if fat distribution might help to explain why the 'fat-fit' are protected from the ravages of obesity.

**METHODS:** Magnetic resonance imaging was used to assess total and regional body fat and magnetic resonance spectroscopy was used to assess liver fat in 13 slim-fit men, 4 slim-unfit men, 12 fat-fit men, and 13 fat-unfit men aged 45 $\pm$ 6 years. Waist girth at the narrowest part of the torso was used to distinguish slim men ( $\leq$ 90 cm) and fat men ( $\geq$ 100 cm). Maximal aerobic power (l $\cdot$ min<sup>-1</sup>) was used to distinguish fit men (above average for age) and unfit men (average or below for age). We excluded fit men who had not trained regularly in the last

two years. General linear model analysis of variance and Bonferroni *post hoc* tests were used to compare groups. Data are mean $\pm$ SD.

**RESULTS:** Total fat was not significantly different in the slim-fit and the slim-unfit (15.2 $\pm$ 4.0 and 19.8 $\pm$ 5.5 l, respectively), but was higher in the fat-fit and the fat-unfit (37.3 $\pm$ 11.4 and 37.5 $\pm$ 6.9 l, both  $p < 0.05$  compared to slim men and NS for inter-group comparison). Abdominal subcutaneous adipose tissue was not significantly different in the slim-fit and the slim-unfit (3.0 $\pm$ 1.4 and 3.5 $\pm$ 1.4 l, respectively), but was higher in the fat-fit and the fat-unfit (9.4 $\pm$ 4.2 and 8.0 $\pm$ 1.8 l, both  $p < 0.05$  compared to slim men and NS for inter-group comparison). Visceral adipose tissue was not significantly different in the slim-fit and the slim-unfit (1.4 $\pm$ 0.8 and 3.1 $\pm$ 1.3 l, respectively), but was higher in the fat-fit (4.8 $\pm$ 1.0 l,  $p < 0.05$  compared to the slim-fit) and higher still in the fat-unfit (7.2 $\pm$ 2.4 l,  $p < 0.05$  compared to every other group). Liver fat (geometric mean) was not significantly different in the slim-fit (0.41 $\pm$ 0.54), the slim-unfit (1.61 $\pm$ 1.59) and the fat-fit (5.90 $\pm$ 6.14), but was higher in the fat-unfit (24.08 $\pm$ 24.2,  $p < 0.05$  compared to every other group). Significant differences remained when total, abdominal subcutaneous, and visceral fat were expressed as percentages (data not shown).

**CONCLUSIONS:** These data suggest that favourable levels of visceral and liver fat may help to explain why the fat-fit enjoy protection from the ravages of obesity.

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**1960 Board #101 May 28 8:00 AM - 9:30 AM**  
**Effect Of 12-wk Exercise Training On Lipogenic Gene Expression In Adipose Tissue In Middle Aged Obese Women**

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(No relationships reported)

Effect of 12-wk walking exercise training on regulation of SREBP1c mRNA in adipose tissue in middle aged obese women

Adipose tissue functions as an endocrine organ and secretes numerous proteins in response to a variety of stimuli and lipid synthesis. Sterol regulatory element binding protein 1c (SREBP1c) is a master regulator of lipogenic gene which is expressed in liver and adipose tissue, while SREBPs involved in fat cell differentiation and lipid accumulation. It was demonstrated that SREBP-1c mRNA levels decreased in streptozotocin induced diabetic rats and showed reversed insulin sensitivity. Despite the potential importance of SREBP1c, little is known about the regulation of SREBP1c with exercise training.

**Objectives:** This study was performed to investigate the effect of 12-wk walking exercise program on lipogenic gene expressions in subcutaneous abdominal adipose tissue in obese middle aged women.

**METHODS:** Fourteen obese middle aged women (45-50 years) who met ITF criterion for abdominal obesity with waist circumference ( $\geq 80$ cm) participated in this study. The subjects performed walking exercise program of 3 days per week for 12 weeks without diet control. Calorie expenditure was monitored by commercial calorimeter during the exercise to burn 400kcal per a session. Before and after exercise program, abdominal subcutaneous fat biopsies were taken and the samples used to measure the levels of SREBP-1c, FAS, PPARgamma, UCP2, and CPT1 mRNA by real-time PCR.

**RESULTS:** SREBP-1c mRNA ( $p < .001$ ) significantly increased with 12-wk walking exercise program whereas other adipocyte-related transcription factors, such as FAS, PPARgamma, UCP2, and CPT1 mRNA unchanged.

**CONCLUSION:** The present study demonstrated that insulin resistance may be positively controlled by increased lipid infiltration in adipose tissues after 12-wk walking exercise training

Key words: exercise training, SREBP-1c, FAS, PPARgamma, UCP2, and CPT1 mRNA, real-time PCR.

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**1961 Board #102 May 28 8:00 AM - 9:30 AM**  
**Exercise-induced Oxidative Cpt I Modification And Lipid Metabolism In Skeletal Muscle**

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Oxidative modification of protein impairs its function. Reactive oxygen species generated from mitochondrial during exercise may oxidize mitochondrial protein and partly limit the function. A rate limiting step of lipid metabolism in myocyte is entry of long chain fatty acids into mitochondria via carnitine palmitoyltransferase I (CPT I) located on the mitochondrial membrane.

**PURPOSE:** We investigated the level of oxidative CPT I modification in prolonged exercise associated with lipid utilization in skeletal muscle.

**METHODS:** ICR mice (8 weeks old) were divided into four different groups: sedentary, sedentary treated with astaxanthin (an antioxidant), running exercise, and exercise treated with astaxanthin. After 4 weeks of treatment, exercise groups performed treadmill running. The respiratory exchange ratio (RER) and substrate utilization were calculated from the level of oxygen consumption and carbon dioxide production during exercise. Immediately after running, gastrocnemius muscle and blood sample were collected for the biochemical measurements.

**RESULTS:** Modification of CPT I by hexanoyl-lysine, one of the lipid peroxides, was increased by exercise, while astaxanthin reduced such oxidative stress-induced modification ( $p < 0.05$ ). An increase of the interaction between CPT I and FAT/CD36 in muscle during exercise was facilitated by astaxanthin ( $p < 0.05$ ). RER was significantly decreased in the mice fed an astaxanthin-containing diet compared with those on a normal diet ( $p < 0.05$ ).

**CONCLUSIONS:** Our results suggested that prolonged exercise increases oxidative CPT I modification, which leads to partly limit lipid metabolism.

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**1962 Board #103 May 28 8:00 AM - 9:30 AM**  
**Relationship Between Vo2 At Lactate Threshold And Maximal Fat Oxidation Across Age, Fitness, And Sex**

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(No relationships reported)

**PURPOSE:** To investigate the relationship between VO<sub>2</sub> at lactate threshold (LT) and VO<sub>2</sub> at maximal rate of fat oxidation (FATMAX) across age, fitness status and sex.

**METHODS:** 77 men and 76 women (Age- 33.2 $\pm$ 1.7, 29.4 $\pm$ 1.4; BMI-26.3 $\pm$ 0.5, 29.1 $\pm$ 0.9; %body fat-22.5 $\pm$ 1.1, 35.1 $\pm$ 1.2; VO<sub>2peak</sub>-32.9 $\pm$ 1.1, 23.9 $\pm$ 1.1 respectively) completed a continuous incremental VO<sub>2peak</sub>/LT protocol. Fat oxidation rates were determined using indirect calorimetry and averaged over the last minute of each 3-min stage. The highest recorded fat oxidation rate was chosen as FATmax. The breakpoint in the VO<sub>2</sub>-blood lactate relationship was chosen as LT.

**RESULTS:** VO<sub>2</sub> at FATmax preceded VO<sub>2</sub> at LT in both men and women (48% v. 54% & 42% v. 47% VO<sub>2peak</sub>,  $p = 0.014$ ,  $p < 0.001$ , respectively). The relationship between VO<sub>2</sub> at FATmax and VO<sub>2</sub> at LT remained constant across young and older subjects (18-35yrs -  $r = 0.81$   $p < .001$ ;  $> 50$ yrs -  $r = 0.74$ ,  $P < .001$ ), across VO<sub>2peak</sub> after controlling for age (highest quartile v. lower 3 quartiles -  $r = 0.58$ ,  $r = 0.52$ ,  $p < .001$ , respectively), and was maintained irrespective of sex (M -  $r = 0.80$ , F -  $r = 0.77$ ,  $p < .001$ ). RPE at Fatmax was lower than RPE at LT in all comparisons: young (10.6  $\pm$  0.2 vs. 9.3  $\pm$  0.2), least fit (10.9  $\pm$  0.6 vs. 9.0  $\pm$  0.2) women (10.5  $\pm$  0.2 vs. 9.0  $\pm$  0.2) (all  $p < .001$ ); old (12  $\pm$  1.5 vs. 9.4  $\pm$  0.3,  $p = .085$ ), most fit (11.1  $\pm$  0.3 vs. 10.7  $\pm$  0.5,  $p = .33$ ) and men (11.5  $\pm$  0.9 vs. 9.8  $\pm$  0.3,  $p = .075$ ).

**CONCLUSIONS:** We conclude that the relationship between VO<sub>2</sub> at LT and VO<sub>2</sub> at FATMAX is robust and not affected by age, sex, or fitness status.

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1963 Board #104 May 28 8:00 AM - 9:30 AM

**Responses Of Acetone In Expired Air During Graded And Prolonged Exercise**

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**PURPOSE:** Ketone bodies (3-hydroxybutyrate, acetoacetate and acetone) is synthesized from a chemical reaction of fatty acids and acetyl CoA in the liver. Mobilization of fatty acids from adipose tissue is accompanied by elevation of ketone bodies in blood. A portion of free ketone bodies in circulation is expired from alveolar to expired air as acetone. Recently, a device for detecting acetone in expired air has been developed. The purpose of this study was to determine the responses of acetone in expired air during exercise and to discuss whether the responses of acetone reflect fat mobilization and/or utilization during the exercise.

**METHODS:** Twenty female college students carried out graded bicycle testing and prolonged walking or running testing on a treadmill. In the former, they performed the exercise with an increasing load of 12 watts every minute until near exhaustion. In the latter, they did treadmill walking or running for 2 hours at a load corresponding to the heart rate inducing their maximal fat combustion rate which was found in the previous testing. During both exercises expired gas was collected into Douglas bags so that acetone, oxygen intake and carbon dioxide excretion could be analyzed, from which the fat combustion rate was calculated.

**RESULTS:** In the graded bicycle testing, acetone in the expired air exponentially increased from about 50%  $\dot{V}O_{2max}$ , at which the maximal fat combustion rate and anaerobic threshold were found. In the prolonged walking or running testing, the acetone level gradually increased during exercise. A significant correlation was found between the acetone levels and fat combustion rate.

**CONCLUSIONS:** Acetone in expired air can be an indicator for fat utilization during endurance exercise at constant intensity levels.

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1964 Board #105 May 28 8:00 AM - 9:30 AM

**Expression Of Novel Organic Cation/carnitine Transporter (octn2) In The Skeletal Muscle**

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(No relationships reported)

The primary function of L-carnitine is to facilitate the transport and the metabolism of long-chain fatty acids into the mitochondria for beta-oxidation and energy production. Since L-carnitine is unable to be synthesized in skeletal muscle, this molecule has to be influx from the blood. However, the mechanism of trans-sarcolemmal L-carnitine transport system remains unclear. Novel organic cation transporter 2 (OCTN2), a sodium-dependent solute carrier, transports L-carnitine from the plasma into cells and is expressed in tissues such as kidney, liver and intestine. Although OCTN2 is also assumed to transport L-carnitine across plasma membrane in skeletal muscle cell, there has been no report to detect the expression of OCTN2 in skeletal muscles.

**PURPOSE:** The purpose of the present study was to show the expression of OCTN2 in various skeletal muscles. Additionally, we compared the OCTN2 expressions between metabolically heterogeneous rat hindlimb muscles in order to establish relationship between the amount of OCTN2 and capacity of muscle fatty acid oxidation.

**METHODS:** Experiments were performed on male Wistar rats (12-wk old). Hindlimb muscles (m. soleus, m. plantaris, red and white portions of m. gastrocnemius), hearts and kidneys were homogenized in RIPA buffer and centrifuged to remove nuclear fractions and debris. The supernatant was used for analysis of Western blotting, and the expression of OCTN2 was investigated.

**RESULTS:** OCTN2 was detected in heart and in red muscles (m. soleus and red portion of m. gastrocnemius), but not detected in m. plantaris and white portion of m. gastrocnemius. Expression of OCTN2 in kidney was more than ten times higher than heart and red skeletal muscles. The difference of expression level of OCTN2 gene product among kidney and other tissues agree to that for rat OCTN2 mRNA observed in the previous studies.

**CONCLUSIONS:** In spite of small amount relative to kidney, OCTN2 was detectable in skeletal muscles especially slow-twitch red muscles, indicating that OCTN2 might contribute to fatty acid oxidation in skeletal muscles. These results suggest that OCTN2 transports L-carnitine from plasma into muscle cells, especially more in highly oxidative muscles.

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1965 Board #106 May 28 8:00 AM - 9:30 AM

**Metformin And AICAR Regulate Fatty Acid Metabolism In L6 Myotubes Via Different Cellular Mechanisms**

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(No relationships reported)

AMP-activated protein kinase (AMPK) is a key regulator of glucose and fatty acid (FA) metabolism. Metformin and AICAR are potent activators of AMPK.

**PURPOSE:** To elucidate whether Metformin and AICAR regulate glucose and FA metabolism via different AMPK-induced cellular mechanisms.

**METHODS:** L6 skeletal muscle cells were treated with AICAR (A group; 2 mM, 2 hrs), or low or high amounts of Metformin (LM group; 800  $\mu$ M, 24 hrs or HM group; 2 mM, 3 hrs), and were subsequently incubated  $\pm$  Insulin (I condition; 100 nM, 15 min). After treatment(s), glucose uptake and FA uptake and oxidation were measured using [2-<sup>3</sup>H]deoxyglucose or [1-<sup>14</sup>C]palmitic acid. The phosphorylation state of AMPK $\alpha_1$ , AMPK $\alpha_2$ , Acetyl CoA Carboxylase (ACC), and Insulin Receptor Substrate-1 (IRS-1) as well as the content of plasma membrane (PM) Glut4 and CD36 were measured. The effects of the pharmacological treatments on metabolic parameters were assessed with ANOVA.

**RESULTS:** Compared to the control condition, A, LM and HM increased glucose uptake by 38 $\pm$ 5%, 40 $\pm$ 2% and 74 $\pm$ 7% ( $P$ <0.05). In each group, I significantly increased glucose uptake by 14-26% ( $P$ <0.05). A increased FA uptake by 16 $\pm$ 6% ( $P$ <0.05) and FA oxidation by 32 $\pm$ 4% ( $P$ <0.05). LM and HM decreased FA uptake by 19-27% ( $P$ <0.05) and FA oxidation by 11-14% ( $P$ <0.05). I significantly increased FA uptake and decreased FA oxidation in all groups ( $P$ <0.05). A, LM and HM increased total AMPK phosphorylation by 36 $\pm$ 5%, 82 $\pm$ 8% and 72 $\pm$ 6% ( $P$ <0.05). LM and HM increased AMPK $\alpha_1$  phosphorylation by 58-65% ( $P$ <0.05). A, LM and HM significantly increased AMPK $\alpha_2$  phosphorylation and the increase was significantly higher in A than LM or HM. I did not affect AMPK phosphorylation. As expected, A increased ACC phosphorylation (50 $\pm$ 7%,  $P$ <0.05). However, LM and HM did not change ACC phosphorylation. ACC phosphorylation was not affected by I in any of the groups. The insulin-induced increase in IRS-1 tyrosine phosphorylation was higher in LM than in A ( $P$ <0.05). PM CD36 content was increased by A treatment alone (44 $\pm$ 5%) and with I in both control (31 $\pm$ 5%) and A groups (64 $\pm$ 3%) ( $P$ <0.05). PM Glut4 content was increased by I, A, LM, and HM ( $P$ <0.05).

**CONCLUSION:** In L6 myotubes, Metformin and AICAR regulate FA uptake and oxidation via different intracellular mechanisms partially due to the preferential activation of different AMPK isoforms.

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1966 Board #107 May 28 8:00 AM - 9:30 AM

**Resistance Exercise Produces A Metabolic Gene Expression Signature Similar To Endurance Exercise**

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(No relationships reported)

Resistance training (RT) has been proposed as a beneficial intervention modality for patients with metabolic syndrome and type II diabetes because of increasing evidence that similar metabolic benefits may be achieved with RT as with endurance training. Much of the improvements resulted from exercise training are associated with transient modifications in skeletal muscle induced by an acute bout of exercise.

**PURPOSE:** to examine the transcriptional regulation of metabolic genes in skeletal muscle induced by an acute bout of resistance exercise (RE).

**METHODS:** Subjects (11 female and 12 male, 18 to 40 y) trained the non-dominant elbow flexors for 12 weeks resulting in a 14.2 +/- 6.2 % increase in muscle volume and a 59.7 +/- 20.4% increase in 1RM strength. Six days after the last exercise session, an acute bout of RE was performed and bilateral biopsies were taken 4 hr post-exercise from both the trained and the untrained arms. RNA was extracted and prepared for expression profiling using the Affymetrix Human Genome U133 Plus 2 chips. Absolute expression values were calculated using MAS.5 and dChip and analysis was carried out using Gene Spring.

**RESULTS:** RE induced augmented mRNA levels of regulators implicated in 1) mitochondrial biogenesis including PGC1- $\alpha$  ( $\uparrow$ 2.88,  $p=0.0015$ ), SIRT1 ( $\uparrow$ 1.25,  $p=0.0152$ ) and PRKAG2 ( $\uparrow$ 4.80,  $p=0.0009$ ); 2) insulin signaling including IRS2 ( $\uparrow$ 3.42,  $p=0.0010$ ), RRAD ( $\uparrow$ 5.01,  $p=0.0007$ ) and NR4A1 ( $\uparrow$ 4.48,  $p=0.0020$ ); and 3) capillary biogenesis including VEGF ( $\uparrow$ 1.85,  $p=0.0027$ ), HIF1A ( $\uparrow$ 1.67,  $p=0.0004$ ) and CYR61 ( $\uparrow$ 3.02,  $p=0.0045$ ). Transcriptional modification of key lipid metabolism genes favored fatty acid repartitioning towards esterification with mRNA levels for LPL and CPT1B being decreased (LPL,  $\downarrow$ 1.71 fold,  $p=0.0001$ ; CPT1B,  $\downarrow$ 1.42 fold,  $p=0.0246$ ), and for FABPs being increased (FABP4,  $\uparrow$ 1.56 fold,  $p=0.0003$ ; FABP5,  $\uparrow$ 1.50,  $p=0.0065$ ).

**CONCLUSION:** Similar to endurance exercise, acute RE exhibits favorable regulation of metabolic gene transcription in skeletal muscle, implying, in part, an explanation for the beneficial role of resistance training in treating metabolic disturbances.

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**1967 Board #108 May 28 8:00 AM - 9:30 AM**

**Effect Of High-intensity Resistance Training On Twenty-four-hour Respiratory Quotient**

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(No relationships reported)

**PURPOSE:** To investigate the effect of high-intensity resistance training (RT) on twenty-four-hour respiratory quotient (24-h RQ) by cross-sectional and interventional settings.

**METHODS:** 1) Sedentary subjects ( $41.7 \pm 9.7$  yr,  $n = 7$ ) and subjects performing habitually high-intensity RT ( $41.6 \pm 6.9$  yr,  $n = 8$ ) participated in the cross-sectional study. Twenty-four-hour energy expenditure (EE) under free living condition was measured by doubly-labeled water (DLW) method, and all meals in 3 days before the chamber measurement were provided to all subjects according to the results from DLW method. Then, 24-h RQ was measured by a metabolic chamber. 2) Fifteen young adults participated in the interventional study. They were randomly divided into control (C) group ( $20.5 \pm 1.2$  yr,  $n = 8$ ) and RT group ( $20.9 \pm 1.8$  yr,  $n = 7$ ). RT group performed high-intensity (80 - 90% one-repetition maximum) RT on 2 days per week for 3 months. Before and after the training period, 24-h RQ was measured by a metabolic chamber under the well controlled-condition.

**RESULTS:** 1) In the cross-sectional study, there was a trend that fat-free mass (FFM) in subjects performing high-intensity RT was larger than that in sedentary subjects. However, no difference was observed in 24-h RQ between two groups. 2) In the interventional study, subjects in RT group significantly ( $P < 0.05$ ) increased FFM and absolute 24-h EE after the training period. However, there was no significant time-by-group interaction in 24-h RQ.

**CONCLUSIONS:** These results suggest that there is no effect of high-intensity RT on 24-h RQ measured by a metabolic chamber. In other words, although high-intensity RT enhances absolute 24-h EE induced by increasing FFM, it may not lead to the improvement of fat oxidation capacity in human subjects.

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**C-33 Free Communication/Poster - Hydration Status and Rehydration**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**1968 Board #109 May 28 9:00 AM - 10:30 AM**

**Total Energy Expenditure, Body Water Turnover, Hydration Status, And Blood Composition During The Western States 100**

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(No relationships reported)

Ultra-endurance running is a unique sport that requires great physical stamina, mental resiliency, and metabolic demand.

**PURPOSE:** The purpose of this study was to measure total energy expenditure, total body water turnover (rH<sub>2</sub>O), and select blood markers for individuals competing in the Western States 100 ultra-endurance race.

**METHODS:** Participants (N=10) were provided with an oral dose of 2H<sub>2</sub>O18 a few days prior to the race. Urine and blood samples, along with body weight, were collected at multiple time points, including pre, mid, and post race.

**RESULTS:** Total energy expenditure during the race was  $66 \pm 12$  MJ ( $15,860 \pm 2,938$  kcal). Average finish time for subjects was  $26.8 \pm 3.1$  hours. Total body water turnover during the race was  $19.4 \pm 3.2$  liters ( $259 \pm 42$  ml.kg<sup>-1</sup>.1.24 hours). Urine specific gravity was significantly higher at mid and post compared to pre, ( $1.015 \pm 0.008$ ,  $1.029 \pm 0.005$ , and  $1.023 \pm 0.008$  for pre, mid, and post, respectively,  $p < 0.05$ ). Urea nitrogen (BUN) and creatinine were outside normal range and were higher mid and post compared to pre. Body weight was significantly reduced at midpoint compared to pre, but the post body weight did not differ from pre ( $71.2 \pm 11.8$ ,  $69.9 \pm 10.8$ , and  $70.3 \pm 10.8$  for pre, mid, and post, respectively,  $p < 0.05$ ).

**CONCLUSION:** During the Western States 100, energy expenditure averaged  $592 \pm 91$  kcal.hr<sup>-1</sup> and water turnover averaged  $0.7 \pm 0.1$  L.hr<sup>-1</sup>. The elevation of BUN and creatinine was slightly above the upper end of typical reference ranges (5% and 12% higher for mid and post BUN; 9% and 6% higher for mid and post creatinine, respectively), demonstrating reduced kidney function compared to normal exercise patterns. This study demonstrates some of the highest rates of human energy expenditure for a 24 hour period. Similarly, subjects experienced large amounts of water flux, signs of dehydration and renal dysfunction, but maintained sufficient energy and sodium supplementation to finish.

Supported by Air Force Research Laboratories, FA8650-06-1-679

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**1969 Board #110 May 28 9:00 AM - 10:30 AM**

**Initial Hydration Status And Fluid Balance During Exercise Of Coaches And Fitness Trainers**

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( M. Mayol-Soto, Gatorade Sports Science Institute, Consulting Fee.)



Current hydration guidelines emphasize the need to personalize fluid replacement strategies due to the extent variation on sweat rates between individuals. Also, it is recognized the importance of begin exercise well hydrated. Coaches and fitness trainers are key advising athletes and fitness enthusiast about having adequate hydration habits during exercise.

**PURPOSE:** To determine initial hydration status and fluid balance during an exercise bout on coaches and fitness trainers who were participating in a sports science course.

**METHODS:** Data were collected from 217 subjects (131 males and 86 females; age  $30.6 \pm 8.9$  years) during one 45-60 min exercise bout. Data were obtained during 4 separate sessions carried out at morning with a mean WBGT in the range of  $17.9\text{--}23.8^\circ\text{C}$ . Exercise bout consisted of intermittent exercise that combines martial arts and kickboxing (Body Combat). Subjects collected a urine sample from their first void of the morning and urine specific gravity (USG) was measured to determine initial hydration status. Subjects were weighted nude before and after the exercise session. During exercise, all subjects had free access to sports drinks bottles, which were weighed before and after training. Urine output was also monitored.

**RESULTS:** 112 subjects (51.9%) appeared to be inadequately hydrated before exercise because they showed  $\text{USG} \geq 1.020$ ; 20 of them (9.3%) with a  $\text{USG} \geq 1.030$ . The sweat volume lost was  $880\text{--}356$  mL ( $200\text{--}2162$  mL) and  $518\text{--}177$  mL ( $88\text{--}1010$  mL) for men and women respectively; fluid intake was  $733\text{--}293$  mL ( $38\text{--}1356$  mL) in men and  $600\text{--}299$  mL ( $0\text{--}1740$  mL) in women. On average, men replaced  $98\text{--}74\%$  and women  $129\text{--}81\%$  of their sweat losses, but this ranged from none to  $600\%$ . 144 subjects (66.4%) maintained their body mass (BM) (range from  $-0.5$  to  $0.5\%$ ), while 34 subjects (15.7%) gained more than  $0.5\%$  of their BM and 39 subjects (18%) had a BM loss  $>0.5\%$  (only one subject finished exercise with a BM loss  $>2\%$ ).

**CONCLUSIONS:** There was a large variation between individuals in the sweat rate and drinking behavior. A significant percentage of the subjects arrived already hypohydrated to the exercise bout, even though they have knowledge about hydration. Coaches and fitness trainers should develop a personalized hydration strategy to help athletes and match their sweat losses.

*Supported by Gatorade Sports Science Institute®*

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#### 1970 Board #111 May 28 9:00 AM - 10:30 AM

##### Effect Of Ramadan On Hydration Status And Concentration In Military Cadets In The United Arab Emirates

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(No relationships reported)

The mission of the Military High School (MHS) is to develop the mind, body and soul of future officers for the United Arab Emirates (UAE) Armed Forces. During the holy month of Ramadan Muslim students at the MHS abstain from fluid and food from sunrise to sunset whilst still participating in an academic and a reduced military program.

**PURPOSE:** To investigate the effect of Ramadan on hydration status and concentration in Emirati adolescents.

**METHODS:** Nineteen males (age  $16.5 \pm 1.1$  yr, body mass  $74.4 \pm 17.5$  kg, height  $1.71 \pm 0.06$  m) from the MHS (Al Ain, Abu Dhabi, UAE) were tested during four 3-day monitoring periods: pre-Ramadan ( $\text{Ram}_{\text{pre}}$ ); during the second and fourth week of Ramadan ( $\text{Ram}_{\text{wk2}}$  and  $\text{Ram}_{\text{wk4}}$ ); and post-Ramadan ( $\text{Ram}_{\text{post}}$ ). During each 3-day monitoring period, hydration status (urine osmolality [ $\text{U}_{\text{osm}}$ ]) was measured bi-daily (morning and evening) and visual scanning ability (100-digit concentration grid) was assessed on days one and three. Mean ambient temperature decreased from  $37.5^\circ\text{C}$  to  $31.0^\circ\text{C}$  during the study period.

**RESULTS:** Seventy-one percent of all samples were above the recommended osmolality suggested for euhydration ( $700 \text{ mOsmol.kg}^{-1}$ ; ACSM Position Stand 2007: *Med Sci Sports Exerc*, 39, 377-390); 17% were  $\geq 1000 \text{ mOsmol.kg}^{-1}$ . Mean  $\text{U}_{\text{osm}}$  ranged from  $743 \pm 132$  to  $884 \pm 167 \text{ mOsmol.kg}^{-1}$  during the study period. Compared to baseline ( $\text{Ram}_{\text{pre}}$ ),  $\text{U}_{\text{osm}}$  remained relatively stable at  $\text{Ram}_{\text{wk2}}$  ( $-2 \pm 101 \text{ mOsmol.kg}^{-1}$ ,  $p > .05$ , effect size [ES] =  $0.01$ ) and then decreased at  $\text{Ram}_{\text{wk4}}$  ( $-103 \pm 103 \text{ mOsmol.kg}^{-1}$ ,  $p < .05$ , ES =  $0.83$ ) and  $\text{Ram}_{\text{post}}$  ( $-72 \pm 140 \text{ mOsmol.kg}^{-1}$ ,  $p > .05$ , ES =  $0.49$ ). Mean concentration grid score increased from baseline to  $\text{Ram}_{\text{wk4}}$  ( $9 \pm 4$  vs.  $15 \pm 9$ ,  $p < .05$ , ES =  $0.86$ ) and  $\text{Ram}_{\text{post}}$  ( $9 \pm 4$  vs.  $18 \pm 13$ ,  $p < .05$ , ES =  $0.96$ ).

**CONCLUSIONS:** Ramadan did not negatively affect hydration status or concentration; rather, both improved during the latter stages. However,  $\text{U}_{\text{osm}}$  data indicate that the majority of students were in a constant state of hypohydration. Consequently, visual cognitive processes (e.g. concentration) may be sub-optimal. Action is required to raise awareness of hydration among these future officers and to devise optimal hydration strategies for extreme environmental conditions and in situations where normal drinking and eating habits are altered.

*This work was sponsored by the United Arab Emirates Armed Forces.*

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#### 1971 Board #112 May 28 9:00 AM - 10:30 AM

##### Hydration Status In Young Males Following Fasting And Prescribed Fluid Intake

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(No relationships reported)

Exercise performance and thermoregulatory ability can be compromised by dehydration. Therefore, it is of interest to determine how younger individuals respond to 12-hours of fluid restriction or prescription.

**PURPOSE:** The purpose was to determine whether 1) a 12-hour fast would elicit clinical signs of dehydration and 2) there are differences in hydration status between 12 hours of fluid restriction and fluid prescription in young adult males.

**METHODS:** Sixteen men (18-25 yr), free from fluid altering medications underwent three distinct trials separated by at least 7 days. Indicators of hydration status were assessed in urine and blood prior to and at the completion of each 12-hour trial. The trials were 1) ad libitum - eat and drink freely throughout, 2) fasting - refrain from all food and drink, and 3) prescribed intake - eat same foods as ad libitum day and drink  $3.0 \text{ mL/kg}$  caffeine and alcohol free fluid each hour. Thirst was assessed prior to, midway, and at the completion of the 12-hours. The following were measured pre and post - hemoglobin (g/dL), hematocrit (%), serum and urine osmolality ( $\text{mOsm/kg}$ ) and creatinine. Change in plasma volume (PV%), glomerular filtration rate (GFR), and fractional excretion of water ( $\text{FeH}_2\text{O}$ ) were calculated for each trial.

**RESULTS:** PV% decreased ( $-3.13 \pm 6.3$ ) during the fasting day and increased during both the control ( $3.94 \pm 5.8$ ) and the prescribed intake ( $2.34 \pm 9.7$ ) trials; there was no significant difference between trials. During the fasting day, there was a significant decrease in serum osmolality and an increase in urine osmolality, while urine osmolality was reduced during both the control and prescribed intake days. For all trials, baseline urine osmolality fell above normal values.  $\text{FeH}_2\text{O}$  was significantly greater during the prescribed intake day ( $62.8 \pm 37.1\%$ ) than during the control day ( $35.7 \pm 14.7\%$ ). Thirst was reduced during the prescribed intake day and unchanged during both other days.

**CONCLUSION:** Most indicators of hydration status were maintained within normal range during the fasting day, suggesting that young males are able to maintain adequate hydration status following a 12-hour fast. Because some loss in PV was noted, active individuals should be encouraged to take in fluid within 12 hours of exercise to maximize performance and thermoregulatory abilities.

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#### 1972 Board #113 May 28 9:00 AM - 10:30 AM

##### Efficacy Of Prevailing Fluid Intake Recommendations For Elite Marathon Running

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Prevailing fluid intake recommendations promote drinking *ad libitum* 0.4-0.8 L·h<sup>-1</sup> during exercise (ACSM, *Med Sci Sports Exerc* 39, 2007). Modelling this fluid intake range in a general population (i.e., 50-90 kg subjects running at 8.5-15 km·hr<sup>-1</sup> in cool (18 °C) and warm (28 °C) ambient conditions) predicts 0.4-0.8 L·h<sup>-1</sup> is sufficient to maintain body mass (BM) loss < 3% and prevent BM gain (Montain et al., *Br J Sports Med* 40, 2006). The calculations are not, however, applicable to elite marathon runners. Furthermore, although the principle of *ad libitum* fluid intake is in agreement with previous observations in elite Kenyan endurance runners during an important period of training (e.g., Fudge et al., *Med Sci Sports Exerc* 40, 2008), there is almost no information on what the best marathon runners actually drink when racing.

**PURPOSE:** To evaluate whether the fluid intake recommendations of drinking *ad libitum* 0.4-0.8 L·h<sup>-1</sup> are appropriate for elite marathon running.

**METHODS:** A retrospective video analysis of the drinking behaviors of the winning male and female runners was undertaken during the 2006 and 2007 London Marathons. To supplement this analysis, a mathematical model was used to predict required fluid intake to prevent a > 3% BM loss or BM gain when BM, running speed and ambient conditions were systematically varied (i.e., 45-75 kg subjects running at (hr:min) 2:04 and 2:30 marathon pace in cold (7.3 °C) and warm (24.8 °C) ambient conditions).

**RESULTS:** The derived total drinking durations of 56, 38, 43 and 31 sec of the winning runners equate to fluid intake rates of approximately 1.5, 1.1, 1.1 and 0.9 L·h<sup>-1</sup>, respectively. The mathematical model predicts that *ad libitum* 0.4-0.8 L·h<sup>-1</sup> is insufficient to prevent > 3% BM loss or BM gain across all conditions modelled.

**CONCLUSIONS:** Fluid intake behaviors of elite endurance runners during a major city marathon do not reflect prevailing fluid intake recommendations. This is corroborated by the mathematical model as it predicts prevailing fluid intake recommendations of 0.4-0.8 L·h<sup>-1</sup> are insufficient to maintain BM loss < 3% and prevent BM gain. Therefore, an *ad libitum* fluid intake strategy may be the best hydration strategy for competitive marathon running in temperate conditions as long as BM loss is kept within acceptable limits, possibly < 3%.

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**1973 Board #114 May 28 9:00 AM - 10:30 AM**

**The Effects Of Different Sodium And Carbohydrate Concentration And pH On The Intestinal Fluid Absorption In Humans**

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( M.L. Tippet, PepsiCo, Salary.)

To be an effective fluid replacement beverage during activity, a beverage must provide enough energy to sustain performance and yet be absorbed rapidly in the small intestine. Although the effect of carbohydrate (CHO) on fluid absorption is well-established, the interactive impact of sodium and CHO concentrations and the effect of pH on fluid absorption are still not clear.

**PURPOSE:** To determine the effects of different levels of sodium content at two different CHO concentrations on water absorption. Secondly, we compared the effect of pH on water flux.

**METHODS:** Seven male subjects were perfused with six beverages (60 min per beverage) at a rate of 15 ml/min in a randomized order using the triple lumen perfusion technique. Water absorption from each solution was calculated based on changes of polyethylene glycol (PEG) concentration in the intestinal samples. Test beverages included water (W, pH = 7), a flavored water placebo (WP, pH = 3), a 3% CHO (sucrose and dextrose) solution with either 18 mEq sodium (LCLS) or 72 mEq sodium (LCHS), and a 6% CHO (sucrose and dextrose) solution with either 18 mEq sodium (HCLS) or 72 mEq sodium (HCHS). Beverage osmolality ranged from 0 to 381 mOsm/kg. A two-factor repeated measures ANOVA was used to determine the significance in water flux ( $\alpha=0.05$ ).

**RESULTS:** CHO concentration ranging from 0 up to 6% did not significantly affect mean water flux ( $-19.7 \pm 3.6$ ,  $-16.3 \pm 2.6$ , and  $-14.0 \pm 0.9$  ml·cm<sup>-1</sup>·h<sup>-1</sup> for W, LCLS, and HCLS, respectively) over the 60 minutes of perfusion. Likewise, the sodium content at either CHO concentration did not affect water flux ( $-12.2 \pm 1.2$  and  $-10.7 \pm 1.0$  ml·cm<sup>-1</sup>·h<sup>-1</sup> for LCHS and HCHS, respectively). Finally, there was no significant difference in water flux based on pH (W:  $-19.7 \pm 3.6$  ml·cm<sup>-1</sup>·h<sup>-1</sup> vs. WP:  $-14.0 \pm 2.7$  ml·cm<sup>-1</sup>·h<sup>-1</sup>).

**CONCLUSIONS:** Increasing the sodium content to 72 mEq in either a 3% or a 6% CHO solution did not facilitate the rate of intestinal fluid absorption. In addition, a decrease of beverage pH from 7 to 3 did not appear to significantly influence intestinal absorption of fluid.

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**1974 Board #115 May 28 9:00 AM - 10:30 AM**

**Rate Of D2O Accumulation With Rehydration Using Three Different Drinks**

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(No relationships reported)

The availability of fluid consumed for thermoregulation and hydration depends on the rate of gastric emptying and fluid absorption in the intestine. Deuterium Oxide (D<sub>2</sub>O) accumulation serves as a marker of fluid uptake and allows for the assessment of the relative temporal availability of a fluid after ingestion.

**PURPOSE:** To compare the rate of D<sub>2</sub>O accumulation during rehydration with three different beverages at rest.

**METHODS:** Twelve males (mean  $\pm$  SD age, 25  $\pm$  3y; mass, 75.91  $\pm$  5.94kg) completed three dehydration trials in a randomized, blocked experimental design. Subjects walked for 1 hour (3.9  $\pm$  0.3mph; 1.5  $\pm$  0.6% incline) in 30  $\pm$  1°C, rh 50  $\pm$  7% followed by a 24h fluid restriction resulting in dehydration of  $-2.69 \pm 1.11$ . Subjects then ingested D<sub>2</sub>O (0.15 g/kg body weight) in either distilled water (WA), a carbohydrate - electrolyte (CE) beverage, or a flavored vitamin drink (VF) in four equal boluses consumed during the initial 5 minutes of a 60 minute rehydration/seated rest period. The total volume of fluid consumed was 50% of body weight lost. Plasma D<sub>2</sub>O and serum osmolality (Osm) were measured at 0, 4, 8, 12, 16, 20, 45 and 60 min. Thirst was assessed at 0, 4, 12, 20 and 60 min. Two-way and one-way repeated-measures ANOVA were conducted with alpha set at 0.05. Post hoc analyses were adjusted using a Bonferroni correction.

**RESULTS:** There was no interaction ( $p>0.05$ ) between beverage and D<sub>2</sub>O accumulation or beverage and attenuation of thirst. Mean D<sub>2</sub>O accumulation in plasma increased ( $p<0.05$ ) at every time point after ingestion except between minutes eight and 12 and between minutes 45 and 60. D<sub>2</sub>O accumulation increased 51.85  $\pm$  11.64% four minutes after ingestion and 78.21  $\pm$  2.98% during the 60 minutes. Serum Osm declined ( $p<0.05$ ) from min 0 to min 60 min in VF and WA, but not in CE. Mean thirst was 7  $\pm$  1 pre-rehydration and 3  $\pm$  2 at 60 min. Decrease in thirst was greater ( $p<0.05$ ) for VF than CE, but not for VF compared to WA or WA compared to CE.

**CONCLUSION:** Using D<sub>2</sub>O accumulation as a marker of fluid uptake, rehydration resulted in a similar rate of uptake among trials. Drink VF attenuated thirst more than CE and WA. Supported by glacéau (a division of The Coca-Cola Company).

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**1975 Board #116 May 28 9:00 AM - 10:30 AM**

**The Effect Of Sodium And Carbohydrate In A Rehydration Food On Subsequent Exercise Performance**

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(No relationships reported)

**PURPOSE:** To determine the effectiveness of a high sodium and carbohydrate meal on endurance exercise performance following exercise- and heat-induced dehydration.

**METHODS:** Twelve male subjects were dehydrated by ~3 % of body mass with exercise and heat exposure. In a randomly assigned, counterbalanced design, subjects were rehydrated at room temperature with either 175 ml of chicken noodle soup (SOUP: Campbell Soup Company, Camden, NJ) or an artificially sweetened placebo (CON) at the beginning of the 120 min rehydration period and 20 min later. Water was ingested every 20 min during the remaining 100 min of rehydration. Soup contained 161.0 mmol/l Na<sup>+</sup>, 5.3 mmol/l K<sup>+</sup>, and 32.6 g total carbohydrate. CON contained 14.4 mmol/l Na<sup>+</sup>, 16.0 mmol/l K<sup>+</sup>, and no carbohydrate. Total fluid ingestion was matched with body fluid loss during dehydration. After rehydration,

subjects performed 30 min of steady state exercise at 68%  $\text{VO}_{2\text{peak}}$ . Subjects then performed a time trial in which they accumulated as rapidly as possible the amount of work equal to 30 min of exercise at 70%  $\text{VO}_{2\text{peak}}$  in a thermoneutral environment (25 C and 40% relative humidity).

**RESULTS:** There was no significant difference in percent recovery of body mass during rehydration (CON:  $79.4 \pm 3.3\%$ ; SOUP:  $80.9 \pm 3.4\%$ ). Time trial performance was significantly improved in SOUP ( $30.6 \pm 0.8$  min) compared with CON ( $33.2 \pm 1.4$  min;  $p=0.031$ ). The rate of carbohydrate oxidation tended to be higher in SOUP ( $2.33 \pm 0.09$  g/min) compared with CON ( $2.18 \pm 0.11$  g/min;  $p=0.076$ ). No differences in heart rate or ratings of perceived exercise were found during post-rehydration exercise.

**CONCLUSIONS:** These results suggest that ingesting chicken noodle soup after exercise in the heat improves subsequent endurance exercise capacity, possibly through enhanced CHO oxidation.

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**1976 Board #117 May 28 9:00 AM - 10:30 AM**  
**Pickle Juice Inhibits Gastric Emptying In Rested, Euhydrated Humans.**

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(No relationships reported)

Approximately 25% of athletic trainers use pickle juice (PJ) to treat exercise associated muscle cramps (EAMC). Some claim 30-60 ml of PJ can relieve EAMC within 35-secs of ingestion due to its high sodium ( $\text{Na}^+$ ) content. Since little absorption occurs in the stomach, if true, the gastric emptying rate of PJ must be fast. No data exist examining the effect of PJ on gastric emptying.

**PURPOSE:** To compare gastric emptying and changes in plasma sodium ( $\text{Na}^+$ ), and plasma volume (PV) following ingestion of large volumes of PJ and deionized water (DIW).

**METHODS:** Ten healthy, euhydrated male subjects (mean  $\pm$  SE, age =  $25.4 \pm 0.7$  yrs; ht =  $177.1 \pm 1.6$  cm; mass =  $77.9 \pm 3.8$  kg) ingested 7 ml\*kg<sup>-1</sup> body weight of PJ or DIW at rest on 2 days separated by  $\geq 72$  hrs. Gastric volume was determined at 1, 5, 10, 20, 30, and 40 min using a phenol red dilution technique. Blood samples were collected before ingestion and at 5, 10, 20, 30, and 40 min postfluid ingestion and analyzed for Hct, [Hb], and  $\text{Na}^+$ .

**RESULTS:** Initial fluid intake was  $624.5 \pm 27.4$  ml for PJ and  $659.5 \pm 43.8$  ml for DIW. Both fluids emptied within the first 5 min postingestion (PJ =  $219.2 \pm 39.1$  ml, DIW =  $305 \pm 40.5$  ml,  $P < 0.05$ ). PJ failed to empty after the first 5 min ( $P > 0.05$ ) where as gastric volume decreased to  $39.9 \pm 20.2$  ml by 40 min with DIW ( $P < 0.05$ ). DIW emptied significantly faster than PJ between 20 and 40 min postingestion ( $P < 0.05$ ). Within 5 min of PJ ingestion, PV decreased  $4.8 \pm 1.6\%$  while  $\text{Na}^+$  increased  $1.6 \pm 0.51$  mM ( $P < 0.05$ ). Similar changes in PV and  $\text{Na}^+$  occurred following DIW ingestion. Calculated  $\text{Na}^+$  content was unchanged for both PJ and DIW ( $P > 0.05$ ) indicating that the increase in  $\text{Na}^+$  was due to the rapid PV shift and not absorption of the ingested  $\text{Na}^+$ .

**CONCLUSIONS:** The initial rapid decrease in gastric volume in the first 5 min with both fluids is attributable to an increase in gastric distension. Once this volume stimulus was gone, PJ failed to empty. This effect may be due to PJ's high osmolality ( $1325 \pm 1.0$  mOsm\*kg H<sub>2</sub>O<sup>-1</sup>), acidity (pH =  $3.2 \pm 0$ ), or both. Cardiovascular reflexes in response to gastric distension resulted in rapid PV shifts and a significant rise in  $\text{Na}^+$  over 40 min (PJ =  $<4.2 \pm 0.84$  mM, DIW =  $<1.5 \pm 0.7$  mM) despite no significant changes in  $\text{Na}^+$  content. It is unlikely that 30-60 ml of PJ relieves EAMC by rapidly altering  $\text{Na}^+$  because gastric emptying of PJ is extremely slow.

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**1977 Board #118 May 28 9:00 AM - 10:30 AM**  
**Gastric Emptying Characteristics Of Carbohydrate/Protein And Carbohydrate Only Sports Drinks During Moderate Intensity Exercise**

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( J.G. Seifert, PacificHealth Laboratories, Contracted Research.)

Previous research has shown that a carbohydrate-protein sports drink (CHOP) improves rehydration after exercise compared to a carbohydrate-only sports drink (CHO).

However, little is known how composition of sports drinks impacts gastric emptying during exercise. Numerous gastric emptying studies have been limited to sampling only at pre- and post exercise. This study was completed by sampling <sup>13</sup>CO<sub>2</sub> at regular intervals during exercise to assess gastric emptying rate during exercise.

**PURPOSE:** To compare the gastric emptying rate of a CHOP sports drink to a CHO sports drink during moderate intensity, steady state exercise.

**METHODS:** 12 healthy subjects cycled for 60min at 65%  $\text{VO}_{2\text{max}}$  while ingesting 300 mL of either a 6% CHO + 1.5% protein sports drink (osmolality: 441 mOsm/kg H<sub>2</sub>O) or a 6% CHO only sports drink (osmolality: 406 mOsm/kg H<sub>2</sub>O). Each drink contained 100 mg <sup>13</sup>C labelled-NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> to serially assess gastric emptying. Beverage ingestion occurred following a 10 min warmup and 13 min of steady state exercise. <sup>13</sup>CO<sub>2</sub> was then collected every 5 min for 45 min after ingestion. Venous blood glucose, HR, and RPE were collected at 15 min intervals during exercise.

**RESULTS:** ANOVA analysis indicated that there were no differences ( $p > 0.05$ ) between treatments in gastric emptying, as measured by the appearance of exhaled <sup>13</sup>CO<sub>2</sub> (CHOP:  $14.1 \pm 6.1$ ; CHO:  $13.7 \pm 6.2$ ), or in blood glucose (CHOP:  $4.9 \pm 9$  mM/L; CHO:  $4.8 \pm 9$  mM/L). Gastric emptying peaked approximately 25 min after beverage ingestion for both treatments. No differences between treatments were observed for HR (CHOP:  $139 \pm 11$  bpm; CHO:  $138 \pm 10$  bpm) or RPE (CHOP:  $13.1 \pm 1.0$ ; CHO:  $13.2 \pm 1.3$ ).

**CONCLUSION:** Multiple studies have shown endurance and post exercise rehydration benefits of CHOP ingestion. This study demonstrates that a CHOP sports drink has similar gastric emptying characteristics during exercise to that of a CHO sports drink.

Supported by PacificHealth Laboratories

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**C-34 Free Communication/Poster - Measurement of Physical Activity, Energy Cost, and Fitness**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**1978 Board #119 May 28 8:00 AM - 9:30 AM**  
**Differential Accuracy Of Physical Activity Self-Report By Body Mass Index**

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(No relationships reported)

Many epidemiologic studies rely on self-reported measures such as the International Physical Activity Questionnaire-Short Form (IPAQ-S) in their assessment of physical activity. Previous work in this population showed moderate correlations between this self-report measure and accelerometer data which varied by gender. What remains

unknown is whether reporting varies by body mass index (BMI).

**PURPOSE:** To determine whether agreement between self-reported physical activity and accelerometer measures varies by BMI.

**METHODS:** 135 Blacks residing in low-income housing completed the IPAQ-S and wore an accelerometer for up to 6 days. Both 1- and 10-minute accelerometer bouts were used to define time spent in light, moderate, and vigorous physical activity. Trained research staff measured participant height and weight. BMI was calculated as weight in kilograms divided by height in meters squared.

**RESULTS:** There were 31 people with BMI of 18-24.9, 30 with a BMI of 25-29.9 and 74 with a BMI of 30 or greater. Agreement between the IPAQ-S and accelerometer determined physical activity did vary by BMI. For a 10-minute bout, correlations were 0.38 (BMI <25), 0.57 (BMI 25-29.9) and 0.15 (BMI 30+). For a 1-minute bout, correlations were 0.34, 0.44, and 0.24 respectively. When we classified participants based on attainment of physical activity recommendations, agreement was much better among non-obese persons and significantly lower for 10-minute bouts compared to 1-minute bouts (non-obese: 1-minute kappa = 0.48, 10-minute kappa = 0.023; obese: 1-minute kappa = -0.024, 10-minute kappa = -0.020).

**CONCLUSION:** Correlations between self-reported physical activity and accelerometer data were consistently lowest for obese persons compared to those of lower BMI. When classifying participants according to attainment of physical activity recommendations, there was no agreement between instruments among obese persons for either bout length. Among those with a BMI of 18-29.9 there was moderate agreement for a 1-minute bout, and no agreement for a 10-minute bout.

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**1979 Board #120 May 28 8:00 AM - 9:30 AM**

**Measurement Error Correction Models For Physical Activity Exposures In Prospective Studies**

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(No relationships reported)

**PURPOSE:** To describe systematic and random errors in, and validity coefficients and attenuation factors associated with, a physical activity (PA) questionnaire using a measurement error correction (MEC) model. Three reference measures were used to fit MEC models and we describe our results in light of the limitations of each.

**METHODS:** Participants were 147 men and 151 women enrolled in two prospective cohort studies in Shanghai. Over 12-months, they completed two physical activity questionnaires (Q) and four 7-day measures by PA log (PAL) and Actigraph (A). PA energy expenditure was estimated for each measure, including two values from the PAL. The first (PAL1) reflected all activity reported each day, while the second (PAL2) was matched to specific behaviors assessed on Q. To describe systematic (activity-related and person-specific biases) and random errors in Q, and associated validity and attenuation factors (AF), we fit the model of Kipnis (AJE 158:14, 2003) to Q with each reference measure. Simulation studies were conducted to evaluate the impact on results for Q when reference measures violate the assumption that they are free of systematic errors in estimating the true PA levels for Q.

**RESULTS:** MEC results indicated that systematic errors were lowest for Q when compared with the PAL2 reference measure, followed by PAL1 and A. Person-specific bias in Q was substantially larger when A was the reference measure. Validity coefficients (r) and attenuation factors (AF) for Q were highest when PAL2 was the reference (r=0.70 and AF=0.56), followed by PAL1 (r=0.55 and AF=0.55), and A (r=0.26 and AF=0.13). Lower AF values indicate more attenuation. Results were similar for men and women. Simulations indicated that larger violations of the systematic error assumption in the reference measures can result in an apparent inflation of activity-related and person-specific biases in Q.

**CONCLUSION:** We found less systematic error, higher validity coefficients, and less attenuation in Q when reference measures were closely matched to Q (PAL2). When implementing MEC models for PA exposures it may be preferable to employ self-reported reference measures that can be closely matched to the Q being evaluated, even if they are susceptible to person-specific biases.

Support: R21CA119073

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**1980 Board #121 May 28 8:00 AM - 9:30 AM**

**A Correction Factor Improves Met Estimates Of Physical Activities**

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(No relationships reported)

The standard 1 MET = 3.5 ml·kg<sup>-1</sup>·min<sup>-1</sup> generally overestimates resting metabolic rate (RMR) for low-fit, overweight, older and female individuals. It is unknown what effect this systematic error has on MET estimates of physical activities in self-report instruments (SRI).

**PURPOSE:** To examine differences in activity METs estimated using measured RMR (measMET) compared to 3.5 ml·kg<sup>-1</sup>·min<sup>-1</sup> (calcMET) and corrected METs (corrMET= mean calcMET \*(3.5/Harris-Benedict RMR)) in sub-groups by age group, BMI category, gender and fitness.

**METHODS:** 252 subjects were classified as: normal weight (NW = BMI < 25 kg·m<sup>-2</sup> n=159) or overweight (OW= BMI ≥ 25 kg·m<sup>-2</sup> n=93), male (n=118) or female (n=134), age group (by decade 20,30,40, or 50 y n=70, 69, 53 and 59, respectively) and fitness quintiles (low to high fit; n= 30, 31, 73, 88 and 39, respectively). RMR was measured after a 15 minute rest following a 4-hr restriction of food, caffeine and exercise. Subjects completed 6 treadmill activities at 3 speeds (1.34, 1.56, 2.23 m·sec<sup>-1</sup>) at 0% and 3% grade and 5 self-paced activities of daily living (ADL). Each activity was performed for 7 minutes while wearing a portable metabolic unit to measure VO<sub>2</sub>. Average MET differences (calcMET-measMET and corrMET-measMET) were computed by sub-group.

**RESULTS:** The (mean ±SD) measMET was 6.1 ±2.64 (n=2555). CalcMET (Mean (95% CI)) was (0.51(0.59,0.42) METs) less than measMET. CorrMET was not statistically different from measMET (0.02 (-0.11,0.06) METs). calcMET underestimated measMET for most individuals who were low fit (-1.04(-1.38,-0.71) METs), OW (-0.65(-0.81,-0.49) METs), older (50-60yrs,-0.67(-0.87,0.47)METs) and female (-0.55(-0.68,-0.41) METs). Differences between corrMET and measMET were less than calcMET and measMET for all subgroups.

**CONCLUSION:** SRI's that transform activity into MET metrics (e.g. MET hrs·day<sup>-1</sup>) using the Compendium of Physical Activities which assumes the 3.5 ml·kg<sup>-1</sup>·min<sup>-1</sup> baseline, will lead to less precise estimates of self-reported physical activity particularly in individuals who are overweight, older, low fit and women. The Harris-Benedict based correction factor improves MET estimates and reduces the systematic error observed within sub-groups.

Supported by NIH RO1 CA121005

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**1981 Board #122 May 28 8:00 AM - 9:30 AM**

**Relationship Between Self-perceived And Measured Health-related Physical Fitness Among College Students**

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(No relationships reported)

Possessing a limited perception of personal, health-related fitness could potentially exacerbate existing health problems or lead to harmful health consequences in the future. College students' perceptions of their own fitness level in comparison to their actual fitness level has not been examined in detail, specifically from a multi-component perspective.

**PURPOSE:** To examine the relationship between college students' self-perceived physical fitness level and measured level of physical fitness (specifically cardiorespiratory endurance, body composition, flexibility, and muscular endurance).

**METHODS:** Twenty students (10 male and 10 female, mean age 20.4 years, SD + 1.27) participated in the study. Institutional Review Board approval was obtained. Each subject completed an informed consent, a medical health history, a Physical Activity Readiness Questionnaire, and five scales from a modified version of the Physical Self-Description Questionnaire (PSDQ). Then, each subject underwent four fitness tests: air displacement plethysmography (body composition), submaximal treadmill test (cardiorespiratory endurance), standardized curl-up test (muscular endurance), and standardized sit-and-reach test (flexibility).

**RESULTS:** Descriptive statistics (means and standard deviations) were calculated for all data, and Pearson Product-Moment Correlations were used to ascertain the relationship between scores from the health-related physical fitness tests and both the scores from the corresponding self-perceived fitness scales and scores from a global physical self-concept scale. A significant relationship was found between self-perceived body composition as determined with the PSDQ and measured body fat ( $r = -0.62$ ,  $p < 0.05$ ), as well as self-perceived cardiorespiratory endurance as determined with the PSDQ and measured cardiorespiratory endurance ( $r = 0.47$ ,  $p < 0.05$ ). No other significant relationships were found.

**CONCLUSIONS:** While the subjects' perception of their own body composition and cardiorespiratory endurance was significantly related to actual measures of these variables, perception of actual muscular fitness and actual flexibility was lacking. Further research is necessary to ascertain why these relationships occurred.

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**1982 Board #123 May 28 8:00 AM - 9:30 AM**  
**Non-exercise Model For Predicting  $\dot{V}O_{2max}$  With Objectively Measured Physical Activity Variable For Japanese Women**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to develop a new non-exercise  $\dot{V}O_{2max}$  prediction model using an objectively measured physical activity (PA) variable in Japanese women.

**METHODS:** The present study included 189 Japanese women aged from 20 to 69 years old. Eighty-seven subjects in the Prediction group used to develop the prediction model were collected from two independent institutions, and 102 subjects in the Validation group used to determine the accuracy of the new prediction model were collected from another institution. All participants were measured for  $\dot{V}O_{2max}$  by using a maximal incremental test on a bicycle ergometer, age (yrs), a PA variable determined by pedometer-determined daily step counts (SC, steps-day<sup>-1</sup>), and BMI (kg·m<sup>-2</sup>) defined as body mass divided by height squared.

**RESULTS:** PA variable SC was significantly related to  $\dot{V}O_{2max}$  (partial correlation coefficient  $r = 0.40$ ,  $P < 0.001$ ) after adjusting for BMI and age. A new non-exercise model was developed by multiple regression to estimate  $\dot{V}O_{2max}$  from age, BMI, and SC ( $R = 0.71$ ,  $SEE = 5.33 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ,  $P < 0.001$ ). When the  $\dot{V}O_{2max}$  prediction equation was applied to the Validation group, predicted  $\dot{V}O_{2max}$  correlated well with measured  $\dot{V}O_{2max}$  ( $r = 0.81$ ,  $P < 0.001$ ), and SEE<sub>1</sub> and TE were 3.25 and 3.43 mL·kg<sup>-1</sup>·min<sup>-1</sup> respectively.

**CONCLUSIONS:** This study demonstrated that SC was useful in predicting  $\dot{V}O_{2max}$  variance and helped the present non-exercise  $\dot{V}O_{2max}$  prediction model generate relatively accurate estimations of  $\dot{V}O_{2max}$  in Japanese women.

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**1983 Board #124 May 28 8:00 AM - 9:30 AM**  
**Energy Expenditure During Varying Intensity Running On A Position Sensitive Automatic Speed Adjusting Treadmill**

Bong Yeon Hwang<sup>1</sup>, Woon Yong Lee<sup>1</sup>, Youn Sun Son<sup>1</sup>, Eun Young Cho<sup>1</sup>, Dae Taek Lee<sup>1</sup>, Yoon Jung Bae<sup>2</sup>. <sup>1</sup>Kookmin Univ., Seoul, Republic of Korea. <sup>2</sup>Dongduk Women's Univ., Seoul, Republic of Korea.

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(No relationships reported)

**PURPOSE:** Conventional treadmill provides manually adjustable but fixed speed during exercise. A newly developed treadmill which senses human position on the treadmill and subsequently adjusts its speed to the runners is evaluated in terms of energy requirements of the exercise.

**METHODS:** Eight healthy young adults ( $n=9$  23±4 yrs, 65±11 kg, 169±6 cm) were recruited and participated in two exercise tests; 1) running on a position sensitive treadmill while varying speed (FTT) and 2) running on a conventional treadmill at a fixed speed (CTT). At FTT, subjects were asked to run at approximately 55-65% of pre-determined individual maximal work capacity for 20 min. And speeding-up and slowing-down of the running was determined by subjects. Once FTT was completed, an average speed of the running was calculated. At CTT, subjects ran on a treadmill at the fixed speed calculated from FTT for 20 min matching exercise distance. No testing order effects were noticed. During the tests, oxygen uptake ( $\dot{V}O_2$ ), respiratory exchange ratio (RER), and heart rate (HR) were measured, and EE was calculated.

**RESULTS:** The average treadmill speed was 7.69±1.16 kph for both FTT and CTT. The average  $\dot{V}O_2$  in FTT (29.9±4.4) was higher than that in CTT (27.1±5.9 mL·kg<sup>-1</sup>·min<sup>-1</sup>) ( $P < 0.05$ ). The calculated total EE during the exercise was higher in FTT (191.1±52.5) compared to CTT (175.0±58.7 kcal) ( $P < 0.05$ ). The average HR during exercise was not different between FTT (136.4±14.8) and CTT (134.7±16.3 bpm). No differences were found in RER between conditions.

**CONCLUSIONS:** Running on treadmill at moderate intensity with varying speed required higher energy expenditure than running at a fixed speed when the running duration and distance were matched. It appears that varying running speed on a position sensitive treadmill can be a potential exercise modality to increase energy expenditure.

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**1984 Board #125 May 28 8:00 AM - 9:30 AM**  
**Metabolic Response During Exercise On A Position Sensitive Automatic Speed Adjusting Treadmill**

Woon Yong Lee<sup>1</sup>, Youn Sun Son<sup>1</sup>, Bong Yeon Hwang<sup>1</sup>, Eun Young Cho<sup>1</sup>, Dae Taek Lee<sup>1</sup>, Won Joo Cho<sup>2</sup>. <sup>1</sup>Kookmin Univ., Seoul, Republic of Korea. <sup>2</sup>Hi-Care, Seoul, Republic of Korea.

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**PURPOSE:** Energy expenditure (EE) during walking and/or running on a fast response treadmill (FT), which is highly responsive to the position of the runner and can adjust its speed for the runner, has been compared to EE of conventional treadmill (CT). In the study, the speed of FT could vary simultaneously according to runner's position while the speed of CT was fixed at one speed.

**METHODS:** Thirteen healthy collegiate men ( $n=7$ ; 27±7 yrs, 74±10 kg, 173±4 cm) and women ( $n=6$ ; 23±4 yrs, 52±2 kg, 162±4 cm) underwent two tests; FT-test and CT-test. At FT-test, subjects walked and/or ran at varying FT speed with their choices at about 40-50% of pre-determined individual maximal aerobic capacity for 30 min. After FT-test, an average speed of FT-test was calculated, and the speed was applied to CT-test matching exercise duration and distance to FT-test. No testing order effects were found. During the tests, oxygen uptake ( $\dot{V}O_2$ ), respiratory exchange ratio (RER), and heart rate (HR) were measured, and EE was calculated. Before and after the exercise, blood samples were drawn for analyses of glucose, lactate, and triglycerides.

**RESULTS:** The average treadmill speed was 6.53±0.47 kph (6.72±0.37 for men, 6.30±0.51 for women) in both tests. The average  $\dot{V}O_2$  was 23.0±2.6 (23.9±2.7 for men, 21.8±2.0 for women) and 21.7±2.9 mL·kg<sup>-1</sup>·min<sup>-1</sup> (22.8±2.9 for men, 20.4±2.5 for women) for FT and CT, respectively ( $P < 0.05$ ). The total EE during the test for FT (212.8±50.2 kcal; 253.9±24.5 for men, 164.8±14.6 for women) was higher than for CT (201.2±51.8 kcal; 242.3±27.4 for men, 153.3±20.5 for women) ( $P < 0.05$ ). HR was also higher for FT (119.6±9.2) than CT (115.1±9.1 bpm) ( $P < 0.05$ ). RER during exercise was similar at both treadmills (0.84±0.04 for FT, 0.83±0.05 for CT). No differences were found in blood



variables between FT and CT.

**CONCLUSIONS:** At an identical exercise duration and distance, varying treadmill speed during exercise induced higher energy expenditure than fixed treadmill speed. It appears speed variations during treadmill exercise may require more energy metabolism than constant speed although the mechanism is unclear.

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## **C-35 Free Communication/Poster - Motor Units and EMG**

MAY 28, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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### **1985 Board #126 May 28 9:00 AM - 10:30 AM**

#### **Quantitative Motor Unit Analysis And Motor Unit Number Estimates In Healthy Subjects And Patients With Lateral Epicondylitis**

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(No relationships reported)

Lateral epicondylitis (LE) is a condition that is caused by repetitive wrist extension activities and involves inflammation of the extensor tendon attachments at the lateral epicondyle. Symptoms associated with LE have been demonstrated to diminish with manual cervical manipulation, and electromyographic (EMG) signal abnormalities have been identified in individuals with LE suggestive of a cervical radiculopathy component.

**PURPOSE:** This study was designed to determine: (i) if the quantitative EMG parameters related to motor unit potential (MUP) morphology, motor unit (MU) firing patterns or motor unit number estimates (MUNEs) detected from the affected extensor carpi radialis brevis (ECRB) muscle of patients with LE are different from those detected in healthy control subjects and whether these measures are suggestive of nerve pathology in patients.

**METHODS:** Ten patients (47.9 ± 10.2 years) with clinically determined LE and eight healthy subjects (30.9 ± 7.9 years) participated in the study. Maximum M-waves, and needle- and surface- detected EMG data were recorded from the ECRB muscle during 30-second contractions performed at 10% of maximum voluntary contraction force. DQEMG<sup>TM</sup> was used to extract needle-detected and surface- detected (S) MUP morphology and MU firing rates. Maximum M-wave amplitudes were divided by the amplitude of the mean SMUP in each subject to obtain MUNEs. Kruskal-Wallis tests were used to determine between-group differences.

**RESULTS:** Patients with LE had significantly larger MUP area-to-amplitude ratio (1.70 ± 0.58 vs. 1.23 ± 0.41), MUP duration (10.08 ± 3.10 ms vs. 6.90 ± 2.36 ms), SMUP amplitude (118.87 ± 111.10 µV vs. 60.15 ± 27.00 µV), and SMUP area (536.8 ± 528.1 µVms vs. 297.4 ± 189.5 µVms) compared to healthy control subjects (p<0.05). MU firing rates were significantly higher in the healthy control subjects (14.29 ± 2.47 Hz) than patients with LE (13.72 ± 2.69 Hz; p<0.05). The MUNEs were not significantly different between the groups (p>0.05).

**CONCLUSIONS:** The MUP morphology differences between patients with LE and healthy control subjects are suggestive of neurogenic changes in the MUs of the ECRB muscle in the patients with LE; however the MUNEs did not suggest that there was any axonal loss.

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### **1986 Board #127 May 28 9:00 AM - 10:30 AM**

#### **The Role Of Neural Tension In Hamstring Flexibility**

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(No relationships reported)

**PURPOSE:** The Slump Test is used to assess adverse neural tension in patients with low back and hamstring injuries, and involves tensioning the neural tissues by flexing the cervical and thoracic spine during hamstring stretch. It is not known if this neural tension increases resistance to stretch. Therefore, the purpose of this study was to determine if neural tension, via the Slump Test, during passive hamstring stretch, affects maximum range of motion (ROM), stretch discomfort, resistance to stretch, or the electromyographic (EMG) response to stretch in healthy subjects.

**METHODS:** Resistance to stretch, EMG response, ROM and stretch discomfort were measured bilaterally during passive hamstring stretches with and without neural tension (n=8, age 39±13 yr, weight 154±24 lb). Stretches were performed on an isokinetic dynamometer (5°/s) with subjects seated, the test thigh flexed 45° above the horizontal, and the seat back at 90° to the horizontal. Knees were passively extended from 90° flexion to maximum stretch tolerance. Starting leg (right or left) and test sequence (stretch with or without neural tension) were alternated between subjects (each stretch separated by 4 min). Stretch-induced EMG signals were normalized to maximum contractions performed prior to stretches. For neural tension stretches the cervical and upper thoracic spine were manually flexed by a physical therapist (Slump Test).

**RESULTS:** Maximum ROM was 8±5° less for the stretches with neural tension versus stretches without neural tension (P<0.01). Stretch discomfort and EMG response were not different between stretches with and without neural tension (discomfort: 7±1 vs. 6±2, P=0.29; EMG: 3±5% vs. 5±5%, P=0.1). Resistance to stretch was progressively greater with increasing ROM for stretches with neural tension versus without neural tension (P<0.001). During the neural tension stretches resistance to stretch at maximum ROM was 12% greater than resistance at the same angle during stretches without neural tension (P<0.05).

**CONCLUSIONS:** Maximum ROM was decreased and passive resistance to stretch was increased by increasing neural tension during passive hamstring stretch. This effect was not due to an increased EMG response to stretch. These data indicate that passive extensibility of neural tissues can limit hamstring flexibility.

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### **1987 Board #128 May 28 9:00 AM - 10:30 AM**

#### **Neuromuscular Fatigue Following Repetitive Endurance Cycling.**

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(No relationships reported)

It is well known that both central and peripheral factors contribute to muscle fatigue following a single bout of prolonged exercise lasting several hours. However, little is known about the cumulative fatiguing effects of repeated bouts of prolonged exercise.

**PURPOSE:** To determine the effects of 20 days of repetitive endurance cycling within a 22 day period, on peripheral and central contributions to fatigue.

**METHODS:** Eight well-trained male cyclists completed 20 prolonged cycling stages interspersed by two rest days (day 9 and 16), which replicated the 2007 Tour de France route and schedule (mean daily distance and cycling time, 165 ±66 km, 522 ±111 min, respectively). Isometric knee extensor torque and electromyographic responses of the Vastus Lateralis in response to percutaneous electrical stimulation and transcranial magnetic stimulation (TMS) were measured before, on day 9, day 16 and 2 d following completion of the Tour. Post exercise measurements on day 9 and 16 were taken >18 h after cessation of the previous exercise bout.



**RESULTS:** Maximal voluntary contraction of the knee extensors decreased by  $20 \pm 10\%$  ( $P < 0.01$ ) during the Tour, but recovered after 2 d of rest. Peripherally evoked M-wave and potentiated twitch responses were also significantly decreased on day 9 and 16, up to  $31 \pm 21\%$  and  $22 \pm 18\%$ , respectively ( $P < 0.05$ ), but returned to baseline values following 2 d recovery. Voluntary activation was reduced to  $75 \pm 8\%$  ( $P < 0.05$ ) during the Tour, and remained significantly depressed ( $79 \pm 7\%$ ,  $P < 0.05$ ) following completion of the Tour. Amplitude of motor evoked potentials, elicited by TMS were also decreased by  $44 \pm 28\%$  ( $P < 0.01$ ) on day 9 and remained significantly depressed during the remainder of, and following, the Tour.

**CONCLUSIONS:** A reduction in knee extensor strength which occurs following repetitive prolonged cycling exercise is a result of both central and peripheral processes. A reduced sarcolemmal excitability and impairment of contractile mechanisms exists following repetitive prolonged exercise bouts, even after a substantial recovery period. These peripheral changes are accompanied by an enduring reduction in corticomotor output, which persists even following 2 d rest.

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**1988 Board #129 May 28 9:00 AM - 10:30 AM**

**Adaptations Of The Neuromuscular Junction To Exercise Training In Young And Aged Rats**

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(No relationships reported)

Although the effects of aging on training-induced remodeling of skeletal muscle have been well studied, little is known regarding the capacity of aging to influence exercise-induced adaptations of the neuromuscular junction (NMJ).

**PURPOSE:** This study aimed to determine whether aged and young adult NMJs responded differently to the same program of endurance training.

**METHODS:** Twenty young adult (8 mo old) and 20 aged (24 mo old) male Fischer 344 rats were randomly assigned to either exercise trained or control groups (4 groups, N=10/group). Trained rats from each age group participated in an identical 10 week program of treadmill running (5days/wk) while age matched controls remained sedentary in their cages. Following the 10 week intervention, all rats were euthanized and soleus muscles were removed and quickly frozen at resting length. Muscles were sectioned and stained with cytofluorescent techniques to visualize pre-synaptic nerve terminal branches, and post-synaptic acetylcholine receptors. Pre- and post-synaptic images were collected with confocal microscopy and used to quantify various parameters of NMJ morphology. Myofiber profiles (fiber size and composition) were determined with standard histochemistry and light microscopy. Data were analyzed with a 2 way ANOVA with main effects of age and treatment.

**RESULTS:** Young adult, but not aged rats demonstrated significant ( $P < 0.05$ ) training-induced increases in pre-synaptic nerve terminal branch number, total branch length, and branching complexity. Similarly, when examining post-synaptic morphology, only young rats displayed significant training-induced increments in perimeter length around endplate regions, and expanded areas occupied by acetylcholine receptors. And although myofibers of aged control rats were smaller than their younger counterparts, training elicited a significant increase in fiber size only among aged rats restoring their size to that observed among younger ones.

**CONCLUSIONS:** Our data show that aging blunts the adaptability of the NMJ to endurance exercise training. This is meaningful because failure of neuromuscular transmission is an important contributor to muscle fatigue, thus limiting exercise performance and associated health benefits.

Supported by the NIH grant R15 AG17440.

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**1989 Board #130 May 28 9:00 AM - 10:30 AM**

**Dose-response Relationship For Neuromuscular Electrical Stimulation To The Quadriceps After Total Knee Arthroplasty**

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(No relationships reported)

**INTRODUCTION:** Neuromuscular electrical stimulation (NMES) has been shown to be effective in aiding the recovery of quadriceps femoris muscle strength after total knee arthroplasty (TKA). Yet, the training intensity (dosage) has not been well described. The purpose of this investigation was to establish a dose-response relationship for NMES in patients after TKA and examine immediate changes in quadriceps muscle fatigue and activation.

**SUBJECTS:** Fifteen patients with end-stage osteoarthritis were studied (67.7±19.4 years; 9 women, 6 men). Patients were simultaneously enrolled in a clinical trial for NMES for which exclusion criteria included the following: uncontrolled hypertension, uncontrolled diabetes, BMI >35, other significant lower extremity orthopaedic problems, or neurological impairments.

**METHODS:** Quadriceps isometric strength and activation were assessed preoperatively and again at 3wks and 6wks after TKA using an isokinetic dynamometer. Muscle activation was quantified using a doublet interpolation technique. NMES training intensities at 3 and 6wks were monitored by logging the electrically elicited knee extension torque and expressing this torque as a percentage of the involved quadriceps muscles' maximal voluntary contraction torque. All patients participated in a standardized rehabilitation program for 9wks after TKA plus NMES treatment using an Empi 300PV 2x/day for 15 minutes/session for 6wks beginning 2 days after TKA.

**RESULTS:** Higher NMES doses more effectively attenuated the quadriceps strength loss at 3wks ( $R^2=0.45$ ;  $p < 0.05$ ) compared to lower doses, but this relationship was weaker at 6wks. Furthermore, quadriceps strength loss at 3wks was significantly attenuated in the NMES group (24.2±23.2% loss) compared to previously reported 60% losses using similar methods in the absence of NMES. After a single session of NMES (at 3wks), average quadriceps muscle fatigue was 8.2±12.7% and activation dropped less than 1% ( $p > 0.05$ ).

**CONCLUSION:** Higher NMES doses were associated with less quadriceps strength loss than lower doses. Early NMES after TKA may help attenuate quadriceps strength loss to enhance functional performance after TKA when used at sufficiently high intensities.

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**1990 Board #131 May 28 9:00 AM - 10:30 AM**

**In Vivo Force Transmission In The Lower Leg During Voluntary And Stimulated Muscle Contraction**

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(No relationships reported)

Force transmission from muscle to bone may occur in a more complex manner than previously appreciated. For example, it has been shown in animals that force transmission between synergists and antagonists muscles may take place, and further, that lateral force transmission may occur within the load bearing tissues such as tendons and aponeuroses. The mechanisms that underlie tendon injury are elusive, however, heterogenous muscle activation and non-uniform force transmission between muscles and/or within tendons may potentially play a role.

**PURPOSE:** To determine if lateral force transmission occurs within and between superficial and deep plantarflexor muscles in humans in vivo.

**METHODS:** Seven subjects performed 4 types of either active contractile tasks or passive joint manipulations with the limb positioned in two different joint configurations (extended and flexed knee): 1) voluntary plantarflexion, 2) voluntary hallux flexion, 3) passive hallux extension and 4) selective percutaneous stimulation of one superficial plantarflexor muscle (medial gastrocnemius (MG)). Muscle displacement during manipulations were determined by ultrasonography obtained at a proximal and distal site for 3 muscles (MG (proximal site), soleus (SOL) (proximal and distal site), flexor hallucis longus (FHL) (distal site)). Neural activation of muscles was assessed by EMG.

**RESULTS:** During passive hallux extension the FHL tendon underwent  $5 \pm 1$  mm (mean±sem) displacement in distal direction without any movement in the adjacent SOL muscle. The

FHL tendon moved  $4 \pm 1$  mm in proximal direction during selective FHL contraction without any movement in SOL. During full plantar flexion SOL and MG displacement was similar in the proximal direction ( $\sim 7 \pm 1$  mm) while FHL only displaced  $2 \pm 1$  mm. Percutaneous stimulation of MG generated  $3 \pm 1$  mm of displacement of GM and  $2 \pm 1$  mm in SOL in the proximal direction while FHL remained fixed.

**CONCLUSIONS:** The present data suggest that lateral force transmission occurs between the superficial plantar flexor muscles (GM and SOL), and that the deep flexor muscle FHL, which is also a strong plantar flexor muscle, seems to be an independent actuator.

*This work was Supported by the Danish Medical Research Council*

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**1991 Board #132 May 28 9:00 AM - 10:30 AM**

**Linear And Control Entropy Analysis Of Electromyography And Mechanomyography Signals During The Wingate Anaerobic Test**

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*(No relationships reported)*

**PURPOSE:** Tools from non-linear dynamical systems analysis may provide unique insight into the nature of fatigue during maximal exercise. Control entropy (CE) is a novel method to quantify the complexity of non-linear dynamic physiological signals and is indicative of control systems constraints. Therefore, the effects of fatigue on surface electromyography (SEMG) and mechanomyography (MMG) were studied during the Wingate anaerobic test (WAnT) using CE analysis.

**METHODS:** Twelve trained (6 M / 6 F) intercollegiate athletes volunteered to participate in procedures approved by the Hope College HSRB. MMG and SEMG of the rectus femoris (RF) and vastus medialis (VM) muscles of the dominant leg were recorded using accelerometers (ACC, ADXL330, Analog Devices, Inc., Norwood, MA) and surface electrodes. Measurements collected at a rate of 1000 Hz were amplified and recorded using Biopac (GA) EM100C, MP150 and AcqKnowledge v3.8.2 software, respectively. Participants performed a 30-second WAnT on a Lode Excalibur cycle ergometer at 0.075 kp/kg of body weight. Linear comparisons of changes in the mean amplitude, peak-peak amplitude, and mean power density for both the MMG and EMG signals were made using repeated measures ANOVA ( $\alpha \leq 0.05$ ). CE of raw MMG and SEMG signals were calculated and tested for significance using Matlab (The Mathworks, MA).

**RESULTS:** Significant differences were observed between genders ( $p < 0.05$ ); and there were significant effects of time (VM; RF) for mean MMG ( $p < 0.001$ ), mean VM SEMG ( $p < 0.05$ ), p-p MMG ( $p < 0.001$ ), and p-p SEMG ( $p < 0.05$ ). Fatigue Index (FI) calculations for MMG-FI and WAnT-FI ( $0.826 \pm 0.010$  and  $0.491 \pm 0.192$ , respectively) revealed a moderately high correlation ( $r = 0.725$ ,  $p = 0.012$ ). CE increased significantly in both MMG and EMG at the start of the WAnT. CE of MMG remained elevated for duration, while EMG declined as fatigue ensued.

**CONCLUSIONS:** SEMG and MMG signals reflect the changes in power output seen in the WAnT. These may provide supplemental information in assessing anaerobic power. In particular, changes in CE indicate that constraints are reduced in both neurological and muscular system components during the WAnT and may provide unique insight into the nature of fatigue from supramaximal exercise.

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**1992 Board #133 May 28 9:00 AM - 10:30 AM**

**Voluntary Activation Of The Knee Extensors Can Be Assessed Reliably Using Transcranial Magnetic Stimulation**

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*(No relationships reported)*

Voluntary activation (VA) is often quantified by comparing the extra force elicited by motor nerve stimulation during a maximal voluntary contraction (MVC) with that produced at rest by the same stimulus. Transcranial magnetic stimulation (TMS) has recently been used to assess VA, where the presence of a superimposed twitch (SIT) during a MVC suggests that incomplete activation is present due to sub-optimal drive from the motor cortex. With TMS, however, it is inappropriate to compare extra force evoked during a contraction to that evoked at rest because corticospinal excitability increases during muscle activity. A method has been devised for the upper limb muscles (Todd et al., 2004) whereby the resting motor cortical output can be estimated by extrapolation of the linear relationship between SIT amplitude and voluntary force. It is unknown whether this method can be used to assess VA of the lower limb.

**PURPOSE:** To investigate whether the TMS extrapolation method can reliably predict VA and detect fatigue of the knee extensors.

**METHODS:** On two occasions, force and EMG responses to TMS were measured from 12 healthy male subjects during isometric knee extension. The size of the resting twitch evoked by TMS was estimated using linear extrapolation, and the level of voluntary drive was quantified using the equation:  $VA (\%) = (1 - SIT/ERT) \times 100$ . To assess fatigue, VA was measured before, immediately after and 30 min after a 2 min isometric MVC. Repeated measures ANOVA was used to assess differences within and between days, whilst reliability was assessed using the intraclass correlation coefficient ( $ICC_{2,1}$ ) and coefficient of variation (CV). Paired samples t-tests were used to determine differences pre- and post-fatigue.

**RESULTS:** SIT amplitude decreased linearly with increasing voluntary force between 50 and 100% MVC. VA measurements were reliable within-day ( $CV = 3.4\%$ ;  $ICC_{2,1} = 0.92$ ,  $p < 0.001$ ) and between-day ( $CV = 5.4\%$ ;  $ICC_{2,1} = 0.94$ ,  $p < 0.001$ ). Immediately after the sustained MVC, VA was reduced by  $16 \pm 9\%$  (mean  $\pm$  SD,  $p < 0.001$ ).

**CONCLUSION:** TMS can be used to reliably measure VA and assess supraspinal fatigue of the knee extensors.

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**1993 Board #134 May 28 9:00 AM - 10:30 AM**

**Acute Effects Of Passive Stretching On The Electromechanical Delay**

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**INTRODUCTION:** The electromechanical delay (EMD) is the latency between muscle stimulation and its resultant force production. The EMD may be influenced by the excitation-contraction coupling process and the muscle's series elastic component (SEC). If a bout of stretching affects the SEC, then it may affect the EMD.

**PURPOSE:** To examine the acute effects of passive stretching on the EMD.

**METHODS:** Sixteen men (mean  $\pm$  SD age =  $21.1 \pm 1.7$  yrs; body mass =  $75.9 \pm 11.4$  kg; height =  $176.5 \pm 8.6$  cm) volunteered for this study. Each subject's foot was stabilized in a custom-built apparatus designed to measure plantar flexion force with a knee joint angle of  $180^\circ$  and ankle joint angle of  $90^\circ$ . The apparatus was also attached to a Biodex System 3 dynamometer (Biodex Medical Systems, Inc., Shirley, NY) that stretched the plantar flexor muscles by passively dorsiflexing the foot at  $5^\circ \cdot s^{-1}$  until a constant-torque threshold was achieved and held at a point of discomfort. Nine repetitions of each stretch were held for 135 s with 10 s rest between repetitions. Before and after the stretching, a supramaximal stimulus was applied to the tibial nerve in the popliteal fossa. Twitch force was recorded from a load cell, while EMG signals were recorded from bipolar, preamplified electrodes placed over the soleus and gastrocnemius muscles. The sampling rate was 2 KHz. EMD was calculated as the time (ms) from the onset of the M-wave to the onset of the twitch response as determined by two separate investigators. A paired samples t-test was used to compare the EMD values at pre- and post-stretching.

**RESULTS:** There was an 11.2% increase ( $p = 0.031$ ) in EMD from pre- (mean  $\pm$  SD =  $5.09 \pm 0.49$  ms) to post-stretching ( $5.66 \pm 0.77$  ms).

**CONCLUSION:** These findings suggested that 20 min of constant-torque passive stretching increased the EMD of the plantar flexors, which may have reflected stretching-induced changes in the SEC. It is possible that the muscle required more time to overcome the increase in compliance and musculotendinous laxity in order to transfer force to the bone as a result of the stretching. In addition, the lower average EMD values in this study compared to previous studies may have been due to the knee joint angle that placed more resting tension on the plantar flexor muscles. **ACKNOWLEDGEMENTS:** This study was funded in part by the NSCA Foundation, Colorado Springs, CO.

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**1994 Board #135 May 28 9:00 AM - 10:30 AM**

**Voluntary Activation At Short And Long Muscle Lengths In The Human Elbow Extensors**

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(No relationships reported)

**PURPOSE:** To evaluate whether muscle length (shortened, or slack versus lengthened muscle) affected voluntary activation when calculated using the twitch interpolation method and compared to two extrapolation methods.

**METHODS:** Twelve healthy men [mean age 26.9(4.3)yrs] performed elbow extensor voluntary contractions at short (20° of elbow flexion) and long muscle lengths (120°). In each condition, doublets were evoked during 5s voluntary contractions at 5%, 10%, 20%, 40%, 60%, 80%, 100% of maximum voluntary contraction torque (MVC), and at rest post-MVC. Voluntary activation at each length was calculated using the formula:  $1 - (\text{interpolated doublet} / \text{post-MVC doublet}) \times 100\%$ . Because the post-MVC doublet amplitude is reduced in the shortened position, voluntary activation also was estimated using linear and non-linear extrapolations of voluntary and interpolated torques at values greater than 20% of MVC.

**RESULTS:** MVC torques were similar at 20° (57 Nm), and 120° (52 Nm). Interpolated doublet amplitude (0.8 Nm) was unaffected by joint angle, but the post-MVC doublet torque (normalized to MVC torque) was 32% lower at 20° than at 120°. Non-linear extrapolations created a 24% increase in post-MVC doublet amplitudes versus a 6% increase estimated from linear extrapolations. Using the predicted post-MVC doublet at the short length improved voluntary activation by 18-33% for submaximal contraction intensities (< 60% of MVC). However, maximal voluntary activations (during MVCs) when calculated, or predicted by both linear and non-linear extrapolations were not affected by muscle length changes (94-96%).

**CONCLUSION:** Voluntary activation of the elbow extensors was length-dependent with lower voluntary activation at submaximal intensities at short lengths. Compared to the calculated twitch interpolation method, in this muscle group, non-linear extrapolation improved the ability to assess voluntary activation below 60% of MVC by accounting for the diminished post-MVC doublet amplitude in a shortened length.

*Supported by NSERC.*

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**1995 Board #136 May 28 9:00 AM - 10:30 AM**

**Velocity Dependent Motor Unit Discharge Rates Of The Anconeus During Elbow Extension**

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Most of our understanding about motor unit properties has been derived in animals and humans from isometric contractions, in which joint angle does not change. Due to the technical difficulty of recording single motor unit action potentials during movement, especially at higher velocities, limited information exists about motor unit firing rates (MUFRs) during lengthening and shortening contractions. The unique mechanical and muscle group features of the anconeus muscle may offer a model to provide reliable recordings of MUFRs during large and fast movements of the elbow joint.

**PURPOSE:** To determine the effect of velocity of elbow joint extension on MUFRs of the anconeus.

**METHODS:** Motor unit recordings (n=594) from five healthy young men (~25yrs) were collected from the anconeus during 120° range of motion of elbow extension at different velocities. Using a Biodex dynamometer, subjects first performed three brief maximal isometric contractions (MVC) at an angle of 60° of elbow flexion (0° = full extension) to determine the preload (30% MVC) for the dynamic contractions. Then, five maximal velocity elbow extensions (Max) were performed to determine the target peak velocities for the subsequent extensions. Subjects completed a number (20-40) of brief (<1s) elbow extensions at each target peak velocity (20, 40, 60, and 80% Max all at a constant load of 30% MVC) with two minutes rest between each set of extensions. Single motor unit action potentials were recorded on two independent channels, each from two pairs of indwelling wire electrodes inserted ~3cm distal to the olecranon process of the ulna in the belly of the anconeus.

**RESULTS:** MUFRs during MVC (~32Hz) were 25% lower compared with MUDRs at maximal preloaded velocity of ~500°/s (~42Hz). From 20% to 80% Max, MUFRs increased nonlinearly from ~13Hz to ~23Hz.

**CONCLUSIONS:** The anconeus may be a useful model to explore MUFRs during dynamic contractions. Preliminary results indicate that higher rates than isometric MVC are recorded during high velocity contractions, and changes in rates are related to changes in velocity.

*Supported by NSERC*

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**1996 Board #137 May 28 9:00 AM - 10:30 AM**

**Neuromuscular And Perceptual Aspects Of Eccentric Muscle Damage And Recovery**

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(No relationships reported)

Strength loss following damaging eccentric exercise ( $E_{dam}$ ) has been widely studied but changes in functional (power) and perceptual (perceived exertion and mood states) responses have received less attention.

**PURPOSE:** The purposes of this investigation were to: 1) quantify neuromuscular function during  $E_{dam}$ , 2) evaluate changes in maximal power ( $P_{max}$ ), muscle soreness (SOR), rating of perceived exertion (RPE), and mood states, and 3) test the hypothesis that the joints that absorb the greatest eccentric work would exhibit the greatest reductions in power during recovery.

**METHODS:** Twenty-two trained cyclists (age:  $31 \pm 7$ yrs) performed eccentric cycling ( $-70 \pm 4$ kJ) with their right leg (damage) and concentric cycling ( $69 \pm 3$ kJ) with their left leg (control). Single-leg  $P_{max}$  was assessed with inertial-load cycling and biomechanical joint powers at the ankle, knee, and hip were determined using inverse dynamic techniques. SOR associated with a squat movement was measured using a visual analog scale. RPE during a standardized submaximal cycling task was assessed with a Borg scale, and mood states were quantified using a profile of mood states questionnaire (POMS). Measures were evaluated at six time points (baseline, 0, 24, 48, 72, 96hr post  $E_{dam}$ ). Differences in dependent variables were assessed using repeated measures ANOVA procedures.

**RESULTS:** The knee absorbed more work (63%) during  $E_{dam}$  than the ankle, hip, and upper body (7%, 23%, and 6%, respectively). Compared to baseline,  $P_{max}$  decreased (0-72hr), SOR increased (0-96hr), and RPE increased (0-72hr) in the damaged leg. Total mood disturbance increased only at the 0 hr time point. No alterations were observed in relative joint powers during sprint cycling.

**CONCLUSION:** Multi-joint eccentric exercise produced greater alterations in neuromuscular and perceptual responses compared to equally matched concentric exercise. RPE provided more functional indications of recovery compared to SOR as participants were able to perform challenging submaximal exercise despite being sore for several days.

The lack of alterations in relative joint powers did not support our hypothesis, suggesting that individual variability in joint power production/absorption strategies may have been a factor.

*Supported by the Gatorade Sports Science Institute.*

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**1997 Board #138 May 28 9:00 AM - 10:30 AM**

**An Electromyographic Analysis Of Three Abdominal Core Muscles: Comparing The Crunch To The Plank**

Anthony Caterisano, FACSM, Jaimie M. Grossnickle, Brian T. Patrick, Raymond F. Moss, Lane Salter, Nicholas Basinger. *Furman University, Greenville, SC.*

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*(No relationships reported)*

Clinical observations suggest a growing interest among fitness trainers to incorporate Pilates exercises into workout routines, instead of abdominal crunches, as a way of developing core strength. One particular exercise, the plank, is often included in these workouts as a way to target core muscles such as the rectus abdominis and external oblique muscles.

**PURPOSE:** To monitor the muscle activation during the plank exercise compared to an abdominal crunch exercise, with both performed to exhaustion, in activating abdominal and external oblique muscles.

**METHODS:** Ten trained, college-age males (mean age = 20.8 yrs) volunteered to perform abdominal crunches and the plank exercise to exhaustion, in separate trials while the electrical activity of the upper rectus abdominis (URA), lower rectus abdominis (LRA) and external oblique (EO) were monitored via electromyography (EMG). The muscle electrical activity was measured using a Biopac™ bipolar electrode EMG system in which data were normalized as a percent of a maximum isometric abdominal curl against resistance. The order of trials was randomized and performed with 48 hours between trials. Data were analyzed using a 2 X 3 linear model ANOVA with a Scheffe post hoc test.

**RESULTS:** The results showed that the crunch (URA =  $10.66 \pm 4.46\%$ ; LRA =  $11.87 \pm 4.30\%$ ; EO =  $13.79 \pm 3.06\%$ ) elicited a significantly higher ( $P < 0.05$ ) level of muscle activity than the plank (URA =  $8.54 \pm 2.23\%$ ; LRA =  $8.75 \pm 3.19\%$ ; EO =  $10.29 \pm 2.25\%$ ) in all three muscle groups tested.

**CONCLUSIONS:** These results suggest that the crunch stimulates a larger percent of maximum electrical activity than the plank exercise in the three areas of the abdominal muscles tested, when completed to exhaustion. This further suggests that the crunch may be a more effective way to elicit greater muscle stimulation than the plank exercise for better potential core strength gains.

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**1998 Board #139 May 28 9:00 AM - 10:30 AM**

**The Effect Of Crunch Exercise Speed On Electromyographic Activity Of Three Abdominal Muscles**

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*(No relationships reported)*

In studies using electromyography (EMG) to analyze the electrical activity of the abdominal muscles during core strengthening exercises, the data are typically collected for a fixed period of time or repetitions, early in the activity. A previous study found no significant difference in EMG activity between a 2 second and a 4 second crunch speed during this aforementioned initial phase. However, it is common practice to perform crunches to the point of fatigue, therefore making it relevant to consider the electrical activity at exhaustion.

**PURPOSE:** To look at the influence of speed of repetitions on the electrical activity of the abdominal muscles during crunches performed to fatigue.

**METHODS:** 10 trained, college-age male subjects (mean age = 20.8 yrs.) performed four second abdominal crunches (FS) and two second crunches (TS), in time to a metronome, to exhaustion in two separate trials. Electrical activity of the upper rectus abdominis (URA), lower rectus abdominis (LRA), and external oblique (EO) muscles were recorded using a Biopac™ bipolar electrode EMG system in which data were normalized as a percent of a maximum isometric abdominal curl against resistance. The order of trials was randomized and performed with 48 hours between trials. Data were analyzed using a 2 X 3 linear model ANOVA with a Scheffe post hoc test.

**RESULTS:** Crunches performed at a faster speed were found to have significantly more electrical activity than slower crunches at fatigue ( $p < 0.01$ ). The comparisons of the fast crunch to the slow crunch by muscle were as follows: URA,  $10.65 \pm 4.46\%$  vs.  $8.04 \pm 1.84\%$ ; LRA,  $11.86 \pm 4.27\%$  vs.  $8.64 \pm 2.26\%$ ; EO,  $13.79 \pm 3.05\%$  vs.  $8.86 \pm 3.07\%$ .

**CONCLUSION:** Contrary to the findings of the previous research which only looked at the initial repetitions, a faster 2 second crunch elicits greater EMG activity than a slower 4 second crunch when completed to fatigue.

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**1999 Board #140 May 28 9:00 AM - 10:30 AM**

**The Effects Of Parallel Versus Perpendicular Electrode Orientations On EMG Amplitude And Mean Power Frequency From The Biceps Brachii**

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*(No relationships reported)*

**PURPOSE:** The purpose of this study was to examine the influence of electrode orientation on the electromyographic (EMG) amplitude and mean power frequency (MPF) versus isometric torque relationships for the biceps brachii muscle.

**METHODS:** Ten adults [five men (mean  $\pm$  SD age =  $23.8 \pm 2.8$  years) and five women (mean  $\pm$  SD age =  $23.8 \pm 2.2$  years)] volunteered to participate in the investigation. Two separate bipolar surface EMG electrode arrangements (20 mm center to center) were placed on the dominant arm over the biceps brachii muscle. One EMG arrangement was placed parallel and the other perpendicular to the direction of the muscle fibers of the biceps brachii. The subjects performed two maximal, 6-second isometric muscle actions at a forearm flexion angle of  $60^\circ$  above the horizontal plane to determine maximal voluntary isometric contraction (MVIC). The subjects then performed a series of randomly ordered submaximal muscle actions in 10% increments from 10 to 90% MVIC. Paired t-test were used to examine mean differences between the two electrode orientations for absolute and normalized EMG amplitude and MPF values at each torque levels.

**RESULTS:** The mean absolute EMG amplitude values for the parallel electrode orientation were greater ( $p < 0.05$ ) than those for the perpendicular orientation at all isometric torque levels except 10% MVIC. For normalized EMG amplitude, there were no significant ( $p > 0.05$ ) mean differences between the parallel and perpendicular EMG electrode orientations for any of the %MVIC values. Furthermore, there were no significant mean differences between the parallel and perpendicular EMG electrode orientations for absolute or normalized EMG MPF for any of the %MVIC values.

**CONCLUSIONS:** These findings indicated that, unlike absolute EMG amplitude, normalized EMG amplitude values were not affected by electrode orientation. Thus, normalization can be used to reduce the effects of electrode orientation on EMG amplitude during isometric muscle actions of the biceps brachii. Furthermore, electrode orientation had no effect on absolute or normalized EMG MPF.

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**2000 Board #141 May 28 9:00 AM - 10:30 AM**



## The Effect Of Electrode Orientation On Electromyographic Amplitude And Mean Power Frequency Versus Isometric Torque Relationships

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**PURPOSE:** To examine the influence of electrode orientation on the electromyographic (EMG) amplitude and mean power frequency (MPF) versus torque relationships for the vastus lateralis (VL) during isometric muscle actions of the leg extensors.

**METHODS:** Eleven subjects ( $x \pm SD$  age =  $23.9 \pm 3.0$  yrs) volunteered to perform isometric muscle actions of the dominant leg extensors on a Cybex II dynamometer. The subjects performed two maximal isometric muscle actions to determine MVC and then a series of randomly ordered submaximal muscle actions in 10% increments from 10% to 90% MVC. Two separate bipolar electrode arrangements were oriented over the VL muscle. The first electrode arrangement (parallel) was placed one-third of the distance between the lateral border of the patella and the anterior superior iliac spine and in line with the approximate pennation angle (20%) of the muscle fibers of the VL. The second electrode arrangement was oriented perpendicular to the parallel electrodes. Paired *t*-tests were used to examine mean differences between the two electrode orientations for absolute and normalized EMG amplitude and MPF values at each torque level.

**RESULTS:** The mean absolute EMG amplitude and MPF values for the parallel electrode orientation were greater ( $P < 0.05$ ) than those for the perpendicular orientation at all ten isometric torque levels (except 20% MVC for MPF). The mean normalized EMG amplitude and MPF values for the parallel electrode orientation were greater than those for the perpendicular electrode orientation at 50 and 60% MVC, and 100% MVC, respectively.

**CONCLUSIONS:** In general, there was no effect of electrode orientation on the mean normalized EMG amplitude and MPF values. These findings indicated that normalization can be used as an effective method for reducing the influence of electrode orientation on EMG amplitude and MPF during isometric muscle actions.

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**2001 Board #142 May 28 9:00 AM - 10:30 AM**  
**Neuromuscular Activation Of Vastus Intermedius Muscle During Isometric Knee Extension At Various Force Intensities**  
Kohei Watanabe, Hiroshi Akima. *Nagoya university, Nagoya, Japan.* (Sponsor: Katsumi ASANO, FACSM)  
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(No relationships reported)

An investigation of the electromyography (EMG)-force relationship is one of the essential approaches to understand motor control in human skeletal muscle. For the quadriceps femoris (QF) muscle group, which plays an important role in human movement, EMG-force relationship is not fully understood, since it has been considered surface EMG can be recorded from only three superficial muscle components of QF muscle group. Recently, we reported the methodology recording the surface EMG from the remaining muscle component of the QF muscle group, the vastus intermedius (VI) muscle. Information about the activation of the VI muscle would be helpful to improve understanding of motor control of QF muscle group.

**PURPOSE:** The purpose of our study is to compare the EMG-force relationship of the VI muscle with that of the other components of the QF muscle group in order to characterize neuromuscular activation of the VI muscle.

**METHODS:** Thirteen healthy men performed maximal voluntary contraction (MVC) and submaximal contraction during isometric knee extension at 10% of the MVC to 90% of the MVC at intervals of 10% of the MVC level. Surface EMG was detected from four muscle components of the QF muscle group, i.e. VI, vastus lateralis (VL), vastus medialis and rectus femoris (RF) muscles. The electrode for the VI muscle was located at superficial region of this muscle defined by guidance of ultrasonography. Root mean squares (RMS) of EMG were calculated for each force level. RMS of submaximal contractions were normalized by the MVC. The difference between exerted force in the relative scale and normalized RMS were calculated at each force level and summed up for individual muscle components.

**RESULTS:** Normalized RMS in the VI muscle was significant lower than in the VL muscle at a lower force level (20% and 40% of MVC,  $p < 0.05$  each) and lower compared to the RF muscle at a higher force level (from 60% to 90% of MVC,  $p < 0.05$  each). Sum of difference in EMG-force relationship of VI muscle from the identity line was significantly larger than RF muscle ( $p < 0.05$ ).

**CONCLUSIONS:** These results suggest that neuromuscular activation in the VI muscle is relatively lower than that of the other components of QF muscle group during submaximal knee extension contractions. In addition, the EMG-force relationship of the VI muscle negatively deviates from the identity line.

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**2002 Board #143 May 28 9:00 AM - 10:30 AM**  
**Reliability Of Linear Versus Log-transformed Models For Torque-related Patterns Of Response For Mechanomyographic Amplitude**  
Trent J. Herda<sup>1</sup>, Joseph P. Weir, FACSM<sup>2</sup>, Eric D. Ryan<sup>3</sup>, Pablo B. Costa<sup>3</sup>, Ashley A. Walter, FACSM<sup>3</sup>, Travis W. Beck<sup>3</sup>, Jeffrey R. Stout, FACSM<sup>3</sup>, Joel T. Cramer, FACSM<sup>3</sup>. <sup>1</sup>*University of Oklahoma, Norman, OK.* <sup>2</sup>*Des Moines University - Osteopathic Medical Center, Des Moines, IA.* <sup>3</sup>*University of Oklahoma, Norman, OK.*  
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**PURPOSE:** To examine the test-retest reliability of the slopes (*b* terms) and y-intercepts (*a* terms) of the absolute linear and log-transformed exponential regression models that can be applied to the mechanomyographic amplitude (MMG<sub>RMS</sub>) versus torque (TQ) relationship.

**METHODS:** Fifteen participants (mean  $\pm SD$  age =  $23 \pm 4$  yrs) completed ten randomly-ordered isometric leg extensions from 5 to 95% of the maximal voluntary contraction (MVC) during three separate trials. MMG<sub>RMS</sub> was recorded from the vastus lateralis. Intraclass correlation coefficients (ICCs) and standard errors of measurement (SEMs) were calculated for test-retest reliability.

**RESULTS:** ICCs for the *b* and *a* terms were 0.89 and 0.90 for the log-transformed and 0.85 and 0.76 for the absolute relationships, respectively. The SEM (expressed as a percentage of the mean value) for the *b* and *a* terms were 9.7% and 16.4% for the log-transformed and 18.9% and 57.1% for the absolute relationships, respectively.

**CONCLUSIONS:** These findings suggested that the *b* and *a* terms from both the absolute linear and log-transformed exponential MMG<sub>RMS</sub> versus TQ relationships were relatively reliable (ICCs), however, the SEMs for the log-transformed relationships were lower than the linear models. Furthermore, the *b* term from the log-transformed relationships may provide meaningful information regarding the nonlinear characteristics (plateau points) of the MMG<sub>RMS</sub> versus TQ relationship, whereas the *a* term may indicate upward or downward shifts in MMG<sub>RMS</sub> across the TQ spectrum. Thus, the log-transformed MMG<sub>RMS</sub> versus TQ relationships may offer an attractive alternative method for reliably quantifying and tracking changes in the TQ-related patterns of response for MMG<sub>RMS</sub> on a subject-by-subject basis.

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**2003 Board #144 May 28 9:00 AM - 10:30 AM**  
**Contractile Properties And Hemodynamics For A Sustained Submaximal Contraction Studied With Electrical Stimulation And NIRS**  
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(No relationships reported)

Low-level repetitive muscle activity, especially with ensuing fatigue, is a risk factor for work related muscle pain (WRMP); however, the mechanism is unclear. Fatigue in this context is determined by evaluating the muscle contractile properties as generated with low frequency electrical stimulation (ES). Near infrared spectroscopy (NIRS) is useful for studying hemodynamics. Identifying fatigue and its physiological attributes may shed light on the link between low-level activity and WRMP.

**PURPOSE:** To determine the muscle contractile properties and hemodynamics before and after a sustained submaximal contraction.

**METHODS:** Subjects (n = 11; 26 ± 4 yrs) were equipped with electrodes for ES and NIRS on the forearm over the finger flexor digitorum muscle. Testing entailed ES (2 Hz; five trains of 15 twitches), followed by upper arm venous occlusion (VO, 50 mmHg for 1 min). Test times in min were before (0m), just after a sustained contraction (15m), and 45m, 75m and 135m. The sustained contraction consisted of 10% MVC for 15 min. During ES the hand was secured in a rig with load cell. Thus, force, contraction time (cont) and ½ relaxation time (½Rx) were determined. For VO, slopes calculated for NIRS derived total hemoglobin (HbT) and deoxyhemoglobin (Hb) were used as estimates of blood flow and oxygen consumption, respectively. Changes in time were tested with one-way ANOVA; if significant post-hoc testing was done.

**RESULTS:** Decreases in force, cont, and ½Rx, and increase in Hb were detected (P < 0.05). Data are below with \* depicting differences relative to 0m.

	0m	15m	45m	75m	135m
Force (N)	2.27 ± 0.83	1.67 ± 0.91*	1.86 ± 1.03	1.78 ± 0.89*	1.89 ± 0.85
Cont (ms)	53.8 ± 5.00	50.7 ± 4.44*	51.0 ± 4.76*	51.9 ± 4.51*	52.5 ± 5.52
½Rx (ms)	47.7 ± 6.40	41.8 ± 4.95*	43.0 ± 6.30*	44.7 ± 5.66	46.3 ± 6.19
HbTslope (% • sec <sup>-1</sup> )	0.13 ± 0.07	0.11 ± 0.06	0.13 ± 0.10	0.10 ± 0.04	0.12 ± 0.04
Hbslope (% • sec <sup>-1</sup> )	0.09 ± 0.06	0.13 ± 0.06*	0.10 ± 0.05	0.09 ± 0.03	0.09 ± 0.04

**CONCLUSION:** Contractile data confirmed fatigue and showed prolonged recovery; whereas Hbslope indicated increased consumption immediately post contraction but with quick recovery.

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**2004 Board #145 May 28 9:00 AM - 10:30 AM**

**Electromyographic Activities Of The Hamstring Muscles In Patients With Acl Reconstruction Using Semitendinosus Tendon**

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(No relationships reported)

Semitendinosus (ST) tendon is commonly used as a replacement graft during anterior cruciate ligament (ACL) reconstruction. However, patients with ACL reconstruction using ST tendon have shown considerable decrease in the strength capability of knee flexors in deep knee flexion. A prior study has indicated that electromyographic (EMG) activities of ST at deeper knee angle were relatively higher than those of the semimembranosus (SM) and biceps femoris (BF) in healthy subjects. After ST tendon removal, it is assumed that EMG activities of ST are modified, which would cause the weakness of knee flexion.

**PURPOSE:** The purpose of this paper is to clarify the effect of ST tendon harvest on EMG activities of ST and other hamstring muscles.

**METHODS:** Eight male patients with harvesting ST tendon for ACL reconstruction (postoperative period: 17±6 months) participated in this study. EMG activities of ST, SM and BF were detected using bipolar fine wire electrodes during maximum voluntary isometric contraction (MVC) at 15, 60 and 90 degrees of knee flexion in prone position. Isometric knee flexion torque during MVC was also measured using a dynamometer. The reconstructed and the contralateral limbs were tested separately.

**RESULTS:** Knee flexion torque of the reconstructed limb was lower than that of the contralateral limb at 60 and 90 degrees of knee flexion. When comparing the reconstructed and the contralateral limbs, only ST showed difference in EMG activity as a function of knee flexion angle particularly at 60 and 90 degrees of knee flexion, where the percentage values were lower for the reconstructed limb (Table 1).

**CONCLUSION:** The results of this study denote that removal of ST tendon induces a decline in the EMG activities of ST at deeper knee angle.

Table 1 EMG of each muscle. All values are expressed as a percentage relative to value at 15 deg.			
	15 deg.	60 deg.	90 deg.
ST of reconstructed limb (%)	100±0	106±29	84±25
ST of contralateral limb (%)	100±0	114±33	105±30
SM of reconstructed limb (%)	100±0	115±69	75±55
SM of contralateral limb (%)	100±0	104±40	75±49
BF of reconstructed limb (%)	100±0	91±22	68±48
BF of contralateral limb (%)	100±0	94±17	77±36

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**2005 Board #146 May 28 9:00 AM - 10:30 AM**

**Changes In Fatigability Of Muscles By Immobilization And Training Measured By Frequency Spectrum Analysis**

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(No relationships reported)

It is generally well accepted that immobilization and training induces changes in morphological, physiological and biochemical characteristics of skeletal muscle. A number of studies have investigated the effect of immobilization or training to fiber composition, or the fatigability of limb muscles using various methods, but results have been

inconsistent. Power spectrum of myoelectric signal has been used to monitor fatigue of skeletal muscle. We designed this study to compare changes of fatigability by immobilization or training of four human extremity muscles, which was known to have different fiber type composition respectively, during sustained muscle contraction using myoelectrical frequency spectrum analysis

**PURPOSE:** To evaluate the effects of immobilization and strengthening exercise on fatigability of different skeletal muscles using of frequency spectrum analysis.

**MATERIALS AND METHODS:** Four muscles(biceps brachii, ten triceps brachii, eighteen tibialis anterior and seventeen soleus) of control(50 male), cast immobilized(31 male) and trained group(17 male) were participated. The frequency spectrum was obtained using 1,024 point Fast Fourier Transformation of myoelectric signal during sustained isometric contraction at 80% MVC. The rate of decline in MPF(Mean Power Frequency) over time, indicative of the fatigue rate, was derived from the slope of the linear regression. We compared the change in fatigability between each muscle tested, as well as between the control group and immobilized group using ANOVA test.

**RESULTS:** Statistical analysis showed that immobilized triceps(-1.48±0.81Hz/sec) had less steep slope value than control groups(-2.16±0.77Hz/sec) ( $p < 0.05$ ), which means the fatigability of triceps was decreased by immobilization. In contrast, the immobilized soleus(-1.18±0.96Hz/sec) showed steeper slope values than control groups(-0.44±0.33Hz/sec), and this change was statistically significant, which means the fatigability of soleus was increased by immobilization. The trained group did not show difference in fatigability of any muscles comparing control group.

**CONCLUSION:** There were differences in changes of fatigability by immobilization of different skeletal muscles according to their muscle fiber compositions.

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**2006 Board #147 May 28 9:00 AM - 10:30 AM**

#### **Enhancement Of Jump Performance After A 5RM Squat And The Role Of Postactivation Potentiation**

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(No relationships reported)

Previous research has indicated that a heavy resistance exercise may enhance the performance of a subsequent biomechanically similar explosive movement. The most commonly proposed mechanism to explain this enhancement is postactivation potentiation (PAP).

**PURPOSE:** To evaluate whether a 5 repetition maximum (RM) squat exercise increases the performance of a subsequently performed set of countermovement jumps (CMJ) and whether a 5RM squat performance is associated with twitch potentiation.

**METHODS:** Eleven athletes experienced in the squat exercise completed 4 laboratory sessions with each session separated by 3-4 days. In each session 5CMJ were performed. In two of the sessions, the 5CMJ were followed by 8 min of rest and then performance of another 5CMJ or evoked twitch torque of the knee extensors. The other two sessions were identical, except that 5RM squat exercise was performed midway through the rest period. In those sessions in which evoked twitch torque was evaluated, a baseline twitch was also performed before the initial 5CMJ performance. The percent difference in 5CMJ performance (pre-post rest) in the 4 sessions was compared using one-way ANOVA with repeated measures.

**RESULTS:** Following the 8-min rest there was a  $4.3 \pm 12.6\%$  decrease in twitch torque and a  $1.4 \pm 4.1\%$  decrease in CMJ height, although these differences were not significant. Following the 5RM squat between CMJs, resulted in a  $9.6\% \pm 13.7\%$ ,  $p < 0.05$  increase in twitch torque and a  $2.8 \pm 2.9\%$   $p < 0.05$  increase in CMJ height.

**CONCLUSIONS:** The concurrent increases in CMJ performance and in twitch torque suggests that a 5RM squat results in PAP, which contributes to improved performance.

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### **C-36 Free Communication/Poster - Musculoskeletal Physiology**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**2007 Board #148 May 28 8:00 AM - 9:30 AM**

#### **An Arm And A Leg: Site Specific Bmc Predictors In Female Division Ii Collegiate Athletes**

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(No relationships reported)

It has previously been reported that lean body mass (LBM) and fat mass (FM) are positive indicators of bone mineral content (BMC). However, the individual relationships of these components to site specific BMC across female athletic populations are unclear.

**PURPOSE:** The aim of this investigation was to determine the relationships of arm and leg LBM and FM to arm and leg BMC in female Division II collegiate athletes.

**METHODS:** The participants were female athletes ( $20.25 \pm 2.15$  years) representing Division II collegiate soccer ( $n = 8$ ) and softball ( $n = 21$ ). LBM, FM, and arm and leg BMC were measured via total-body dual energy X-ray absorptiometry (iDXA). An independent samples t-test was used to determine if differences existed between the two athletic groups. Multiple regression analyses were then applied to determine the relationships between the independent (LBM and FM) and dependent (arm and leg BMC) variables.

**RESULTS:** No significant differences ( $p > .05$ ) were found between the two groups for either arm or leg BMC; therefore, multiple regression analyses were subsequently performed with all athletes representing one group. When leg fat and lean mass were entered into the multiple regression analysis,  $62.2\%$  ( $F[2,26] = 21.43$ ,  $p < .0001$ ) of the variation was accounted for in leg BMC. Upon further analysis, it was determined out of the two independent variables, lean mass of the legs had a greater unique contribution ( $32.4\%$ ) when compared to fat mass of the legs ( $.03\%$ ). The contribution of fat and lean mass to the arms was determined to be insignificant accounting for less than 1% of the variability ( $R^2 = 0.8\%$ ,  $F[2,26] = 0.108$ ,  $p > .05$ ).

**CONCLUSION:** Based on the results, lean body mass is a significant predictor of BMC in the legs for female Division II soccer and softball collegiate athletes. This information is consistent with previous findings for similar female Division I athletic populations and can potentially be used to design and implement training programs that will help increase or maintain BMC throughout life.

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**2008 Board #149 May 28 8:00 AM - 9:30 AM**

#### **Estrogen Receptor-alpha Genotype Affects Exercise And Nutrient Intake-related Change Of Bone Mass.**

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(No relationships reported)

Bone mass is affected not only by environment factors, e.g., physical activities and foods, but also by gene polymorphism.

**PURPOSE:** The present study was to determine whether gene polymorphism in the estrogen receptor (ER) alpha gene (ESR1) affect bone mass. And, the interaction between

genes and physical activities and/or dietary intakes on bone mass in young women.

**METHODS:** Seventy 20-23 years old Japanese women were chosen for the study. They were either very active physically (exercise three times per week) or not active. Food frequency questionnaires were used to estimate calcium intake. Bone mass was measured by quantitative ultrasound measurement (QUS). Genomic DNA was extracted from buccal cell. The ESR1 polymorphisms at intron I (*Pvu II* for a T/C substitution and *Xba I* for an A/G substitution) were genotyped using the PCR-RFLP. The relationships between ER1 genotype and physical activity, and/or dietary were evaluated.

**RESULTS:** There were no significant differences between bone mass and ER1 genotypes. However, body weight, BMI and high physical activity showed the positive correlation with bone mass in the Pp heterozygote ( $P < 0.01$ ). Furthermore, bone mass was higher in the individual who eats fish (three times per week) in the Xx heterozygote ( $P < 0.01$ ).

**CONCLUSIONS:** Our data suggested that physical exercise or a correct calcium intake is more important to bone mass for young women with Pp heterozygote or Xx heterozygote of ER alpha gene, respectively.

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**2009 Board #150 May 28 8:00 AM - 9:30 AM**  
**The Effect Of The Bench Press Grip On The Upper Body Muscle Activity**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to investigate the effect of varying bench press grip on the EMG activity of the upper body muscle during bench press exercise.

**METHODS:** 12 male students (22.5±2.7 yrs) were participated. To assess the myoelectric activities of selected muscles, surface electrodes were attached to pectoralis major, trapezius, front deltoid and triceps brachii. IEMG and NEMG were measured for each muscles. For each variable, one-way repeated ANOVA was used to determine whether these were significant difference among three grip bench press. From the above experiment, this study analyzed muscle activities and participations in wide grip (WD), normal grip (NM), and narrow grip (NR) during bench press. When a significant difference was found in three grip bench press, post hoc analysis were performed using Tukey procedure. Significant level was .05.

**RESULTS:** IEMG of triceps brachii muscle was significantly affected depending on the change of bench press grip (WD 35.42±9.25% vs NM 52.68±11.02%,  $p < .05$ ). NEMG of pectoralis major was significantly different between WD and NM & NR grip (30.91±6.93% vs 17.61±3.75 & 15.56±5.53,  $p < .05$ ). NEMG of trapezius was significantly different between WD and NR (3.63±1.21 vs 10.86±2.23,  $p < .05$ ). NEMG of triceps brachii was significantly difference between WD and NM (28.17±4.39 vs 40.97±7.53,  $p < .05$ ).

**CONCLUSIONS:** Pectoralis major muscle activity reduced as a grip narrow. And muscle activity of trapezius and triceps brachii increased as a grip narrow.

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**2010 Board #151 May 28 8:00 AM - 9:30 AM**  
**Effects Of Loading And Unloading On Physical Performance And Cardiovascular Function In Rats**

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(No relationships reported)

**PURPOSE:** Skeletal muscles are vulnerable to rapid and marked remodeling induced by the levels of mechanical load placed on the body. Under reduced levels of mechanical load, muscle mass will decrease (atrophy), while under increased load, the muscle mass will increase (hypertrophy). The cardiovascular system also undergoes profound changes when the body is exposed to various load levels. Our aim was to determine the effect of altered energy states (loading/unloading) on performance and cardiovascular parameters. More specifically, we compared the deleterious effect of a short period of unloading vs. the beneficial effects of two distinct periods of training.

**METHODS:** We measured O<sub>2</sub> uptake (VO<sub>2</sub> ml/kg/min), CO<sub>2</sub> output (VCO<sub>2</sub> ml/kg/min), respiratory exchange ratio (RER), and blood lactate (mmol/L) before and after suspension and training. In addition, Mean (MBP), Systolic (SBP), Diastolic (DBP) blood pressures and heart rate (HR) were measured by tail-cuff. Adult rats underwent either one week of hindlimb suspension (HSU) or two and four weeks of exercise training on a motorized treadmill, 5 d/wk, 45 min/d. Training intensity was ~75% VO<sub>2</sub>max.

**RESULTS:** We observed ~30% increase after unloading in basal VO<sub>2</sub> (19.8±1.6 vs. 27.2±2.1), VCO<sub>2</sub> (16.2±1.3 vs. 21.5±1.8) and lactate (1.9±0.1 vs. 2.5±0.4). We also found an increase of heart rate ~7% (403±33 vs. 431±21) and decrease in 6% tail blood flow (44.7±11 vs. 41.9±12, µl/min). Two or four weeks of exercise training did not change resting systolic diastolic or mean blood pressures; however, significantly reduced HR by 7%, 411±25 vs. 399±33 and 388±40, for controls and two or four-week loading, respectively. During the maximal exercise test, two and four weeks of training increased total running time by 30% and 53%, peak speed by 23% and 36%, VO<sub>2</sub> by 13% and 41%, and VCO<sub>2</sub> by 13% and 39%, respectively. In contrast, unloading decreased running time by 27%, peak speed by 21%, and peak lactate by 30%; however, no changes were observed in peak VO<sub>2</sub> and VCO<sub>2</sub>.

**CONCLUSION:** Our data suggests that the increase in baseline values in HSU animals is due to the stress of unloading. Data also shows that while 1 week of HS does not affect aerobic capacity, it impairs exercise performance. On the contrary, exercise training greatly improves both physical performance and aerobic capacity.

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**2011 Board #152 May 28 8:00 AM - 9:30 AM**  
**Reduced Leg Muscle Oxygenation During Underwater Treadmill Walking**

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(No relationships reported)

Central circulation and whole body metabolism adjustments, in particular, have been investigated using respiratory gas analysis and heart rate (HR) measurement. However, local muscle circulation and oxidative metabolism have never been investigated during underwater walking.

**PURPOSE:** The purpose of this study was to determine muscle oxygenation in the lower extremities during underwater walking on a treadmill.

**METHODS:** Eight healthy men (age 25 ± 3 y.r., height 175 ± 4 cm, weight 69.6 ± 5.7 kg, BMI 23 ± 2, VO<sub>2</sub>max 56.7 ± 5.9 ml/kg/min) performed a treadmill walking test twice, once in water and once on land. Each subject began underwater treadmill walking at 1.0 km/h in 0.5 km/h increments at intervals on 2 minutes until 3.5 km/h. Each subject also began land-treadmill walking at 2.0 km/h in 1.0 km/h increments at intervals of 2 minutes until 7.0 km/h. The HR was continuously monitored by a telemeter. Muscle electromyographic (EMG) activity was monitored in the vastus lateralis (VL) and the medial head of the gastrocnemius (MG). The muscle oxygenation level was continuously monitored in the VL and the MG using near-infrared spectroscopy (NIRS).

**RESULTS:** Muscle oxygenation decreased greater during underwater walking than during land walking both in the VL and in the MG. There is no significant difference in the EMG activity between the two conditions in both muscles. The combination of EMG and NIRS results indicate that the greater decrease in the muscle oxygenation is due to reduced muscle perfusion resulting from the facilitated venous return to central circulation during underwater walking.

**CONCLUSIONS:** The results of this study indicate that the greater decrease in the muscle oxygenation is due to reduced muscle perfusion resulting from facilitated venous

return to central circulation during underwater walking.

Supported by the Mizuno Sports Foundations (2006) and by the twenty-first century COE program, Ministry of Education, Culture, Sports, Science and Technology (2002-2006 Nishihira Project), Japan.

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**2012 Board #153 May 28 8:00 AM - 9:30 AM**  
**b-adrenergic Stimulation And Whole Body Protein Turnover**

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Recent evidence in animals indicates that exercise-induced changes in mitochondria turnover are largely the result of an increase in beta-adrenergic (b-AR) stimulation. If true, increases in b-AR stimulation may induce increases in protein turnover, a necessary process for exercise-induced adaptation. We hypothesized that in human subjects, b-AR stimulation would increase whole body protein turnover and synthesis.

**PURPOSE:** To evaluate the effects of b-AR stimulation on whole body protein turnover (WBPT) in resting humans.

**METHODS:** Six healthy untrained subjects ( $19.8 \pm 1.5$  yrs) received isovolumetric intravenous infusions of either saline (CON) or the non-selective b-AR agonist isoproterenol (ISO, 12 ng/kg fat free mass/min for 60 minutes) on two separate days. WBPT was determined using a 6-hour primed continuous infusion of  $[1,2]^{13}\text{C}$ -leucine (0.8 mg/kg prime, 1.25 mg/min infusion, and 0.5 mg/kg  $\text{NAH}^{13}\text{CO}_3$  prime) with breath and plasma samples collected hourly. CON or ISO infusions were performed between 1h and 2h. Plasma enrichment of  $\alpha$ -ketoisocaproate acid (KIC) was determined by gas chromatography mass-spectrometry (GC-MS), while breath enrichment of  $^{13}\text{CO}_2$  was determined by isotope ratio mass-spectrometry (IRMS). Calculations of leucine rate of appearance ( $R_a$ ), rate of oxidation ( $R_{ox}$ ), and non-oxidative leucine disposal (protein synthesis, NOLD) were made according to the single pool model. Statistical significance was set at  $p=0.05$  and data are displayed as mean $\pm$ SD.

**RESULTS:** Leucine  $R_a$  was not significantly different between trials ( $p=0.62$ ). However, there was a trend toward an interaction of time and treatment for  $R_{ox}$  ( $p=0.099$ ) and NOLD ( $p=0.092$ ). The trend towards a significant increase of NOLD after ISO was largely the effect of an increased ( $p<0.05$ ) rate of NOLD immediately post infusion (ISO:  $93.9 \pm 7.27$  vs. CON:  $80.13 \pm 13.15$   $\mu\text{mol/kg/min}$ ).

**CONCLUSIONS:** Our results suggest that in the one-hour period during b-AR stimulation there is an increase in whole body protein synthesis, which may contribute to observed post-exercise increases in protein turnover.

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**2013 Board #154 May 28 8:00 AM - 9:30 AM**  
**Anaerobic Work Capacity From Linear And Nonlinear Mathematical Models**

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(No relationships reported)

The critical torque (CT) test for isometric muscle actions provides estimates of two parameters; CT and anaerobic work capacity (AWC). Theoretically, CT is the maximal isometric torque that can be maintained without fatigue and AWC is the total "isometric work" associated with stored energy sources within the muscle.

**PURPOSE:** The purpose of this study was to determine if there were differences between the estimates of AWC from two linear and two nonlinear mathematical models.

**METHODS:** Nine adults (4 men, 5 women; age  $\pm$ SD =  $21.6 \pm 1.2$  yr) volunteered for this study. The first of five visits served as an orientation. Maximum voluntary isometric contraction (MVIC) of the dominant leg extensors was determined during the second visit. During visits 2-5, each subject performed one continuous, fatiguing, isometric muscle action to voluntary exhaustion to determine the time to exhaustion (limit time;  $T_{lim}$ ) and total isometric work performed (limit work;  $W_{lim}$ ) at a randomly ordered percentage of MVIC (30%, 45%, 60%, or 75%). The  $T_{lim}$ ,  $W_{lim}$ , and torque values were used in two linear and two nonlinear mathematical models to calculate four separate estimates of AWC.

**RESULTS:** A one-way repeated measures ANOVA indicated no significant differences between the estimates of AWC from the four mathematical models. In addition, the AWC estimates were highly intercorrelated at  $r = 0.986$  to  $0.999$ .

**CONCLUSION:** The results of the current study indicated that linear and nonlinear mathematical modeling of the  $T_{lim}$ ,  $W_{lim}$ , and torque data had no effect on estimates of AWC during isometric muscle actions of the leg extensors. Thus, the four mathematical models examined in the present study can be used to estimate the total isometric work that can be performed from stored energy sources within the muscle.

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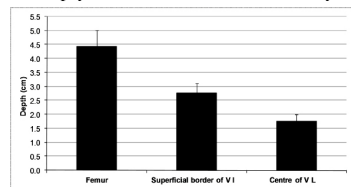
**2014 Board #155 May 28 8:00 AM - 9:30 AM**  
**The Use Of Diagnostic Ultrasound To Evaluate The Optimum Depth For Muscle Biopsy Of The Vastus Lateralis Muscle.**

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**PURPOSE:** Biopsy of the vastus lateralis (VL) muscle is a common procedure in sports science. A depth of 3 to 4cm has commonly been described in the literature as the level at which the biopsy should be taken without consideration for individual variation. During studies to ensure accurate placement of muscle temperature probe we observed that for many athletes a depth of 3-4cm would result in a biopsy from the vastus intermedius (VI) or even the femur (F). The purpose of the study was to identify the optimum depth for biopsy of VL and to reduce erroneously biopsying the incorrect muscle group.



Method: Using diagnostic ultrasound (Sonosite Micromaxx) the depth from the skin surface to the centre of VL, the junction between the VL and VI, and to F, was recorded in 21 male active subjects. The measurement was taken at the midpoint between the greater trochanter and the lateral femoral condyle.

**RESULTS:** The mean depth to the centre of VL was 1.75cm (sd 0.25). The mean depth to the surface of VI was 2.76cm (sd 0.36) and to F 4.43cm (sd 0.6). A 3cm depth would biopsy VI in 16/21 subjects.

**CONCLUSION:** Current protocols overestimate the depth for muscle biopsy which may result in sampling VI rather than VL. At a depth between 3 and 4cm it is more likely

that the biopsy is from VI. In male subjects a maximum depth of 2cm should be used if VL biopsy is required or preferably individual assessment should be made using diagnostic ultrasound.

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**2015 Board #156 May 28 8:00 AM - 9:30 AM**  
**Free Radical Detection In Exercised Thoroughbred Muscles By Electron Magnetic Resonance**

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(No relationships reported)

**PURPOSE:** To find a new parameter indicating muscle physiological condition in Thoroughbred horses, we examined time-dependent recovery of glycogen content and sarcoplasmic reticulum (SR)  $\text{Ca}^{2+}$ -ATPase activity of skeletal muscle after intensive treadmill running. In addition to the biochemical analysis, we determined a free radical generation in the muscle by using electron paramagnetic resonance (EPR).

**METHODS:** Six male Thoroughbred horses that weighed  $476 \pm 32$  kg were used in this study. Before the exercise test, all horses stayed on the pasture in the daytime and were accustomed to running on a treadmill for a short time. Two repeated 50-second running sessions were performed on a 7% incline treadmill (approximately 100%  $\text{VO}_{2\text{max}}$ ). Muscle samples of the middle gluteal muscle were taken before exercise (pre) and 1 min, 20 min, 60 min, and 24 h after exercise. Muscle fiber type composition was determined in the pre muscle samples by immunohistochemical staining with monoclonal antibody to myosin heavy chain. SR  $\text{Ca}^{2+}$ -ATPase activity of the muscle and glycogen content of each muscle fiber type were determined with biochemical analysis and quantitative histochemical staining, respectively. Furthermore, we measured the free radical in the homogenate using EPR at room temperature, and the amount was expressed as relative EPR signal intensity.

**RESULTS:** Type IIA and Type IIX fibers were the highest in number and area percentages, respectively ( $45.0 \pm 5.1\%$ ,  $45.2 \pm 5.4\%$ ). As compared to the pre value, the glycogen content of each muscle fiber type was reduced by 15%-30% at 1 min, 20 min, and 60 min after the exercise and recovered to the pre value at 24 h after exercise test. The mean value of the SR  $\text{Ca}^{2+}$ -ATPase activity showed a slight decrease immediately after exercise and a complete recovery at 24 hours after exercise. While, the mean value of relative EPR signal intensity showed a significant increase immediately after exercise, and an incomplete recovery at 24 hours after exercise.

**CONCLUSIONS:** These results indicate that 24 hours after short-term intensive exercise is enough time to recover glycogen content and SR  $\text{Ca}^{2+}$ -ATPase, but not in relative EPR signal intensity. Although further studies are needed, the EPR signal might be a useful parameter to detect muscle physiological conditions, at least in Thoroughbred horses.

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**2016 Board #157 May 28 8:00 AM - 9:30 AM**  
 **$\text{VO}_2$  On-kinetics In Isolated Canine Muscle *In Situ* During Slowed Convective  $\text{O}_2$  Delivery**

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Numerous studies have measured heart rate, cardiac output, and limb blood flow as proxies for exercising muscle blood flow; and pulmonary oxygen uptake ( $\text{VO}_2$ ) and limb  $\text{O}_2$  as proxies for exercising muscle  $\text{VO}_2$ . However, relatively few studies have characterized  $\text{O}_2$  delivery on-kinetics and  $\text{VO}_2$  on-kinetics directly across a contracting muscle. Furthermore, to our knowledge, no one has altered only the time course of the transition between metabolic rates, leaving resting and steady state  $\text{O}_2$  delivery unchanged.

**PURPOSE:** To slow the blood flow on-kinetics (via pump perfusion control), and thereby  $\text{O}_2$  delivery on-kinetics to a contracting isolated muscle *in situ* and determine the resultant  $\text{VO}_2$  on-kinetics.

**METHODS:** A step change in metabolic rate was elicited by stimulating canine gastrocnemius-plantaris muscles ( $n=6$ ) via their sciatic nerves (6-8 V, 0.2 ms duration, 50 Hz, 200 ms train) at a rate of 0.5 Hz. With arterial  $\text{O}_2$  concentration maintained constant, in random order trials, blood flow tau was set at a control transition speed between rest and contractions (determined in pilot work) of 20 sec (CT20) or was slowed to tau values of 45 sec (EX45) and 70 sec (EX70). Resting and steady state (4 min of contractions) blood flows were not altered between the transition conditions. An indwelling venous oximeter continuously measured venous  $\text{O}_2$  saturation, from which a  $\text{a-vO}_2$  difference was determined.  $\text{VO}_2$  was calculated on a contraction-by-contraction basis from  $\text{a-vO}_2$  difference and blood flow.

**RESULTS:**  $\text{VO}_2$  average mean response time ( $\text{MRT} = \tau + \text{time delay}$ ) values for EX45 and EX70 were significantly different from each other and from CT20 (mean  $\pm$  S.D.; CT20= $19.9 \pm 3.8$ , EX45= $26.3 \pm 5.9$ , and EX70= $31.7 \pm 4.1$  sec).  $\text{VO}_2$  on-response MRT values were linearly related to the blood flow on-response MRT values ( $R=0.99997$ ).

**CONCLUSIONS:** These results suggest that in this highly-oxidative muscle, blood flow and thereby  $\text{O}_2$  delivery is finely matched to  $\text{O}_2$  demand in the transition from rest to contractions at a submaximal metabolic rate, and that there is little "buffer" of blood flow/ $\text{O}_2$  delivery during this transition.

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**2017 Board #158 May 28 8:00 AM - 9:30 AM**  
**Viscoelastic Creep In Human Skeletal Muscle**

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**INTRODUCTION:** Viscoelastic creep can be defined as the increase in tissue length under a constant force or torque.

**PURPOSE:** To examine viscoelastic creep in the plantar flexor muscles.

**METHODS:** Thirteen healthy participants (mean age  $\pm$  SD =  $22 \pm 3$  yrs; stature =  $168 \pm 12$  cm; mass =  $69 \pm 17$  kg) performed four 30-s constant-torque passive stretches of the plantar flexor muscles on a calibrated Biodex System 3 dynamometer. Each 30-s passive stretch was completed by the dynamometer lever arm by passively dorsiflexing the foot at  $5^\circ/\text{s}$  to the point of discomfort, but not pain as acknowledged by the participant. This was quantified as the maximum tolerable passive torque threshold (i.e. 33 N-m), which was held constant for all 4 stretches while the change in dorsiflexion position was monitored under the constant passive torque. Each 30-s passive stretch was separated by 20 s of rest. Position ( $^\circ$ ) values were sampled from the dynamometer at 1 KHz during the stretches and were quantified at every 5-s period (0, 5, 10, 15, 20, 25, and 30 s). In addition, the percent change in position was quantified for each 5-s epoch (0-5, 5-10, 10-15, 15-20, 20-25, and 25-30 s) relative to the total increase in range of motion (ROM) for each 30-s stretch. A two-way repeated measures ANOVA [stretch  $\times$  time;  $4 \times 7$ ] was used to analyze the absolute changes in position, whereas a two-way repeated measures ANOVA [stretch  $\times$  time;  $4 \times 6$ ] was used to analyze the percent changes in ROM.

**RESULTS:** For each 30-s stretch, the absolute position increased such that  $0 < 5 < 10 < 15 < 20 < 25 < 30$  s ( $P < 0.05$ ). At all time points, the position for stretch 1 was less than stretches 2 - 4 ( $P < 0.05$ ), and stretch 2 was less than stretches 3 - 4 ( $P < 0.05$ ). There were no differences at any time points between stretches 3 and 4 ( $P > 0.05$ ). The percent changes in ROM were the same for stretches 1, 2, 3, and 4 during each epoch ( $P < 0.05$ ), however, as the stretch progressed for 30 s, the relative increases in ROM diminished.

**CONCLUSIONS:** During these constant-torque stretches, most of the increases in range of motion occurred as a result of the first two 30-s stretches, since there were no differences in dorsiflexion position between stretches 3 and 4. In addition, the relative changes in ROM that occurred during each of the four 30-s stretches were the same, but the greatest increases (42%) occurred during the first 5-s.



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2018 Board #159 May 28 8:00 AM - 9:30 AM

**Time-to-fatigue And Intramuscular Ph Measured Via Nirs During Handgrip Exercise In Trained And Sedentary Individuals**

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(No relationships reported)

**INTRODUCTION:** In exercising muscles force production and muscular endurance are impaired by a decrease in intramuscular pH. The effects of aerobic training (AT) on preventing acidosis and prolonging exercise time in muscles not specifically targeted by the training are unknown.

**PURPOSE:** To compare interstitial pH, measured non-invasively with near infrared spectroscopy (NIRS), in the flexor digitorum profundus (FDP) during rhythmic handgrip exercise in sedentary subjects and those who participate in AT activities that target the lower body.

**METHODS:** Maximal isometric force (MIF) was measured on three separate days in AT (n=5) and sedentary (n=8) subjects using a handgrip dynamometer (HGD). Isometric muscular endurance (IME) was measured during five trials, each separated by at least 48 hrs. For each IME trial subjects rhythmically squeezed (4 sec at 40% of MVC) and relaxed (2 sec) to fatigue or failure to reach the target force in three consecutive contractions or four non-consecutive contractions. Interstitial pH was derived from spectra collected using a NIRS sensor adhered to the skin over the FDP. The first four IME trials served to familiarize subjects with the protocol; the fifth trial was used for analysis. NIRS-derived pH was averaged in 30 sec increments. Differences between groups for MIF and exercise time were tested using paired t-tests. A repeated measures ANOVA was used to analyze effects of AT and exercise time on pH.

**RESULTS:** MIF was not different between groups (mean  $\pm$ SD; aerobic=415.6 $\pm$ 95.4 N vs. sedentary =505.1 $\pm$ 107.4 N). Time to fatigue was greater in the AT than in the sedentary group (mean  $\pm$ SD: 611 $\pm$ 173 sec vs. 377 $\pm$ 162 sec, p<0.05). pH was not different between groups at any time point. Average pH decreased (p<0.05) in both groups from rest (pH=7.4) through 90 sec of exercise (pH=6.9), but did not decrease further throughout the remainder of exercise.

**CONCLUSION:** Although between group differences in pH were not detected, differences during the onset of exercise may exist with a more frequent sampling. AT individuals appear to better tolerate decreased interstitial pH and are able to continue submaximal muscular work, possibly due to psychological familiarization to muscular fatigue and/or systemic physiological benefits.

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2019 Board #160 May 28 8:00 AM - 9:30 AM

**The Arm Of The Professional Tennis Player**

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(No relationships reported)

Professional tennis players have a marked inter-arm symmetry due to 10-20% greater muscle mass in the dominant compared to the non-dominant arm. However, the effect of tennis on individual muscles has not been previously studied.

**PURPOSE:** The aim of this study was to describe the effect of professional tennis participation on the individual muscle volumes of the dominant arm, and the changes elicited in the morphology of the triceps brachii muscle, using the non-dominant arm as a control.

**METHODS:** Fifteen professional tennis players (22 $\pm$ 4 years) were divided into two groups: one underwent muscle volumes examination by magnetic resonance imaging (n=8) in both arms, and the other group a body composition examination (DXA, n=7) and muscle biopsies from both triceps brachii (short head, n=7).

**RESULTS:** Muscle fiber type distribution was similar in both arms. The dominant arm had 15% higher lean mass (DXA) than the non-dominant arm (P<0.05). The type 1, 2a and 2x muscle fibers of the dominant arm were hypertrophied compared to the non-dominant arm by 20 (4962  $\pm$  452 and 4210  $\pm$  460  $\mu$ m<sup>2</sup>, P < 0.01), 22 (7700  $\pm$  873 and 6311  $\pm$  707  $\mu$ m<sup>2</sup>, P < 0.01) and 34% (7058  $\pm$  878 and 5225  $\pm$  451  $\mu$ m<sup>2</sup>, P < 0.01), respectively. Compared to the contralateral arm, the dominant arm had a 10% greater mean muscle volume (P < 0.001). All the muscle groups of the dominant arm were hypertrophied compared to the non-dominant arm: the deltoid muscle 13 % (P < 0.001), the arm flexors 9 % (P < 0.05) and the triceps brachii 13 % (P < 0.05). The volume of the superficial flexor muscles of the forearm was 12 % higher in the dominant compared to the contralateral forearm (P < 0.05). No significant differences were observed between the dominant and non-dominant forearm in deep flexors, mobile pad, forearm extensors and supinator muscle volumes (P = 0.62, P = 0.23, P = 0.98 and P = 0.59, respectively).

**CONCLUSIONS:** Professional participation in tennis elicits an harmonic muscle hypertrophy in the dominant arm, where individual muscle maintain between them the same proportions observed in the contralateral arm. However, the forearm muscles show great variability between tennis players.

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2020 Board #161 May 28 8:00 AM - 9:30 AM

**Monitoring Total And Free IGF-I In Serum Vs. Transdermal Body Fluid Biocompartments: Effects Of Endurance Exercise**

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(No relationships reported)

**PURPOSE:** Examination of hormones in transdermal body fluid (TBF) instead of blood may provide more physiologically relevant information due to closer proximity to tissue and cells. No previous study has determined whether total and free insulin-like growth factor-I (IGF-I) in TBF and serum differ during rest and exercise.

**METHODS:** 10 healthy men (mean $\pm$ SD, 23 $\pm$ 3 years old, 178 $\pm$ 3 cm tall, 79 $\pm$ 7 kg) with a VO<sub>2 peak</sub> of 44 $\pm$ 3 mL/kg/min had blood obtained by venipuncture and TBF obtained using a patented and proprietary methodology that uses minimally-invasive vacuum pressure in combination with a laser microporation process in the stratum corneum during an exercise and a control condition (i.e. laying supine quietly). Exercise consisted of 60 minutes of cycling at 60% VO<sub>2 peak</sub>. Post-exercise time points 40, 105, and 225 minutes were pooled for both TBF and serum samples allowing for adequate volumes for analysis. Total and free IGF-I were measured using immunoassays. Repeated-measures ANOVA (biocompartment x condition x time) was used for statistical analysis. Data were log transformed to ensure normal distribution.

**RESULTS:** Total IGF-I concentration in TBF was significantly lower than serum pre-exercise (serum, 483 $\pm$ 142 ng/mL; TBF, 100 $\pm$ 30 ng/mL), and post-exercise (serum, 432 $\pm$ 105 ng/mL; TBF, 127 $\pm$ 67 ng/mL). Total IGF-I in TBF significantly increased from baseline in the control condition (pre, 107 $\pm$ 39 ng/mL; pool, 198 $\pm$ 91 ng/mL), but not the exercise condition (pre, 100 $\pm$ 30 ng/mL; pool, 127 $\pm$ 67 ng/mL). Free IGF-I concentrations were not significantly different between serum and TBF pre-exercise (serum, 2.4 $\pm$ 1.7 ng/mL; TBF, 2.0 $\pm$ 0.9 ng/mL), but were ~12% greater in TBF post-exercise (serum, 2.5 $\pm$ 2.1 ng/mL; TBF, 2.8 $\pm$ 0.9 ng/mL). Proportion of free to total IGF-I in TBF increased ~29% post-exercise, while serum levels remained unchanged.

**CONCLUSION:** This study demonstrates the utility of a minimally invasive method for monitoring total and free IGF-I in TBF during exercise recovery. Our data confirm the working hypothesis that measurement of IGF-I in various biocompartments yield different information. The higher post-exercise free IGF-I in TBF vs. the circulation does suggest that the biologically active form of IGF-I is more proximal to cells/tissues and readily available to mediate exercise-induced responses.

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**2021 Board #162 May 28 8:00 AM - 9:30 AM****Biocompartmentalization Of Insulin-like Growth Factor-I In Blood, Interstitial Fluid, And Muscle Following Acute Exercise**

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(No relationships reported)

Insulin-like growth factor-I (IGF-I) is a regulator of skeletal muscle growth/metabolism, and is located across different biocompartments (blood, interstitial fluid, and skeletal muscle), highlighting both systemic and local influences. Concomitant examination of exercise-induced IGF-I responses in these biocompartments has not been examined previously.

**PURPOSE:** To examine potential disparate regulation in IGF-I between biocompartments with differing proximities to skeletal muscle *via* I.V. catheter, skeletal muscle microdialysis (MD), and muscle biopsy (MB).

**METHODS:** Seven volunteers (3 men and 4 women; age:  $24 \pm 6$  yr) performed an acute bout of plyometric exercise (10 sets of 10 reps at 40% of 1-RM). Subjects had blood drawn and vastus lateralis MB's taken PRE and POST ( $\sim 120$  min) exercise. Interstitial fluid (ISF) from MD catheters in the vastus lateralis was collected for 60 min PRE ( $\sim 60$  min pre) and 60 min POST ( $\sim 60$ - $\sim 120$  min post) exercise, and was corrected for ethanol relative recovery. Serum and ISF free IGF-I concentrations were measured *via* ELISA, while MB's were analyzed for IGF-I mRNA (qRT-PCR) and protein (immunoblot). To make comparisons between varying units of biological samples, data analysis was performed on the POST vs. PRE fold change.

**RESULTS:** Raw serum free IGF-I concentrations trended to significantly increase PRE to POST ( $1.0 \pm 0.6$  to  $1.2 \pm 0.6$  ng/mL;  $p=0.06$ ), while MD free IGF-I concentrations did not change ( $11.2 \pm 8.6$  to  $15.0 \pm 10.0$  ng/mL;  $p=0.19$ ). The gradient difference between MD and serum IGF-I was more than 25-fold, but did not change PRE to POST exercise ( $p=0.65$ ). When expressed as fold change relative to PRE, only serum IGF-I trended to significantly increase  $\sim 120$  min POST ( $1.2 \pm 0.2$  fold change;  $p=0.06$ ), while fold changes of IGF-I in the other biocompartments were not altered following exercise (MD:  $1.8 \pm 1.5$ , mRNA:  $8.9 \pm 15.5$ , MB:  $0.9 \pm 0.4$ ;  $p \geq 0.2$ ).

**CONCLUSION:** Trends for increased circulating free IGF-I observed  $\sim 120$  min post-plyometric exercise were not accompanied by significant local IGF-I increases in muscle ISF, mRNA, or protein. However, the difference between ISF IGF-I and circulating IGF-I (ISF/serum ratio of  $>25$ -fold), a gradient higher than previously reported, suggests that conventional measures of IGF-I (serum) may not reflect expected local observations in muscle.

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**2022 Board #163 May 28 8:00 AM - 9:30 AM****Respiratory Alkalosis Enhances Sprint Performance**

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(No relationships reported)

Glycolysis dominates energy provision in long sprint events like 200 to 400 m running, 50 m swimming, 500 m speed skating or short term flat out testing like the Wingate Anaerobic Test (WAnT). High glycolytic rates lead to the accumulation of lactate and a drop in pH with an impeding effect on glycolytic key enzymes. After bicarbonate ingestions an increase in minimum power has been reported in the WAnT. However, many athletes are reluctant to use this legal ergogenic aid because it is ingested 2 to 3 hours pre exercise and may also cause performance detrimental side effects like severe gastrointestinal distress and diarrhea.

**PURPOSE:** To examine the effect of a controlled hyperventilation-induced hypocapnic alkalosis (HYP) on WAnT performance and metabolism.

**METHODS:** Ten male subjects (age:  $26.6 \pm 4.9$  yrs, height:  $184.4 \pm 6.1$  cm, body mass:  $81.0 \pm 7.2$  kg) performed a WAnT after a standardised preparation without (CON) or with HYP in randomised order. Mechanical power ( $P_{\text{mech}}$ ), blood lactate concentration (BLC) and acid base status and oxygen uptake were analysed.

**RESULTS:** HYP decreased ( $p < 0.05$ )  $p\text{CO}_2$  ( $22.5 \pm 1.6$  vs.  $40.5 \pm 2.8$  mmHg) and increased ( $p < 0.05$ ) pH ( $7.61 \pm 0.03$  vs.  $7.41 \pm 0.01$ ) pre WAnT. Average  $P_{\text{mech}}$  ( $713.5 \pm 43.9$  vs.  $681.1 \pm 40.8$  W), maximum BLC ( $15.2 \pm 2.0$  vs.  $14.4 \pm 1.9$  mmol  $\text{L}^{-1}$ ) and the increase in  $p\text{CO}_2$  during WAnT ( $14.7 \pm 3.3$  vs.  $3.5 \pm 2.7$  mmHg) were higher ( $p < 0.05$ ), minimum pH ( $7.16 \pm 0.03$  vs.  $7.15 \pm 0.02$ ) was unchanged, and oxygen uptake during WAnT ( $867 \pm 191$  vs.  $940 \pm 184$  ml) was lower ( $p < 0.05$ ) at HYP than at CON.

**CONCLUSIONS:** Controlled hyperventilation-induced hypocapnic alkalosis increased WAnT performance based on an increase in the glycolytic energy, which is higher than a corresponding decrease in aerobic energy.

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**C-37 Free Communication/Poster - Objective Measurement of Physical Activity: Beyond Accelerometry and Pedometry**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**2023 Board #164 May 28 9:00 AM - 10:30 AM****The Use Of Heart Rate Monitors To Document Exercise Adherence In Large Field Studies**

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(No relationships reported)

Exercise adherence has typically been determined only from attendance records, ignoring exercise intensity and duration.

**PURPOSE:** Develop and validate an exercise adherence summary score (the heart rate physical activity score: HRPAS) that includes exercise intensity, duration and frequency and is suitable for use in large field studies.

**METHODS:** Data were collected over four years of an exercise intervention study (TIGER Study) using computerized heart rate monitors (Polar) to measure exercise heart rate, duration and frequency. The 1,459 participants who enrolled in the study were young college-age adults ( $21.7 \pm 4.5$  y) with an average BMI of  $26.5 \pm 6.2$ , sedentary (estimated  $\text{VO}_{2\text{max}} = 38.2 \pm 7.7$  ml/kg/min), primarily female (60.9%); and racially/ethnically diverse, (Non-Hispanic White [29.2%], African American [28.0%], Hispanic [23.1%], and Asian [7.4%]).

**RESULTS:** A total of 31,308 heart rate monitor observations were recorded during a 15-week intervention of exercise three days per week over four years. Of all observations,

94% were judged to be suitable for analysis. Participants exercised at a mean intensity of 68% of estimated maximum heart rate, and a mean duration of 37 minutes per session. A heart rate physical activity score (HRPAS) was calculated as the product of intensity and duration summed over the total number of workouts. HRPAS was associated with improvements in percent body fat ( $t = -4.46$ ,  $p < 0.001$ ) and estimated  $\text{VO}_2\text{max}$  ( $t = 3.83$ ,  $p < 0.001$ ). For example, an accumulated HRPAS of 1,000 over a 15-week exercise training program was associated with a 2.3% loss of body fat and an increase in  $\text{VO}_2\text{max}$  of 2.7 ml/kg/min.

**CONCLUSIONS:** Heart rate monitoring is practical for use in a large field study and provides an objective measure of exercise adherence that incorporates intensity, duration, and frequency. HRPAS was positively associated with improvements in body fat and aerobic capacity and provides a valid exercise adherence model.

Supported by NIH Grant DK062148

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**2024 Board #165 May 28 9:00 AM - 10:30 AM**  
**Multi-sensor Approach For Estimating Activity Energy Expenditure**

Todd A. Hagobian<sup>1</sup>, Shaopeng Liu<sup>2</sup>, John Staudenmayer<sup>1</sup>, Robert Gao<sup>2</sup>, Patty S. Freedson, FACSM<sup>1</sup>. <sup>1</sup>University of Massachusetts Amherst, Amherst, MA. <sup>2</sup>University of Connecticut, Storrs, CT.

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(No relationships reported)

The Physical Activity (PA) Guidelines recommend development of improved objective PA assessment methods to enhance the precision of PA dose exposure estimates. Accelerometers are used to assess PA, but transforming the movement signals into an accurate estimate of energy expenditure remains elusive. Combining a physiological measure known to be affected by exercise to the motion measure from accelerometer estimates may improve prediction of PA energy expenditure.

**PURPOSE:** To determine whether combining accelerometer counts (AC) with measured ventilation (VE) or breathing frequency (BF) improves predicted PA energy expenditure.

**METHODS:** Fourteen (9W,5M) adults completed 3 treadmill (0.67, 1.34, 2.0 m/s) and 2 activities of daily living (sweep, move box). An accelerometer was worn while simultaneously measuring energy expenditure, VE and BF using a portable metabolic system. Energy expenditure was predicted from AC, VE and BF using multiple linear regression. The regression models were evaluated using a 'leave one subject out' cross validation.

**RESULTS:** For all activities, combining AC with VE improved (19%) predicted energy expenditure compared to AC alone. Combining AC with BF also improved predicted energy expenditure (10%). Bias was low for the AC prediction model and AC times VE or BF interaction models, indicating that the error in energy expenditure prediction is mainly due to variability.

Independent Variables	AC	AC,VE & Interaction	AC,BF & Interaction
Root Mean Square Error (METs)	0.913	0.742	0.822
Bias (METs)	-0.007	-0.002	-0.031

**CONCLUSION:** Combining AC with measured VE or BF as predictor variables improved PA energy expenditure estimate. Future research will focus on the development of a device to measure VE and BF combined with accelerometer output to enhance the accuracy of free-living energy expenditure estimates.

Supported by NIH grant U01-CA130783.

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**2025 Board #166 May 28 9:00 AM - 10:30 AM**  
**Physical Activity Energy Expenditure Predictions Using Accelerometry And Heart Rate**

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(No relationships reported)

Accelerometers are commonly used in the quantification of physical activity. The accuracy of this method is inherently limited as it relies on a single physical measure for conversion to a physiological variable in the estimation of physical activity energy expenditure (PAEE). Therefore, the addition of a physiological input, such as heart rate (HR), may improve the accuracy of this conversion.

**PURPOSE:** To assess the benefit of adding heart rate to a linear regression model (LRM; Freedson Equation) on the accuracy of PAEE prediction.

**METHODS:** Thirty-two healthy adults (16 men, age=38.2 ± 12.1 y, BMI=23.2 ± 2.0 kg•m<sup>-2</sup>) completed 6 treadmill activities (TM) at 3 speeds (1.34, 1.56, 2.23 m•sec<sup>-1</sup>) at 0% and 3% grade and 5 self-paced activities of daily living (ADL). Each activity was performed for 7 minutes while wearing an accelerometer, heart rate monitor, and portable metabolic unit. Differences between the criterion and each model were assessed by a repeated measures ANOVA.

**RESULTS:** Overall, predicted PAEE using the HRM was more strongly correlated with the criterion compared to the LRM ( $r=0.86$  and  $0.68$ , respectively). However, accuracy of predicted PAEE, regardless of model, was inconsistent among individual activities independent of PA intensity; HRM PAEE prediction was more strongly correlated for TM at 1.56 m•sec<sup>-1</sup> and 3% grade ( $r=0.75$  HRM,  $r=0.67$  LRM), but LRM was more strongly correlated with PAEE for ascending stairs ( $r=0.79$  LRM,  $r=0.60$  HRM). Overall, differences in PAEE between the criterion and each of the models were not significant among all activities (HRM, adjusted  $p=0.62$ ; LRM, adjusted  $p=0.46$ ). Further, differences between the criterion and both models were not significant for TM (adjusted  $p=0.41$  and adjusted  $p=0.74$ , respectively). Significant differences for ADL were observed between the criterion and LRM (adjusted  $p<0.0001$ ), but not between the criterion and HRM (adjusted  $p=0.26$ ).

**CONCLUSION:** These data suggest the addition of heart rate to a LRM improves accuracy in measurement of PAEE for grouped activities. Further, HRM estimates of PAEE exhibited improved accuracy in the assessment of unstructured activities, which contribute to total daily energy expenditure.

Supported by NIH CA121005

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**2026 Board #167 May 28 9:00 AM - 10:30 AM**  
**GPS Watches For Estimating Energy Expenditure And Promoting Physical Activity**

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(No relationships reported)

**PURPOSE:** Recently, global positioning system (GPS) watches have been introduced commercially, transforming frequent measurements of time and location into energy expenditure (EE) estimates (through derivations of distance, speed and pace). Our approach for promoting physical activity (PA) exploits recent innovations in GPS, geographic information systems (GIS), and interactive Internet map services. Our overall aim is to provide opportunities for sustained PA among intervention participants while also engaging those who do not typically participate in the traditional exercise, fitness or PA programs.

**METHODS:** Our work includes validating geospatial technology for measurement of EE and using it to promote PA. For validation, 9 females and 7 males, aged 18-27 years

(BMI 19.1-26.6) wore 4 different GPS watch models and walked at 3 different speeds (3, 5 and 7 km/hr) covering a known distance on a 400-m track. We compared EE measured by each GPS watch to accelerometer estimates (RT3) using mixed-effect linear regression. Through a formative and participatory process, we have also developed an education approach and associated materials designed to encourage PA without PA being the main focus of the project. To test our approach, we introduced GPS, GIS and interactive Internet mapping to groups of adolescents involved in five civic engagement projects.

**RESULTS:** Three GPS units significantly underestimated EE and one significantly overestimated EE compared to accelerometer (24+/-3, 28+/-2, 29+/-3, 85+/-3 kcal vs. 54+/-3 kcal;  $p<0.001$ ). These differences were not significant after adjustment for body weight and walking speeds (-6+/-18, -2+/-18, 0+/-18, 55+/-18 kcal vs. 23+/-18 kcal;  $p>0.2$ ). Use of the technology in non-traditional PA setting led to enhanced levels of PA that youth reported "was fun".

**CONCLUSION:** Commercial GPS watches provide an approximation of EE. They also provide coordinates of activity and points of interest when linked to GIS and web mapping. We found incorporation of the technology into projects not focused on PA per se led to greater PA in youth who were not participants in traditional PA programs.

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**2027 Board #168 May 28 9:00 AM - 10:30 AM**

**Accurate Physical Activity Energy Expenditure Estimation Using Heart Rate, Accelerometry And A Branched Model**

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(No relationships reported)

To design effective weight management programs, there is a need to develop devices that accurately estimate daily physical activity energy expenditure (PAEE). Dual sensor devices that simultaneously measure heart rate and accelerometry, and estimate PAEE via a constrained branched algorithm have recently been developed.

**PURPOSE:** To assess the accuracy achievable by dual sensor device and an unconstrained branched algorithm (BA) assessment of daily-living physical activity energy expenditure (PAEE) within a sedentary population.

**METHODS:** Sedentary men (n=8) and women (n=8) first performed a treadmill calibration protocol, during which heart rate (HR), accelerometry (ACC), and PAEE were measured in 1-minute epochs. From these data, HR-PAEE, and ACC-PAEE regressions were constructed and used in a BA model to predict PAEE from ACC and HR data collected during a subsequent daily-living protocol. We used simulated annealing to optimize the BA parameters, and assessed the stability of the BA parameters by repeating the optimization 50 times to determine the distribution of parameter solutions. Criterion PAEE was measured during both protocols via indirect calorimetry. The accuracy achieved by the BA model was assessed by the root mean square of the difference between model-predicted and criterion PAEE.

**RESULTS:** Unconstrained optimization of BA parameters resulted in accurate estimates of PAEE. For men, estimates using individual calibration were more accurate than estimates using group calibration (1% vs. 5% error, respectively), while the opposite was true for women (14% vs. 7% error, respectively). PAEE estimation accuracy decreased when BA parameters optimized for the opposite sex were used, suggesting that BA parameters are sex-specific. Analyses of BA parameter stability by iterative optimization suggests that ACC and high intensity HR threshold values, as well as weighting of HR and ACC regressions at higher exercise intensities are the strongest determinants of accurate functioning of the algorithm.

**CONCLUSION:** Optimized branched algorithms are superior to other popular analytic techniques for predicting PAEE from HR and ACC in sedentary adults performing activities of daily living.

Supported by grants from Berkeley Heartlab, Inc. and NIH R01DK42549

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**2028 Board #169 May 28 9:00 AM - 10:30 AM**

**Assessment Of Light Activities In Adults Using A Pattern-recognition Activity Monitor**

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(No relationships reported)

Non-exercise activity thermogenesis (NEAT) is the most variable component of energy expenditure (EE) in humans. The importance of NEAT in human energy balance supports the need for accurate and objective tools to measure light activity EE under free-living conditions. The Sensewear Pro armband (SWA) monitor integrates data from multiple sensors (including heat related sensors) and has potential for assessing the energy cost of light intensity, non-locomotor activities typically labeled as NEAT.

**PURPOSE:** The purpose of the study was to evaluate the accuracy of the SWA monitor for assessing light (fidgeting) activities.

**METHODS:** Fifteen males and 15 females (mean ages: 36.3±9.7 and 40.1±11.5, respectively) completed a resting metabolic rest assessment (RMR) and 4 light intensity activities (sitting, sitting/fidgeting, standing and standing/fidgeting) for intervals of 7 minutes each. Participants wore the SWA monitor and a portable metabolic analyzer (Oxycon Mobile, OM) during the activities. Data from the SWA monitor and the OM were processed on a minute-by-minute basis and merged by time. Percent increase over resting EE was computed for the SWA and OM. T-tests were computed to evaluate the accuracy of group level estimates of EE from the SWA.

**RESULTS:** The percent increases in EE for the 4 activities were as follows: sitting (23.9%), sitting/fidgeting (33.4%), standing (18.2%) and standing/fidgeting (51.3%). The corresponding increases in estimated EE by the SWA were as follows: sitting (6.3%), sitting/fidgeting (39.3%) standing (3.4%) and standing/fidgeting (69.9%). Differences in EE estimation were non-significant for sitting/fidgeting ( $p=0.49$ ) and standing/fidgeting ( $p=0.09$ ), and were significant for sitting ( $p=0.006$ ) and standing ( $p=0.03$ ).

**CONCLUSION:** The results demonstrate that the SWA is able to detect subtle changes in EE during light lifestyle activities. Because participants did not engage in locomotor activities during the protocol, it is likely that the heat flux variables detected the increased EE associated with the fidgeting activities. Additional work is needed to better understand the potential of the SWA for assessing light activities and NEAT.

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**C-38 Free Communication/Poster - Pedometry**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**2029 Board #170 May 28 8:00 AM - 9:30 AM**

**Effects Of Leg-length, Pedometer Tilt, Sex, And Walking Speed On Pedometer Accuracy**

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(No relationships reported)

It is critical that researchers, practitioners, and the public understand the limitations of pedometers as objective measures of physical activity. However, there is limited research on factors that affect pedometer accuracy.



**PURPOSE:** To determine the effect of leg-length, pedometer tilt, sex, and walking speed on the accuracy of a spring-levered pedometer during treadmill walking.

**METHODS:** Twenty-nine men (age: 25.3 +/- 5.8 yr; BMI: 25.6 +/- 2.7 kg/m<sup>2</sup>) and 30 women (age: 21.6 +/- 1.9 yr; BMI: 22.4 +/- 2.3 kg/m<sup>2</sup>) were selected to participate in this study based on having an upper leg-length that was short (< 15%ile), normal (25-75%ile), or long (> 85%ile) relative to sex based on CDC-NHANES reference data. Pedometer tilt angle was measured using a magnetic protractor, with the participant standing in a neutral position. Each participant performed 3 minute walking trials on a treadmill at speeds of 59, 67, 80, 94, 107 m/min and at a self-selected pace (89.2 +/- 9.8 m/min) while wearing a spring-levered pedometer (Yamax Digiwalker SW-701) on the anterior aspect of the waistline. During each walking trial, two observers hand tallied the participant's step count.

**RESULTS:** Pedometer tilt angle was significantly associated with pedometer accuracy at treadmill walking speeds of 59 and 67 m/min ( $r > -0.38$ ,  $p < 0.003$ ), but not at the remaining treadmill speeds. After statistically controlling for the effects of pedometer tilt angle, there were no effects of leg-length ( $F(10, 84) = 0.95$ ,  $p = 0.49$ ) or sex ( $F(5, 42) = 0.80$ ,  $p = 0.47$ ) on pedometer accuracy. Pedometer accuracy significantly improved as walking speed increased ( $F(5, 42) = 5.85$ ,  $p < 0.001$ ). Specifically, the pedometer counted 85.6-93.2% of the observed steps at slower treadmill walking speeds (59 and 67 m/min) and 99.2-100.7% of the observed steps at moderate-to-fast treadmill walking speeds (80-107 m/min).

**CONCLUSION:** Individuals should recognize that more accurate step count data are obtained from spring-levered pedometers when the pedometer is placed in a more upright position on the waistband and when walking at faster paces. Furthermore, leg-length and sex do not affect pedometer accuracy at a range of treadmill walking speeds.

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**2030      Board #171      May 28      8:00 AM - 9:30 AM**  
**Making Sense Of Pedometer Instructions**

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(No relationships reported)

Physical activity (PA) is one of the most cost effective means maintaining health and fitness, while minimizing the cost burden of chronic illness. Pedometers are both a convenient and minimally invasive method of measuring PA. Well designed and reading level appropriate instructions accompanying pedometers are paramount in assuring accurate and reliable PA assessments. Unfortunately, disparities between reading demands of typical instructional materials and the actual literacy skills of American adults are well documented in the literature.

**PURPOSE:** To evaluate readability and related features of English-language instructions accompanying pedometers, including reading grade level, dimensions, text point size, use of illustrations, layout/formatting characteristics, and emphasis of key points (e.g., recommendation of 10 000 steps per day).

**METHODS:** We identified and purchased fifteen (n=15) pedometers currently available in the US. Reading grade level was calculated using Flesch Reading Ease (FRE). Text point size was determined by measuring the distance from the ascent line to the descent line with a C-Thru Ruler. Total number of illustrations was tallied. Illustration dimensions were measured to the nearest millimeter. We also assessed layout features using the established User-Friendliness Tool (UFT).

**RESULTS:** FRE scores ranged from 8<sup>th</sup> to 11<sup>th</sup> grade, while text point size averaged 6.9±1.9 (range=4-11). Pedometer instructions averaged 8.7±9.0 (range=0-36) illustrations, most about the size of a US quarter. While most pedometer instructions avoided use of specialty fonts (n=12; 80.0%), most used a minimal amount of white space, making directions difficult to read. Just 4 (26.7%) sets of instructions highlighted the widely established target goal of 10 000 steps per day.

**CONSLUTION:** Pedometer manufacturers should increase the size of instructions, thereby allowing for larger text size and illustrations, and increasing the amount of white space. Making these relatively small formatting changes would ensure that those electing to use a pedometer are able to understand and follow accompanying instructions.

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**2031      Board #172      May 28      8:00 AM - 9:30 AM**  
**Validity Of The Walk4life Pedometer Based On Self-reported Mvpa**

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(No relationships reported)

**BACKGROUND:** Physical activity (PA) can be assessed indirectly through self reports (SR) or directly through observation, accelerometry, pedometers, and doubly labeled water. In large epidemiological studies due to economical constraints, pedometers and SRPA are common methods to estimate amount of PA. The Walk4Life MVP pedometer measures steps, distance, total PA time, and MVPA time based on user defined steps per minute (SPM) as a lower limit for MVPA.

**PURPOSE:** To examine the relationship between two similar but different pedometers (Walk4Life and Accusplit Eagle 120 XL;AE) and SRPA data during a 7-day period in women being observed for musculoskeletal injuries in a prospective observational study. Method: Thirty females attended two sessions, 7 days apart. Following session 1, women wore the Walk4Life MVP and AE pedometers (different hips) continuously for 1 week. At session 2, women returned to the orientation site 1 week later and responded to BRFSS PA questions on a secure website as they had been doing for at least the previous 24 weeks. Participants reported days and min per day of moderate and vigorous (separately) PA as well as BRFSS physical activity questions about walking, strengthening activities, and typical work PA.

**RESULTS:** The AE and Walk4Life pedometers were highly correlated (.90;  $p < .001$ ). The average difference between pedometers steps was 175±9,600 (AE = 45,251 ±21,834; MVP = 45,426 ±20,993) across an average of 45,000 steps. SR MVPA and Walk4Life MVP recorded MVPA MET-mins per week correlated .41 ( $p < .03$ ).

**CONCLUSIONS:** The Walk4Life MVP pedometer appears to validly record steps and MVPA minutes when used at the group level. Careful pedometer placement and confirmation of steps should be monitored if individual results are to be utilized as is the case in all pedometer use. The Walk4Life MVP pedometer appears to be an inexpensive, valid alternative to more expensive accelerometers and pedometers.

Sponsored by NIH Grant R01 AR052459-03

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**2032      Board #173      May 28      8:00 AM - 9:30 AM**  
**Impact Of Season On Step-count Reliability: A Generalizability Theory Approach**

Tiago V. Barreira<sup>1</sup>, Brian G. Ragan<sup>2</sup>, David R. Bassett, Jr., FACSM<sup>3</sup>, Catrine Tudor-Locke, FACSM<sup>4</sup>, Minsoo Kang<sup>1</sup>. <sup>1</sup>*Middle Tennessee State University, Murfreesboro, TN.* <sup>2</sup>*Case Western Reserve University, Cleveland, OH.* <sup>3</sup>*University of Tennessee, Knoxville, TN.* <sup>4</sup>*Pennington Biomedical Research Center, Baton Rouge, LA.*

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Many have reported a range of the number of days needed to obtain reliable estimates of physical activity (PA) by examining the influences of many factors. One factor that has not been adequately addressed is the impact that season (i.e., winter, spring, summer) has on the number of days needed for reliable PA.

**PURPOSE:** The purpose of this study was to examine the impact that season has on PA variability in step counts, and based on the type of season, determine the minimum number of days necessary to achieve reliable estimates for step counts.

**METHODS:** Thirty-two participants (ages 18-30 years) wore an Omron pedometer (HJ-720) for 7 consecutive days with a randomly assigned start day during winter, spring, and summer. After the data were screened, mean ± SD for steps/day were computed. Further analysis was done using Generalizability theory approach. Participant (P), Season (S), and Day (D) were considered random facets in a fully crossed design (P x S x D). First a G-study was performed with all seasons together to determine the percentage of variance associated with



each facet and interactions in the model. Following the G-study, the data were analyzed based on each season through D-studies to determine the minimum number of days of data collection to achieve a desirable reliability coefficient ( $G \geq .80$ ).

**RESULTS:** The overall average step-count, considering all seasons, was  $6,937 \pm 3,847$ , and the averages for winter, spring, and summer were  $7,124 \pm 4,122$ ,  $7,758 \pm 4,304$ , and  $5,930 \pm 3,115$  steps/day, respectively. The results from the G-study showed that P accounted for 28% of the variance, S alone and the interaction (P x S) accounted for 8% of the variance, and D had little effect on the total variance. The interaction between P x S x D and unidentified error accounted for the majority of the variance (62%). Follow-up D-Studies for each season separately demonstrated that a minimum of 10, 7, and 7 days were necessary to achieve a G-coefficient  $\geq .80$  during the winter, spring, and summer respectively.

**CONCLUSIONS:** During the winter season, a larger amount of days was needed to achieve a desirable reliability level for step-count data. It appears that 7 days of data collection might not guarantee reliable estimates of step counts. Researcher and practitioners should be aware of this when making data collection plans.

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**2033 Board #174 May 28 8:00 AM - 9:30 AM**  
**School And Class-level Intra-class Correlations For Pedometers In 3<sup>rd</sup> Grade Children**

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Much of children's activity occurs at school. Given the unique environmental characteristics of schools, this creates a degree of shared variance amongst the children that violates the assumption of independence underlying the General Linear Model. The degree of shared variance at the nested level can be calculated through intra-class correlations (ICCs). As random assignment often occurs at the school level, these ICCs are critical in determining the number of schools required for adequate power. Studies have published ICCs at the school-level for accelerometers. Surprisingly, there is relatively little data on ICCs for pedometers. Nor is there much information for ICCs at the class-level. This is problematic as classroom teachers implement many interventions, which creates a second level of nesting (i.e. child within classes within schools) to be modeled.

**PURPOSE:** ICCs were calculated at the school (n=8), classroom (n=45) and within student levels (n=720) to determine if there was significant shared variance at each level of analysis.

**METHODS:** In-school steps were collected through pedometer counts over 5 school days. Research staff placed an OMRON HJ 104 pedometer on the hip of each child within 30 min of the onset of the school day, along with their removal within 30 min of dismissal. These procedures were repeated 6 months later.

**RESULTS:** ICCs were calculated as the amount of variance due to a specific level of the model (e.g., schools) by the total amount of variance (i.e., the sum of the variances from the school, teacher, child, and within-child levels of the model). The ICCs for the pedometers were: 0.06 for schools, 0.06 for teachers, and 0.27 for the students. These are in-line with other school-based data for accelerometers that found ICCs of .057 for schools during 7-day assessments.

**CONCLUSION:** Both the classroom and the school resulted in significant shared variance for the children nested within those levels. Thus, statistical models should be designed to model variance at both the classroom and school-levels. Interestingly, the magnitude of these effects was similar for studies of accelerometry. Thus, regardless of the mode of assessment, children show a consistent degree of shared variance at the school-level.

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**2034 Board #175 May 28 8:00 AM - 9:30 AM**  
**3,500 Daily Steps Increment Enhances Exercise Tolerance At Anaerobic Threshold In Sedentary Men**

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Walking is the most feasible way of reaching the public health recommendations in physical activity (PA) programs. Pedometers are valid and widely used tools to evaluate patterns of walking. The ventilatory anaerobic threshold (AT) by respiratory gas exchange protocol may be employed as a marker of metabolic efficiency at a sub-maximal level of PA.

**PURPOSE:** To investigate the effectiveness of a pedometer-measured 3,500 steps/day increment on the improvement of physical performance at the AT.

**METHODS:** Nineteen healthy sedentary men, aged 19 - 46 years, clinically normal, with mean  $\pm$  sd BMI equal to  $24.6 \pm 2.7$  kg/m<sup>2</sup>, wore a Yamax-SW700 pedometer for 2 weeks, without any PA change, in order to quantify their habitual daily steps at baseline. After this control period, the new daily steps target was calculated by adding 3,500 steps to the baseline mean of week days. Thereafter, the subjects were submitted to the first cardiopulmonary exercise stress test (CPX) for determination of the AT. Following the first CPX, volunteers were oriented to achieve their new daily step target during 3 weeks (intervention phase). At the end of this period, a second CPX was performed to evaluate the effect of the increased number of daily steps on exercise tolerance at AT. The visual identification of AT in each CPX was done solely by one expert author, blinded to the volunteer identity and to the order of the CPX. Medians of weekends and week days steps counts were pair-wised compared by the Wilcoxon test. Differences were considered significant when a two-tailed "p" value was less than 5% ( $P < 0.05$ ).

**RESULTS:** Median (interquartile range) of daily steps in the intervention phase was 11,772 (8,998 - 18,620), whereas at baseline it was 7,295 (4,700 - 14,752) ( $p=0.0001$ ). Time until AT onset during CPX was higher after (359s; 179-521s) than before the increment of daily steps (340s; 208-436s) ( $p=0.027$ ). The distance attained at AT was higher after (398,6 m; 165,6 - 637,5 m) than before the intervention (372,2 m; 197,8 - 528,8 m).

**CONCLUSION:** The accumulated increment of 3,500 steps per day above the habitual pattern, during three weeks, was effective for improving exercise tolerance at AT, and thus increased the physical capacity, in healthy sedentary men.

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**2035 Board #176 May 28 8:00 AM - 9:30 AM**  
**Influence of Pedometer Tilt Angle On Step Counting Validity During Controlled Treadmill Walking Trials**

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Pedometers are assessment tools frequently used to monitor walking-related physical activity patterns of overweight and obese populations. However, there is a known association between increasing body mass index (BMI) and decreasing pedometer accuracy that may be attributed to pedometer tilt angle (TA). Currently, the specific TA where pedometers fail to count steps accurately is unclear.

**PURPOSE:** This study tested two popular pedometer mechanisms, accelerometry-(ACC) and pendulum(PND)-based, to determine the specific TA(s) where the pedometers failed to count steps accurately.

**METHODS:** Twenty subjects (10 men, Mean $\pm$ SD: 26 $\pm$ 4.5yrs, 75.7 $\pm$ 5.4 kg, 22.7 $\pm$ 1.6 kg/m<sup>2</sup> BMI; 10 women: 21.6 $\pm$ 3yrs, 56.7 $\pm$ 6.7 kg, 20.5 $\pm$ 1.8 kg/m<sup>2</sup> BMI) walked two sets of 21 trials at a combination of treadmill speeds (67.0, 80.4, 93.8 m/min) and TAs (-30,-20,-10, 0,+10,+20,+30°) while wearing two pedometers: 1) Experimental pedometer was attached to custom-built gimbal for altering TA; 2) Control pedometer was attached at TA=0°. Positive TAs indicated an anterior rotation about a medial-lateral axis while

negative TAs indicated a posterior rotation. Pedometers were worn on the left and right hips just anterior to the iliac crest in line with the mid-axillary line of the thigh. Mean step counts from the experimental pedometers (STEP<sub>E</sub>) were compared to the control pedometer (STEP<sub>C</sub>) by calculating the difference (DSTEP = STEP<sub>C</sub>-STEP<sub>E</sub>) and comparing the DSTEP values within pedometer mechanisms using 3-factor repeated measures ANOVA at a 0.05 alpha level.

**RESULTS:** Mean DSTEP values differed significantly by TA and speed. Specifically, mean DSTEP for the ACC pedometers differed significantly from 0 when TA was equal to  $\pm 10^\circ$  and treadmill speed was 67.0 m/min,  $\pm 20^\circ$  and  $\leq 80.4$  m/min and  $\pm 30^\circ$  and  $\leq 93.8$  m/min. Mean DSTEP for the PND pedometers were significantly different than 0 when tilt angle was equal to  $+10^\circ$  and treadmill speed was  $\leq 80.4$  m/min,  $\geq \pm 20^\circ$  and all treadmill speeds and  $-10^\circ$  and all treadmill speeds.

**CONCLUSIONS:** Increasing TA in either direction caused a decrease in pedometer accuracy for both pedometer mechanisms, although the ACC pedometers were less affected. Negative TAs had less effect on pedometer accuracy than positive TAs, and the combination of slower speeds and increasing positive TA had the greatest impact on step counting accuracy.

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**2036 Board #177 May 28 8:00 AM - 9:30 AM**  
**Effects Of Seasonal And Monthly Variability On Measurement Of Pedometer Data**

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**PURPOSE:** The purpose of the study was to attempt to reduce measurement error in objectively measured physical activity (i.e., pedometer-determined steps per day) by controlling (a) the length of the measurement period and (b) the season or month of the year in which sampling was conducted.

**METHODS:** This was a secondary analysis of an existing data set of 23 individuals (7 men, 16 women; age =  $38 \pm 9.9$  years) residing in South Carolina and Tennessee. The step-count data were collected over a one-year period using Yamax SW 200 pedometers. For controlling seasons, the data set was separated by the four seasons, and the measurement periods of different lengths (2, 3, 4, 5, 6, 7, and 14 days) were randomly selected 10 times during each season. A similar approach was done with a division by months. For each month, a total of 10 step-count measurements were randomly selected from each of the following measurement periods: 2, 3, 4, 5, 6, 7, 8, 9, and 10 days. To determine valid estimates of step-count measurement, absolute percentage error (APE) was calculated. The year-round average was considered as a criterion measure. A smaller APE represents a better estimate of yearly physical activity.

**RESULTS:** The results by seasons demonstrated that spring and fall had the lowest APE values on six out of seven measurement periods. The difference in APE values among seasons, however, was not substantial. Except for the 2-day measurement period, there was at most a 3% difference in APE values across the four seasons at all measurement periods. From the month analysis, May had the lowest APE values (e.g., 7 days at 10.2%) on eight out of nine measurement periods. The months that include season changes (March, June, September, and December) presented the highest APE values. Those months showed APE values for the 7-day measurement period that were up to 9.7% higher than May.

**CONCLUSIONS:** The difference in APE values among seasons was trivial; however, they varied among different months. Targeting the data collection during the months that include no season changes (e.g., April and May) may reduce measurement error and provide more accurate yearly step-count estimates.

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**2037 Board #178 May 28 8:00 AM - 9:30 AM**  
**Comparison Of Physical Activity Measurement Methods In Preadolescent Girls**

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Children should accumulate at least 60 minutes of MVPA daily in order to achieve benefits. Valid PA measurement in children is necessary to establish dose-response associations with health outcomes and evidence-based recommendations. Self-report remains the most efficient way to obtain population-level data despite its limitations. Measurement of average steps/d using a pedometer presents an opportunity to evaluate convergent validity of self-report data with an objective measure.

**PURPOSE:** To evaluate convergent validity of pedometer steps with two PA self-reports and to test whether these instruments identify girls who meet PA guidelines.

**METHODS:** 201 4th and 6th grade girls wore pedometers for 7 continuous days and completed 2 self-administered PA recalls (PYPAC and 3DPAR). Girls were categorized as meeting or failing to meet PA recommendations based on average pedometer step counts. Total PA score (measured by PYPAC) and METS/day (measured by 3DPAR) were estimated for each girl. Pearson correlations were used to describe relationships between steps and physical activity scores for each instrument. Independent t-tests were used to test whether PA measured by recall differed between girls who met and did not meet guidelines.

**RESULTS:** 72% of 4th graders and 53% of 6th graders met recommended PA based on pedometer cut-points. In 4th graders, pedometer steps were positively associated with METS/d ( $r=0.18$ ,  $p<0.10$ ) but not General Activity Score ( $r^2=-0.02$ ,  $p=0.88$ ). In 6th graders, steps were positively associated with General Activity Score ( $r^2=0.13$ ,  $p=0.20$ ) but not METS/d ( $r^2=0.05$ ,  $p=0.64$ ); In 4th graders, there were no significant differences in either METS/d or General Activity Score based on pedometer groups, while in 6th graders, General Activity Scores were significantly higher for girls who met recommendations than those who did not ( $p<0.05$ ); there was no difference in METS/d between groups.

**CONCLUSIONS:** Pedometer step counts were weakly correlated with PA levels estimated using two self-report instruments; these relationships differed by grade. The PYPAC identified 6th grade girls who met physical activity guidelines, but not 4th graders. The 3DPAR was not able to distinguish between girls who did or did not meet guidelines. More research is needed to identify valid and reliable PA measures.

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**2038 Board #179 May 28 8:00 AM - 9:30 AM**  
**Minute-by-minute Stepping Rate Of Daily Physical Activity In Normal And Overweight Adults**

Makoto Ayabe<sup>1</sup>, Junichiro Aoki<sup>2</sup>, Hideaki Kumahara<sup>1</sup>, Eiichi Yoshimura<sup>1</sup>, Sakiko Matono<sup>1</sup>, Takuro Tobina<sup>1</sup>, Keizo Anzai<sup>1</sup>, Akira Kiyonaga<sup>1</sup>, Hiroaki Tanaka<sup>1</sup>. <sup>1</sup>Fukuoka Univ., Fukuoka, Japan. <sup>2</sup>Juntendo Univ., Chiba, Japan.  
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(No relationships reported)

**PURPOSE:** The purpose of the present investigation was to compare the levels of physical activity (PA) based on the minute-by-minute stepping rate under free-living conditions between normal weight (NW) and overweight and obese (OB) individuals.

**METHODS:** A total 40 volunteers participated in the present investigation. These participants were divided into NW or OB according to the body mass index ( $<25$  kg/m<sup>2</sup> or  $\geq 25$  kg/m<sup>2</sup>). All participants wore a pedometer with a uni-axial accelerometer (Lifecorder-EX 4sec, Kenz, Japan) for 7 days continuously. The LC determined the number of steps and time spent in PA at  $<100$ , 100 to 129, 130 to 159,  $\geq 160$  steps/min according to the minute-by-minute stepping rate.

**RESULTS:** The time spent in PA at  $<100$  steps/min in the OB and NW subjects was  $267 \pm 85$  and  $300 \pm 81$  min/day ( $p = 0.221$ ). The time spent in PA at 100 to 129 steps/min in the OB and NW subjects was  $14 \pm 9$  and  $23 \pm 15$  min/day ( $p = 0.035$ ). The time spent in PA at 130 to 159 steps/min in the OB and NW subjects was  $0.8 \pm 1.3$  and  $5.8 \pm 6.9$  min/day ( $p = 0.003$ ). The time spent in PA at  $\geq 160$  steps/min in the OB and NW subjects was  $0.0 \pm 0.1$  and  $0.7 \pm 1.3$  min/day ( $p = 0.018$ ). The proportion of PA at  $<100$  steps/min in the

OB and NW subjects was  $95 \pm 4\%$  and  $91 \pm 5\%$  ( $p = 0.010$ ). The proportion of PA at 100 to 129 steps/min in the OB and NW subjects was  $5 \pm 3\%$  and  $7 \pm 4\%$  ( $p = 0.1316$ ). The proportion of PA at 130 to 159 steps/min in the OB and NW subjects was  $0.3 \pm 0.5\%$  and  $1.9 \pm 2.4\%$  ( $p = 0.007$ ). The proportion of PA at  $\geq 160$  steps/min in the OB and NW subjects was  $0.0 \pm 0.0\%$  and  $0.3 \pm 0.6\%$  ( $p = 0.031$ ).

**CONCLUSIONS:** These results indicate that the OB subjects spent a significantly shorter time in PA at 100 steps/min or a faster stepping rate. These findings constitute the original aspect of the present investigation where the OB subjects had a lower daily average stepping rate due to a shorter time of PA at  $\geq 100$  steps/min and a larger proportion of PA at  $< 100$  steps/min.

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## C-39 Free Communication/Poster - *Perceived Exertion*

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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### 2039 Board #180 May 28 9:00 AM - 10:30 AM

#### Perceived Exertion During Acute Resistance Exercise Performed At Self-selected And Imposed Loads In Trained Women

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(No relationships reported)

Previous research has demonstrated that untrained women report significantly lower ratings of perceived exertion (RPE) during self-selected (SS) load bouts of acute resistance exercise (RE) when compared to sessions performed using typically imposed RE loads. However, the extent to which RPE responses differ between SS and imposed-load bouts of acute RE among trained women remains unclear.

**PURPOSE:** The purpose of this investigation was to examine RPE responses to self-selected and imposed-load bouts of acute RE in a sample of trained women.

**METHODS:** Twenty-one ( $M$  age = 23 years) recreationally-trained women completed acute bouts of RE using loads of 40% of one repetition maximum (1RM), 70% of 1RM, and a self-selected (SS) load. RE consisted of 3 sets of 10 repetitions for each of the leg extension (LE), leg curl (LC), lat pull-down (LPD), and chest press (CP) exercises. Assessments of RPE were obtained immediately after each set during the 3 RE conditions.

**RESULTS:** Results of separate 3 (Condition)  $\times$  3 (Set) repeated measures ANOVAs yielded significant main effects for Condition ( $p < 0.01$ ) and Set ( $p < 0.01$ ) for each exercise and significant Condition  $\times$  Set interactions ( $p < 0.05$ ) for both the LPD and CP exercises. Post-hoc analyses revealed that RPE increased from Set 1 to Set 3 for the CP and LPD exercises in both the 70% 1RM and SS conditions but did not increase across sets in the 40% condition. RPE were also found to be significantly higher in the 70% condition relative to the SS or 40% conditions and RPE reported during SS condition were higher when compared to the 40% condition for all exercises.

**CONCLUSIONS:** The present results suggest that RPE reported during SS bouts of RE differ significantly from RPE observed during imposed-load bouts of RE. Although evidence addressing RPE responses to acute RE remains limited, effort sense experienced during acute RE may serve as a salient determinant of the adoption and maintenance of regular RE behavior. Accordingly, the differences in RPE during acute RE observed in the present investigation may have valuable practical implications for the prescription of RE participation.

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### 2040 Board #181 May 28 9:00 AM - 10:30 AM

#### Response Normalized Omni Rpe At The Ventilatory Breakpoint In Young Adult Males And Females

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(No relationships reported)

Response normalized ratings of perceived exertion (RPE) corresponding to the ventilatory breakpoint ( $V_{pt}$ ) during cycling have been identified in children using the Children's OMNI Scale of Perceived Exertion. However, a normalized response has not been examined in adults using the OMNI-Cycle RPE Scale.

**PURPOSE:** To identify a response normalized RPE-Overall (O), RPE-Legs (L), and RPE-Chest/Breathing (C) corresponding to the  $V_{pt}$  in recreationally active males and females.

**METHODS:** Thirty-one recreationally active ( $< 150$  min $\cdot$ wk $^{-1}$  activity) males ( $n = 21$ ,  $20.7 \pm 2.6$  yrs) and females ( $n = 10$ ,  $21.4 \pm 2.6$  yrs) completed a load-incremented cycle ergometer protocol to measure  $VO_{2peak}$ . The Adult OMNI-Cycle RPE Scale was employed to measure RPE-O, L and C during the last 30 s of each exercise minute. The  $V_{pt}$  was determined for each subject as the % $VO_{2peak}$  at which  $Ve:VO_2$  increased without an accompanying increase in  $Ve:VCO_2$ . RPE-O, L and C corresponding to the  $V_{pt}$  were identified using individual linear regression analysis. All data are presented as means  $\pm$  SD.

**RESULTS:** Mean  $VO_{2peak}$  was  $42.9 \pm 6.7$  ml $\cdot$ kg $^{-1}\cdot$ min $^{-1}$  for males and  $34.8 \pm 5.3$  ml $\cdot$ kg $^{-1}\cdot$ min $^{-1}$  for females. Mean  $V_{pt}$  for males and females corresponded to  $70.9 \pm 6.9\%$  and  $74.4 \pm 4.9\%$  of  $VO_{2peak}$  and  $83.9 \pm 5.0\%$  and  $86.2 \pm 4.4\%$  of peak heart rate, respectively. Mean response normalized RPEs corresponding to the  $V_{pt}$  during cycle ergometry were: RPE-O =  $5.5 \pm 1.2$ , RPE-L =  $6.0 \pm 1.1$ , RPE-C =  $5.4 \pm 1.2$  for males and RPE-O =  $6.1 \pm 1.0$ , RPE-L =  $6.2 \pm 1.1$ , RPE-C =  $6.2 \pm 1.3$  for females. There was no interaction effect of gender and rating site. However, a rating site main effect was observed when RPE data were analyzed for the combined male and female groups. Analysis of response normalized values at the  $V_{pt}$  indicated that RPE-L  $>$  RPE-O ( $p < 0.05$ ) and RPE-L  $>$  RPE-C ( $p < 0.01$ ).

**CONCLUSIONS:** Response normalized OMNI RPEs at the  $V_{pt}$  were identified for undifferentiated and differentiated perceptual reports for adult males and females during cycling. These normalized responses were consistent with those reported previously for children. A normalized RPE- $V_{pt}$ : (1) reduces the need for pre-participation testing to prescribe exercise intensity (i.e.  $V_{pt}$ ) that provides an overload stimulus for cardiorespiratory training and (2) facilitates exercise intensity self-regulation by recreationally active young adults.

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### 2041 Board #182 May 28 9:00 AM - 10:30 AM

#### Effect Of Adiposity On Physiological, Perceptual, And Affective Responses During Treadmill Walking At Self-selected Pace

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(No relationships reported)

**PURPOSE:** To investigate the influence of adiposity on physiological, perceptual, and affective responses during treadmill walking at a self-selected pace.

**METHODS:** Forty-five previously sedentary women were assigned to one of three groups according to their percentage of body fat (% body fat): Low Tertile (LT,  $n = 15$ , age:  $28.1 \pm 5.7$  yr, % body fat:  $23.8 \pm 2.2$ ,  $VO_{2max}$ :  $39.7 \pm 6.7$  ml $\cdot$ kg $^{-1}\cdot$ min $^{-1}$ ), Medium Tertile (MT,  $n = 15$ , age:  $28.8 \pm 6.4$  yr, % body fat:  $28.5 \pm 0.8$ ,  $VO_{2max}$ :  $34.9 \pm 4.5$  ml $\cdot$ kg $^{-1}\cdot$ min $^{-1}$ ), and High Tertile (HT,  $n = 15$ , age:  $32.4 \pm 4.8$  yr, % body fat:  $32.1 \pm 2.0$ ,  $VO_{2max}$ :  $30.3 \pm 4.2$  ml $\cdot$ kg $^{-1}\cdot$ min $^{-1}$ ). Each participant performed an incremental treadmill test to

determine  $\text{VO}_{2\text{max}}$  and a 20-min treadmill walking bout at a self-selected pace. During 20-min of treadmill walking at a self-selected pace, the physiological (oxygen uptake,  $\text{VO}_2$ ) responses were recorded continuously. The perceptual (Borg-RPE for the overall body, 6-20) and affective (Feeling Scale, Hardy & Rejeski, 1989) responses were determined every 5 min throughout the test. A one-way ANOVA (adiposity) was used to examine group differences in physiological, perceptual, and affective responses during 20-min of treadmill walking at a self-selected pace.

**RESULTS:** The preferred walking pace did not differ between the groups ( $1.63 \pm 0.19$ ,  $1.60 \pm 0.20$ ,  $1.47 \pm 0.18 \text{ m}\cdot\text{sec}^{-1}$  for LT, MT, and HT, respectively), whereas the  $\% \text{VO}_{2\text{max}}$  was significantly higher ( $P < .05$ ) in HT ( $61.8 \pm 8.6\%$ ) compared to MT ( $55.8 \pm 6.8\%$ ) and LT ( $52.8 \pm 6.8\%$ ). The perceptual ( $11.8 \pm 1.5$ ,  $12.2 \pm 1.3$ , and  $11.7 \pm 1.1$ ) and affective ( $2.36 \pm 1.33$ ,  $1.80 \pm 1.74$ , and  $1.85 \pm 1.82$  for LT, MT, and HT, respectively) responses were similar between the groups.

**CONCLUSIONS:** The findings of this study indicate that adiposity influences physiological, but not perceptual and affective responses of previously sedentary women during treadmill walking at a self-selected pace.

This study was supported in part by grants from the Istituto per il Credito Sportivo (C. F. Buzzachera) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (H. M. Elsangedy and K. Krinski).

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**2042 Board #183 May 28 9:00 AM - 10:30 AM**  
**Cross-validation Of  $\text{VO}_{2\text{peak}}$  Prediction Equations Using Submaximal Omni Rpe Responses**

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(No relationships reported)

Ratings of perceived exertion (RPE) derived from the Adult OMNI RPE Cycle Scale have been used to develop statistical models to predict  $\text{VO}_{2\text{peak}}$  from submaximal cycle ergometer responses in college age males and females. However, cross-validation of these prediction models in an independent cohort of subjects has not been examined.

**PURPOSE:** The purpose of this study was to cross-validate statistical models for prediction of  $\text{VO}_{2\text{peak}}$  using RPE estimated during submaximal cycle ergometry.

**METHODS:** Recreationally active ( $< 150 \text{ min} \cdot \text{week}^{-1}$ ) males ( $n = 21$ ;  $20.6 \pm 0.58 \text{ yrs}$ ) and females ( $n = 9$ ;  $21.1 \pm 0.84 \text{ yrs}$ ) completed a load-incremented cycle ergometer protocol. Predictor variables of RPE-Overall (O), Legs (L), Chest/Breathing (C) and heart rate (HR) were recorded during each test stage. Data from the first three stages were entered into the prediction models.  $\text{VO}_{2\text{peak}}$  was estimated using previously developed 3 stage statistical models for each of the three RPE predictors and the HR predictor.

**RESULTS:** Mean measured and predicted  $\text{VO}_{2\text{peak}}$  ( $\text{L} \cdot \text{min}^{-1}$ ) for the 3 stage models are shown in Table 1. There were no significant differences ( $p > 0.05$ ) between measured and predicted  $\text{VO}_{2\text{peak}}$  for any of the models within either gender.

Table 1. Measured and predicted $\text{VO}_{2\text{peak}}$ (Data: mean + SE).					
Gender	Measured	RPE-O	RPE-L	RPE-C	HR
Males	$3.12 \pm 0.10$	$2.98 \pm 0.08$	$2.96 \pm 0.08$	$2.95 \pm 0.06$	$3.05 \pm 0.05$
Females	$2.06 \pm 0.04$	$2.06 \pm 0.04$	$2.01 \pm 0.06$	$2.01 \pm 0.05$	$2.18 \pm 0.06$

**CONCLUSION:** Previously developed statistical models for prediction of  $\text{VO}_{2\text{peak}}$  based on 3 stage submaximal cycle RPE responses are valid for use in recreationally active college age males and females.

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**2043 Board #184 May 28 9:00 AM - 10:30 AM**  
**Perception Of Walking Effort Predicts One-year Weight Regain**

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(No relationships reported)

Background: Participation in physical activity is a critical factor in maintaining long-term weight loss. Perception of exercise difficulty could in part explain differences in recidivism after weight loss. We tested the hypothesis that inter-individual variation in perceptual responses to exercise was related to weight regain following weight loss.

**METHODS:** One-hundred and six weight-reduced premenopausal women (BMI  $< 25$ ) were used in this analysis. Submaximal and maximal fitness testing were performed after the completion of an investigator-administered weight loss program to determine physiological and perceptual responses to a standardized walk test. During the walk test, heart rate, ventilation, and respiratory exchange ratio data were summed as an index of physiological exertion and rating of perceived exertion was concurrently recorded as an index of perceived effort. Body composition was assessed following a subsequent one-year free-living period.

**RESULTS:** Over the one-year follow-up period, participants who had a greater relative perception of effort during the walk test regained a significantly greater amount of weight at one year ( $6.5 \pm 0.51 \text{ kg}$ , 95 % CI 5.48 to 7.50 kg,  $p = 0.008$ ) compared to participants whose perception of effort was more congruous with measured physiological effort ( $4.7 \pm 0.41 \text{ kg}$ , 95 % CI 3.90 to 5.50 kg).

**CONCLUSIONS:** These findings provide support for our hypothesis that individuals who over-perceive exercise exertion regain more weight following weight loss. This finding may have considerable practical application for implementing more precise treatment strategies to prevent recidivism after the completion of a successful weight loss program.

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**2044 Board #185 May 28 9:00 AM - 10:30 AM**  
**A Comparison Of Subjective And Objective Measures Of Physical Exertion**

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(No relationships reported)

Better methods are needed to improve the validity and reliability of physical activity (PA) assessment instruments when measuring intensity of PA. Research suggests people tend to overestimate level of exertion when self reporting activity on Physical Activity Questionnaires (PAQs).

**PURPOSE:** To compare a subjective method, Borg's Rate of Perceived Exertion (RPE) survey to an objective method utilizing ambulatory PA recorded by an accelerometer.

**METHODS:** Accelerometers were fitted around the waist and positioned on the right side according to manufacturer protocols on 117 participants, (43% male, 67% female, age range 18-74, BMI  $26.1 \pm 5.4$ , 53% reporting regular exercise). Participants performed three, 0.29-mile laps of increasing self-selected intensity, and then rated exertion by filling out a Borg's 15-point RPE form for each lap immediately following exercise. Exercise categories were divided into four intervals based on validated Hendelman 2 cut-points for comparing metabolic equivalents (METs) and subjective categories (i.e., light, moderate, hard, and very hard). A sub sample was selected to complete the same RPE survey 6 to 8 weeks later recalling their RPE during the three 0.29 mile laps, to assess differences over time. Chi-square tests, logistic regression, and Wilcoxon signed ranks tests measured differences between groups, develop odds ratios where appropriate, and measured discrepancies over time.



**RESULTS:** There were significant differences between genders and overall accuracy ( $\chi^2=10.9$ ,  $p=0.004$ ), as well as whether or not the individual self-reported exercising ( $\chi^2=15.5$ ,  $p<0.001$ ). Neither BMIs nor age had an impact on overall accuracy. Odds of underestimating RPE for a regular exerciser are 3.67 times greater than that of a nonexerciser while controlling for all other variables (95% CI=1.48, 9.11). In assessing differences over time, the sub sample underestimated RPE to a greater extent 6 to 8 weeks after the activity ( $Z=-2.324$ ,  $p=0.020$ ).

**CONCLUSION:** Males and those regularly exercising were more likely to underestimate exertion, while sedentary women tended to overestimate. Recall of PA intensity may decline over time. Misreporting exercise intensity on PAQs is more likely to occur in a subset of the population.

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**2045 Board #186 May 28 9:00 AM - 10:30 AM**  
**Production Strategy During Self-regulated Cycle Ergometer Exercise**

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During self-regulated exercise using a target rating of perceived exertion (RPE), some individuals may *overshoot* or *undershoot* the prescribed exertional level at the beginning of an exercise session. This is known as the Production Strategy component of the Intensity Self-Regulation Model (Wiser et al., 2007) and has not been examined in recreationally active adults.

**PURPOSE:** To examine production strategy during 21 min of self-regulated cycle ergometer exercise performed at a target RPE of 5 on the Adult OMNI-RPE Cycle Scale.

**METHODS:** Nine recreationally active males ( $20.4 \pm 2.8$  yrs) participated in this investigation. Initially, subjects underwent an estimation trial (EST) consisting of a load incremented cycle ergometer protocol to determine the  $\text{VO}_2$  corresponding to a target RPE of 5. 48 hrs later subjects performed a trial during which exercise intensity was self-regulated to produce a level of exertion just noticeably greater and just noticeably less than the target RPE of 5. This established the just noticeable difference (JND) in perceived exertion and its corresponding oxygen consumption ( $\text{VO}_2$ ) range. Exercise  $\text{VO}_2$  responses above and/or below the JND- $\text{VO}_2$  range indicated intensity self-regulation error for each subject. For the subsequent session, subjects completed a production trial (PROD) consisting of 21 min continuous self-regulated exercise at a target RPE of 5.

**RESULTS:** During the PROD trial, eight out of nine subjects exercised at an intensity that resulted in a  $\text{VO}_2$  below the JND- $\text{VO}_2$  range for at least one of the measurement time points, while the  $\text{VO}_2$  for one subject was within the JND- $\text{VO}_2$  range for the entire 21 min session. The mean ( $\pm$  SD) error below the JND- $\text{VO}_2$  range associated with a RPE of 5 ranged from  $0.26 (\pm 0.33)$  to  $0.46 (\pm 0.54) \text{ L}\cdot\text{min}^{-1}$ . 68.3% and 31.7% of the measurement time points for all subjects were below and within the JND- $\text{VO}_2$  range, respectively.

**CONCLUSIONS:** A majority of subjects used an undershoot Production Strategy in contrast to previous reports of an overshoot strategy in elite athletes and cardiac patients. The present results may lead to a more accurate application of exercise prescriptions for recreationally active adults where individual production strategies are employed.

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**2046 Board #187 May 28 9:00 AM - 10:30 AM**  
**Session Perceived Exertion Response To A Load-incremented Perceptual Estimation Cycle Ergometer Protocol**

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Session RPE (S-RPE) is defined as the post-exercise rating of global exertion experienced during an entire exercise session. Thekkada et al. (2007) found S-RPE was higher than the mean RPE during a load-incremented estimation cycle ergometer protocol in young, recreationally active females. In contrast, Krause et al. (2008) found S-RPE did not differ from the mean RPE during an intermittent perceptual production cycle ergometer protocol in young, recreationally active males.

**PURPOSE:** To compare: 1) S-RPE with the mean RPE (M-RPE), and 2) Mean  $\text{VO}_2$  with the  $\text{VO}_2$  corresponding to both the S-RPE ( $\text{VO}_{2\text{-S}}$ ) and the M-RPE ( $\text{VO}_{2\text{-M}}$ ), as measured during a load-incremented perceptual estimation cycle ergometer protocol in recreationally active males ( $\leq 160 \text{ min}\cdot\text{wk}^{-1}$  physical activity).

**METHODS:** Thirty-nine (mean age  $20.7 \pm 2.45$  yrs) recreationally active males performed 2 min cycle stages, with progressive ( $75 \text{ W}\cdot\text{stage}^{-1}$ ) increases in power output until peak intensity. RPE was obtained at 1:45 of each stage using the Adult OMNI-Cycle Scale. S-RPE was obtained 7 min following exercise. M-RPE was the average of all stage-by-stage RPE. Mean  $\text{VO}_2$  was the average of each exercise minute value. Linear regression analysis was used to predict the  $\text{VO}_2$  corresponding to a scale category that was the same as the S-RPE and the M-RPE for each subject.

**RESULTS:** S-RPE (mean  $\pm$  SD;  $6.85 \pm 1.46$ ) differed from the M-RPE ( $4.23 \pm 1.33$ ) ( $p<0.001$ ).  $\text{VO}_{2\text{-S}}$  ( $2.74 \pm 0.80 \text{ l}\cdot\text{min}^{-1}$ ) differed from the mean  $\text{VO}_2$  ( $1.93 \pm 0.36 \text{ l}\cdot\text{min}^{-1}$ ) ( $p<0.001$ ).  $\text{VO}_{2\text{-M}}$  ( $2.06 \pm 0.39 \text{ l}\cdot\text{min}^{-1}$ ) was greater than the mean  $\text{VO}_2$  ( $1.93 \pm 0.36 \text{ l}\cdot\text{min}^{-1}$ ) ( $p<0.001$ ). Correlation analysis determined a moderate association between mean  $\text{VO}_2$  with  $\text{VO}_{2\text{-S}}$  ( $r=0.69$ ;  $p<0.001$ ) and a strong association between mean  $\text{VO}_2$  with  $\text{VO}_{2\text{-M}}$  ( $r=0.91$ ;  $p<0.001$ ). No significant association between M-RPE and S-RPE was noted.

**CONCLUSIONS:** The results indicated a positive relation between physiologic (i.e. mean  $\text{VO}_2$ ) criteria and both S-RPE and M-RPE. S-RPE was not representative of the average rating of global exertion experienced during the entire exercise test. Future research should continue to explore the underlying perceptual and physical substrata that contribute to the S-RPE.

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**2047 Board #188 May 28 9:00 AM - 10:30 AM**  
**Rating Of Perceived Exertion In Cycle Ergometer: Effect Of Maximal Capacity Differences**

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(No relationships reported)

**PURPOSE:** To evaluate the physiological responses to exercise intensities determined by heart rate reserve (HRR) method and to detect whether perceived exercise intensity can be affected by individuals fitness level.

**METHODS:** Twenty sedentary participants of both sexes aged 20 to 41 (mean 26.9) participated. Rating of perceived exertion (RPE) scores were collected at different percentages of subjects' HRRs during graded exercise test on a cycle ergometer. Following the test, subjects were divided into two groups according to their maximal  $\text{O}_2$  uptakes ( $\text{VO}_{2\text{max}}$ ) as high ( $\text{MET} \geq 10$ ;  $n=9$ ), and low MET groups ( $\text{MET} < 10$ ;  $n=11$ ). After 48 hours, participants performed the steady state exercise test at a perceived exertion level of 13-14. For regression analysis the mean values for intercepts, slopes, and Pearson r correlations were determined.

**RESULTS:** In all HRR levels low MET group had significantly lower MET values ( $p<0.01-0.001$ ). Perceived exertion was significantly higher in low MET group compared to high MET group during graded exercise test. In steady state cycling test, low MET group exercised at higher relative  $\text{VO}_2$  values compared to high MET group ( $p<0.05-0.001$ ). The groups cycled at similar HRR percentages to a given RPE score.

**CONCLUSIONS:** Our results demonstrate that exercise intensity can be prescribed in individuals with different  $\text{VO}_{2\text{max}}$  levels by HRR percentages or by RPE scale methods considering the fact that individual oxygen consumptions may differ.

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**2048 Board #189 May 28 9:00 AM - 10:30 AM**



## Predicted And Actual Ratings Of Perceived Exertion During Cycle And Treadmill Exercise In Young Women

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(No relationships reported)

**PURPOSE:** To examine the effect of aerobic training status on predicted and actual undifferentiated and differentiated ratings of perceived exertion (RPE) in young women.

**METHODS:** Subjects were 18-25 yr old women (19 untrained, 22 trained) who underwent two graded exercise tests (GXT) separated by 48 hours. The first GXT used a treadmill and employed a modified Bruce protocol terminated at  $\dot{V}O_{2max}$ . The second GXT used a load-incremented cycle ergometer test terminated at  $\dot{V}O_{2max}$ . Predicted RPE-Overall (O), -Legs (L), and -Chest (C) were recorded before the start of each GXT using a mode specific OMNI perceived exertion scale. Actual RPEs for both sessions were recorded immediately post-exercise and represented the global perceived exertion for the entire session. Six separate two way (training status (2) x time (2)) ANOVAs with repeated measures on time were computed.

**RESULTS:** Descriptive data for the sample were: RPE-O, -L, -C: range = 0 to 10; mean  $\dot{V}O_{2max}$  untrained = 33.40 ml/kg/min, mean  $\dot{V}O_{2max}$  trained = 43.3 ml/kg/min. No significant differences were found between predicted and actual RPEs for the untrained and trained groups (Table 1) during treadmill exercise. For both groups performing cycle ergometry, predicted RPE-O and -C were greater ( $p < 0.05$ ) than global RPE actually reported immediate post-exercise (Table 1).

Table 1: Mean RPE responses

	Time Point	Treadmill			Cycle Ergometer		
		RPE-O	RPE-L	RPE-C	RPE-O*	RPE-L	RPE-C*
Trained	Predicted RPE	7.23	6.91	6.95	7.67	8.24	7.86
	Actual RPE	6.82	6.91	6.91	6.76	7.90	6.86
Untrained	Predicted RPE	6.32	6.37	6.37	7.21	7.58	7.42
	Actual RPE	6.05	5.95	6.42	6.84	7.74	6.42

\*Indicates significant difference ( $p < 0.05$ ) between predicted and actual RPE for both groups

**CONCLUSION:** Based on the actual global perceptual experience there was a consistent over prediction in both RPE-O and RPE-C during cycle exercise in both groups. Such over prediction of actual exercise related exertional perceptions may pose psychological barriers to exercise adoption and maintenance.

## 2049 Board #190 May 28 9:00 AM - 10:30 AM

### Omni Scale Perceived Exertion: Progressive Aerobic Cardiovascular Endurance Run (pacer) Validation And Direct Kinematic Observation

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The OMNI Scale of perceived exertion (category 0 to 10) has been validated for children and adults, primarily using ergometry, i.e. treadmill, cycle, step. The OMNI scale has not been validated for use with the Progressive Aerobic Cardiovascular Endurance Run (PACER) which is a validated field oxygen consumption test.

**PURPOSE:** To validate the OMNI Scale for use with the PACER. In addition direct kinematic observation was used to rate perceived exertion (OMNI Scale; RPE) during the PACER.

**METHODS:** 9 subjects (age  $24.9 \pm 3.8$ , BMI  $23.6 \pm 2.9$ , PACER  $\dot{V}O_{2peak}$   $44.3 \pm 7.0$ ) clinically normal adults participated in the study. A cross-sectional, perceptual estimation paradigm was used. Oxygen consumption (Cosmed K4 b<sup>2</sup>) ( $\dot{V}O_2$ : ml·min<sup>-1</sup>, ml·kg<sup>-1</sup>·min<sup>-1</sup>) and heart rate (HR beats·min<sup>-1</sup>) were measured at the end of each continuously administered incremental PACER stage. Subjects were instructed to run back and forth across a 20 meter distance at a pace that increased each minute. Subjects performed the exercise test to exhaustion. RPE for the overall body (RPE-O) was estimated by 3 trained observers and self rated by the subjects at the end of each PACER stage.

**RESULTS:** Subject self-rated RPE-O, Observer 1, 2, 3 RPE-O and  $\dot{V}O_2$  respectively for the first 4 stages were: Stage 1:  $1.2 \pm 0.4$ , O1  $1.0 \pm 0.5$ , O2  $0.9 \pm 0.6$ , O3  $1.0 \pm 0.5$ ,  $28.5 \pm 4$  Stage 2:  $2.8 \pm 0.7$ , O1  $1.8 \pm 0.7$ , O2  $1.8 \pm 0.8$ , O3  $2.1 \pm 0.6$ ,  $35.0 \pm 3.7$  Stage 3:  $4.6 \pm 1.6$ , O1  $2.8 \pm 1.7$ , O2  $3.6 \pm 0.9$ , O3  $3.1 \pm 1.0$ ,  $38.3 \pm 4.0$  Stage 4:  $6.3 \pm 2.3$ , O1  $4.1 \pm 2.0$ , O2  $5.1 \pm 1.6$ , O3  $4.6 \pm 1.5$ ,  $40.0 \pm 5.6$ . Linear regression analysis for the first 4 stages, showed that RPE-O, distributed as positive functions of both  $\dot{V}O_2$  ( $r = .86$ ) and HR ( $r = .86$ ). All regression functions were statistically significant ( $p < 0.01$ ). RPE responses between observers and subject self-rating were not significantly different for all stages ( $p < 0.05$ ).

**CONCLUSIONS:** OMNI Scale validity was established for use in conjunction with the PACER field oxygen consumption test. Findings also confirmed that direct kinematic observations were similar to self-ratings of RPE during the PACER. The utility of the OMNI scale for field settings is thus extended to the PACER. Valid observations of RPE in perceptual-based field exercise testing using the OMNI scale can enhance the effectiveness and efficiency of programs in health and fitness, the school and public health settings.

## 2050 Board #191 May 28 9:00 AM - 10:30 AM

### Tracking Strength Changes And Safety Using Omni Scale Rpe During Resistance Training In Older Adults

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It has been shown that the OMNI resistance exercise scale (OMNI-RES) is an effective method to track both absolute and relative strength increases in older adults. What is unclear however, is if the OMNI-RES tracks strength increases in consequent to training intended to minimize injury risk.

**PURPOSE:** To: (1) use the OMNI-RES to track strength changes following a low-risk resistance training program and (2) examine the drop-out rate due to injury during a 12-week resistance exercise program guided by RPE in male and female hexagenarians.

**METHODS:** Twenty-two men ( $64.3 \pm 3.2$  yrs.) and 27 women ( $63.8 \pm 2.8$  yrs.) volunteered. Subjects underwent orientation to determine a pre-training resistance associated with RPEs of 4, 5, 6, 7-8 and 9. Training consisted of 8-12 repetitions (reps) with weights set at 75 % of 1-RM three days a week for 12 weeks. Seven exercises: leg press, lat pull down, chest press, leg extension, leg curl, arm extension, and arm curl were performed. Participants were instructed to perform as many reps as possible but not to exceed 12 reps. When a participant achieved three sets of 12 reps on an exercise, the weight was increased to a level that allowed only 8 reps. Subjects then underwent a post-training assessment to again determine the resistance associated with the criterion RPEs.

**RESULTS:** Subjects significantly increased strength in each of the seven exercises over the course of the 12-week resistance exercise program ( $p < .05$ ). Resistance at each RPE was lower post- than pre-training ( $p < .05$ ). Despite these significant increases in post-training 1-RMs, there were zero dropouts due to injury over the 12-week program.

**DISCUSSION:** With the current increase in resistance exercise prescriptions for an aging population, it was important to establish a safe method to gauge exercise intensity. It

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## C-40 Free Communication/Poster - *Posture/Balance*

MAY 28, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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### 2051 Board #192 May 28 8:00 AM - 9:30 AM

#### Development Of Posture Control In Primary School Children Evaluated By A Balance Board Equilibrium Test

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Posture control has been evaluated as an integration of the center of pressure during upright posture on a flat surface. However, since this motor task is easy, variation are difficult to detect, especially in healthy people.

**PURPOSE:** To evaluate the development of posture control in primary school children utilizing a balance board equilibrium test, which is a more advanced motor task.

**METHODS:** 345 primary school children in the first to sixth grade (female: 164, male: 181) participated in this study. Height, body mass, and body fat percentage were measured. Posture control ability was evaluated as an integration of the center of pressure during upright posture (15sec) on a commercial balance board placed on an instrument to determine center of pressure (Active balancer, SAKAI Medical.Co.,Ltd, JAPAN). In addition, grip strength and squat jump were investigated.

**RESULTS:** The velocity of center of pressure was significantly lower between the second grade and the third grade ( $p<0.01$ ), but there was no significant difference after the third grade. There was no significant difference between females and males. Grip strength significantly increased from the first grade to the second grade ( $p<0.01$ ), and from the second grade to the third grade ( $p<0.01$ ). Squat jump significantly increased from the second grade to the third grade ( $p<0.01$ ), and from the fourth grade to the fifth grade ( $p<0.01$ ).

**CONCLUSIONS:** It was suggested that posture control highly developed during the second grade to the third grade period, and that the development of posture control was different from other motor developments.

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### 2052 Board #193 May 28 8:00 AM - 9:30 AM

#### The Effect Of Localized Cold Exposure On Static And Dynamic Postural Stability

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(No relationships reported)

Decreased temperature, both whole-body and localized, potentially alters human movement function. Specifically, exposure to cold environmental temperature can lower intramuscular temperature and may affect postural stability.

**PURPOSE:** To investigate effects of localized lower-limb cold exposure on static and dynamic postural stability.

**METHODS:** Fourteen subjects (7 females, 7 males; body mass  $72.4 \pm 13.9$  kg; ht  $170.2 \pm 6.9$  cm) participated. A balance platform system was used to assess one-leg static postural stability (overall score), one-leg dynamic postural stability (overall score), and manipulation of center of pressure using Limits of Stability testing (LOS) on a moderately-challenging dynamic setting (composite score for anterior-posterior direction only). After establishing baseline (pretest), one leg was randomly chosen for cold exposure treatment (whole leg submersion at  $5^{\circ}\text{C}$  for 10 min) using contra-lateral leg as control. Post-testing followed treatment.

**RESULTS:** Two-way repeated measures ANOVA revealed no PrePost effect, ContCold effect, or PrePost x ContCold interaction for static postural stability ( $F_{1,13} = 0.59$ ,  $p=0.46$ ;  $F_{1,13} = 0.34$ ,  $p = 0.57$ ,  $F_{1,13} = 3.50$ ,  $p = 0.08$  respectively) or LOS ( $F_{1,12} = 0.16$ ,  $p=0.070$ ;  $F_{1,12} = 1.28$ ,  $p = 0.28$ ;  $F_{1,12} = 0.06$ ,  $p = 0.81$  respectively). Similarly, dynamic stability had no main effects ( $F_{1,13} = 0.28$ ,  $p = 0.61$ ;  $F_{1,13} = 0.31$ ,  $p = 0.59$ ), although an interaction was observed ( $F_{1,13} = 14.9$ ,  $p = 0.002$ ).

	CONT	COLD
	Pre-test, Post-test	Pre-test, Post-test
Postural Stability (Static)	$1.5 \pm 0.5$ , $1.2 \pm 0.4$	$1.3 \pm 0.8$ , $1.5 \pm 0.7$
Postural Stability (Dynamic)	$1.4 \pm 0.6$ , $1.7 \pm 0.8$	$1.6 \pm 0.8$ , $1.4 \pm 0.8$
LOS (Dynamic)	$35.6 \pm 12.0$ , $34.8 \pm 13.2$	$32.9 \pm 15.9$ , $35.3 \pm 15.3$

**CONCLUSION:** Localized cold exposure neither inhibited nor enhanced static postural stability or LOS performance. Similarly, cold exposure did not affect dynamic postural stability as measured by main effects, although the occurrence of an interaction complicates data interpretation.

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### 2053 Board #194 May 28 8:00 AM - 9:30 AM

#### An Inverted Seated Posture Decreases Elbow Flexion Force and Muscle Activation.

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**PURPOSE:** While much is known about neuromuscular responses performed with an upright posture, muscle force and activation during an inverted posture have not been previously studied.

**METHODS:** To determine if postural-induced discrepancies exist, maximal voluntary contraction (MVC) elbow flexor force, MVC force produced in the first 100 ms (F100), MVC rate of force development, electromyographic (EMG) activity of the biceps and triceps and trunk musculature were investigated during isometric elbow flexion in both an upright and inverted seated posture. Heart rate and blood pressure were monitored with upright and inverted positions at rest.

**RESULTS:** Results showed significantly ( $p=0.01$ ) higher MVC force ( $543.6 \text{ N} \pm 29.6$  vs.  $486.5 \text{ N} \pm 23.0$ ), F100 ( $328.3 \text{ N} \pm 94.5$  vs.  $274.6 \text{ N} \pm 101.8$ ) and rate of force development ( $p=0.003$ ) ( $1851.9 \text{ N.s}^{-1} \pm 742.2$  vs.  $1591.0 \text{ N.s}^{-1} \pm 719.6$ ), in the upright versus inverted condition. Biceps (48%;  $p=0.01$ ) EMG activity was greater in the upright position. There was relatively greater co-contractions (86%,  $p=0.006$ ) with the inverted position. Heart rate (16.8%), systolic (11.6%), and diastolic (12.1%) blood pressures were also significantly ( $p<0.0001$ ) decreased with inversion.

**CONCLUSION:** These results illustrate decrements in neuromuscular performance with an inverted seated posture which may be related to an altered sympathetic response.

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2054 Board #195 May 28 8:00 AM - 9:30 AM

**The Effects Of Eight-week Archery Training On Postural Control In Young Children**

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(No relationships reported)

**PURPOSE:** To examine the effects of an eight-week archery training program on postural control (PC) in young children during the standard, aiming, and archery shooting standing posture.

**METHODS:** Thirty-two young children were recruited and grouped as experimental group (E, 16 children, Height 138.66±7.45 cm, Weight 34.47±9.29 kg) or control group (C, 16 children: Height 136.75±6.01 cm; Weight 36.34±6.92 kg). The E group underwent archery training for forty minutes a time, three times a week, for eight weeks, and the C group did not received any regular physical training. PC was evaluated by the measurement of COP displacement on a force platform as the COP radius, speed and sway area during each testing position. The training program was planned by expert archery coaches and based on the training of basic archery skill and coordination. Data were analyzed by the mixed design, two-way ANCOVA to determine if any difference in PC between groups before and after training during the standard posture. Repeated measures, dependent *t* test was also used to determine if any difference in PC before and after training during the aiming and shooting posture in experimental group. The significant level for statistic was set at *p*<.05.

**RESULTS:** 1. No significant differences were found in PC during each testing position before and after the eight-week period in C group; 2. The COP radius and sway area were significantly decreased after archery training in E group during the standard, aiming, and shooting posture, but not in the COP velocity.

**CONCLUSIONS:** This study demonstrated that regular eight-week archery training not only improved the performance of archery shooting, but also improved the PC during the standard, aiming, and shooting posture. The results of this study could provide a practical training regimen for archery coaching and understand the possible relationships between the archery performance and PC.

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2055 Board #196 May 28 8:00 AM - 9:30 AM

**Dynamic Balance Assessment For Children With Down Syndrome**

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(No relationships reported)

For Down syndrome (DS), developmental dysfunctions include psychological and physical problems. Dynamic balance affects the performances of their daily life. There were many studies regarding static balance assessment under different sensory conditions. But, dynamic balance assessment in the limits of stability (LOS) for children with DS is still lacking.

**PURPOSE:** To assess dynamic balance performance in the limits of stability for children with DS.

**METHODS:** Subjects were eight children with DS (4 boys/4 girls, age 9.8 ± 2.1 yrs, height 126.5 ± 10.5cm) and eight healthy children (4 boys/4 girls, age 8.7 ± 0.5 yrs, height 130.3 ± 7.0cm). Both groups were assessed with clinical assessments including heel-toe walking for 15 steps and jumping squares (45 × 45cm<sup>2</sup>) with both feet on the floor(both recorded accomplish second and correct steps). Subjects were then assessed by the Basic Balance Master system including Rhythmic Weight Shifting (RWS) assessment (right/left, R/L; forward/backward, F/B) and the test of stability (LOSt)(F, B, R, L). Student *t*-test was used to compare the difference between DS and control group. The level of statistical significance was set at *p* < .05.

**RESULTS:** Significant difference was found between two groups for the heel-toe walking with correct steps, accomplish jumping time and correct jumping steps (all *p* < .05). In RWS, there was significant difference for fast speed on-axis velocity in RWS (F/B) (7.9 ± 1.9 vs. 9.8 ± 2.1 °/sec, *p* < .05), but not in RWS (R/L) between DS and control. All directional control (DCL) of RWS were significantly different between groups (*p* < .05). In LOSt, only F direction of movement velocity was significantly different between groups (5.0 ± 2.3 vs. 7.7 ± 2.5 °/sec, *p* < .05). All directions endpoint excursion of and directions of maximal endpoint excursion were significantly different between groups (*p* < .05). Besides, three directions (F, R, L) of DCL were significantly different between groups (*p* < .05), but not in B of DCL (22.6 ± 28.7 vs. 49.2 ± 22.4 %LOS, *p* > .05).

**CONCLUSIONS:** In general, DS children had poorer dynamic balance than control group. These data can be used in understanding deficit in children with DS. Further studies can focus on designing appropriate perception-motor and muscle strength training programs to improve their dynamic balance and prevent risk of fall.

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2056 Board #197 May 28 8:00 AM - 9:30 AM

**Effects Of Physical Fitness Level And Anthropometric Parameters On Postural Sway In Girls**

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(No relationships reported)

Postural sway has been widely used as a number of maintenance of balance. The balance ability in adults depends on their muscular strength and aerobic and anaerobic working capacity.

**PURPOSE:** The purpose of this study was to examine the influence of physical fitness level and anthropometric parameters on postural sway in girls at the age of three, four and five years.

**METHODS:** 504 children: 168 girls at the age of three years, 168 girls at four years and 168 girls at five years participated in this study. The height and weight of all subjects were measured, then the Caup's index (weight/height<sup>2</sup> × 1000) was calculated. Postural sway was measured by a portable grabicorder (GS-10A, ANIMA, Tokyo, Japan). The children were asked to stand upright on a pedometer and look at a target placed 2m away from them. The body sway was measured as each child stood without shoes for 30 seconds, and the measurements were stored on the floppy disk. On the physical fitness test, the 25m sprint run, hopping, standing-broad-jump, side-jump and one-leg standing were analyzed. Each girl performed the same test twice, and the better results for each set of tests were taken. Then the One-factor ANOVA (analysis of variance) was used to analyze the differences between the measurements on the three study groups. A post hoc test (Fisher's PLSD) was used to decompose significant effects.

**RESULTS:** It was found that LNG of five-year old group was lower than the three (*p*<0.001) and four year old groups (*p*<0.001). However, the height, weight, and physical fitness level increased significantly with increasing of age in all groups (*p*<0.001). Moreover, the physical-fitness tests show that LNG was correlated with the height of the three-year old group. The LNG was related with the results of the four year old group's standing-broad-jump (*p*<0.01) and side-jump-frequency (*p*<0.01) respectively. Also the LNG was related with the results of the five year old group's hopping (*p*<0.05), standing-broad-jump (*p*<0.05), and side-jump-frequency (*p*<0.01) respectively.

**CONCLUSIONS:** The results confirmed that the magnitude of the postural sway in girls at ages four and five depends on their physical fitness level. However, the three year old girls depend on their body height rather than their physical fitness level.

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2057 Board #198 May 28 8:00 AM - 9:30 AM

## The Effects Of Cold Temperature On Gait Initiation And Dynamic Balance In Young And Older Females

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(No relationships reported)

This is an ongoing study examining epidemiological evidence suggesting a non-slip related increase in the rate of falls during the winter for females versus males. Previous research has shown cold has no effect on quiet standing parameters in young versus old females.

**PURPOSE:** To examine the effects of cold temperature on gait initiation and *dynamic* balance in young and older females.

**METHODS:** Six older (70.5 ± 2.7 yrs) and seven younger (23.9 ± 2.4 yrs) females performed dynamic balance and gait initiation tests at thermal neutral (33°C) and cold conditions (3°C). Legs were cooled using liquid cooling garment pants. The NeuroCom Balance<sup>®</sup> Manager™ Equitest<sup>®</sup> system provided composite scores for dynamic balance assessment. Ground reaction forces were used to calculate COP traces during gait initiation. Three segments of the COP trace were recorded to analyze X (medio-lateral) and Y (fore-aft) displacement, velocity, and smoothness at each temperature. A 2x2 ANOVA was conducted on dynamic balance tests. A 2x5 repeated measures MANOVA was conducted for each segment of the COP trace. A one-way ANOVA was conducted on each segment at both temperatures to determine age differences.

**RESULTS:** Equitest<sup>®</sup> balance measurements revealed no effect of temperature, although age effects were confirmed. One-way ANOVA revealed a significant between-group difference for segment one x-velocity (p=.02) at thermal neutral. Repeated measures analyses revealed a significant temperature effect on all variables of segment three for young females (each with p<.01).

**CONCLUSION:** We believe our “to date” gait initiation results may be due to a relatively insufficient cold stimulus and limited subject power. The disappearance of a significant between-group difference at cold suggests that young females were more adversely affected by the cold stimulus, which we feel is due to adiposity factors at the induced temperatures. A significant body composition difference was observed between the two age groups (p=.001). This would explain lower leg skin temperatures in younger subjects during the testing, and subsequently, the significant finding of temperature effects for their segment three values. Currently, additional subjects are being recruited to increase analytical power.

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### 2058 Board #199 May 28 8:00 AM - 9:30 AM Reducing Ankle Movement Has No Effect On Postural Control Dynamics

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(No relationships reported)

**PURPOSE:** To determine the effect of restricting movement about the ankle on the dynamics of postural control.

**METHODS:** 19 young adults completed the Sensory Organization Test (SOT) in the Neurocom Equitest System to index postural control while either barefoot, ankles taped or wearing an ankle brace. The SOT consists of six different conditions which incrementally challenge the underlying postural control conditions. Center of pressure excursion in the anterior-posture (AP) and medial-lateral (ML) directions, total sway length and sway area (95% ellipse) were calculated. Approximate entropy (ApEn) was calculated for measuring the complexity of the ML and AP center of pressure (COP) signals.

**RESULTS:** As expected postural sway increased with increasing postural difficulty. However, there was no effect of ankle immobilization on postural sway parameters (p >.05). In the anterior-posterior direction ApEn increased with postural difficulty (0.38-0.50). In the mediolateral direction there was minimal changes in ApEn as a function of postural difficulty. There was no significant effect of restricting ankle motion of postural dynamics (0.62, 0.64, and 0.63).

**CONCLUSION:** Restricting ankle movement has no effect on the dynamics of postural control. The findings suggest that individuals are able to compensate for restricted ankle mobility and maintain their postural stability.

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### 2059 Board #200 May 28 8:00 AM - 9:30 AM An Analysis Of The Posture Control After Rapid Flexion And Extension Movement In The Lower Extremities

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(No relationships reported)

In sports and daily living activity, it is important that muscular strength is coordinated as well. In particular, muscle coordination after ballistic movement and countermovement were most important factor to improve human movement. The control of local muscles during sports performance and daily living activity serves to stabilize a body during these maneuvers.

**PURPOSE:** The purpose of this study is to examine the muscular strength in posture control after rapid flexion and extension movement on the lower extremities.

**METHODS:** Twelve healthy male students participated in this study. EMG active surface electrodes (DL-142, S&ME, Japan) were applied. Eight muscles were selected for this study: lateral gastrocnemius, medial gastrocnemius, soleus, tibialis anterior, hamstrings, vastus lateralis, vastus medialis, rectus femoris. The ground reaction forces (GRF) exerted with the selected actions were recorded with a piezo-electric force platform (9281C, KISTLER, Swiss). The subjects were monitored by a video camera (HDR-HC9, SONY, Japan) of the sampling frequency of 60Hz by the sagittal plane to measure the angular displacement of the different joints. It makes subject to stand up on a force platform which is an apparatus for determining GRF and to perform the short ballistic movements which exerted rapidly flexion and extension on the lower leg joints.

**RESULTS:** The angular displacement was showed large differences between individual subjects to exert the selected actions, since it appears to exert the action with voluntary. The power curves were depicted a pattern of negative phase during joint flexion and positive phase during joint extension. The EMG activity increased in tibialis anterior muscle.

**CONCLUSIONS:** That indicating the greater computed power and work during upward action of a whole body than that during downward might be due to generating positive power and work, which is it in exerting antigravity work of body movement, on the muscles used in the selected actions. It is obscured what is the reason why that are generated on the greater power and work calculated in quickly returning to a starting level of a body position. It is seemed that an elastic energy stored into an active muscle-tendon complex which stretched immediately before shorting the active muscle-tendon complex.

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### 2060 Board #201 May 28 8:00 AM - 9:30 AM Exploration Of A Novel Task For Improvement Of Balance In Older Adults

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(No relationships reported)

It is known that balance is compromised with aging as is evidenced by increased falls in the elderly.

**PURPOSE:** The purpose of this study was to examine the effects of a retro-locomotion training protocol on static balance characteristics for young and older adult participants. Owing to our interest in older adults, a priori, we chose to examine the pre-post effects of the intervention for this group.

**METHODS:** Healthy young adults (n=8; 21.4±2.3 yrs; 70.5±8.5 kg; 176.9±6.9 cm) and healthy older adults (n=8; 69.0±7.0 yrs; 68.6±15.7 kg; 166.1±11.8 cm) volunteered to participate in a training session tri-weekly for 2 weeks. Each session entailed walking backwards on either a treadmill or over ground for 10-15 minutes at preferred speed. Subjects also participated in 2 laboratory testing sessions that took place prior to the training session (pre) and after the completion of the 2 week training session (post). Timing



lights were used to measure over ground retro-locomotion velocity (OGRV). A treadmill was used to identify preferred retro-locomotion treadmill speed (RLTS). A balance platform was used to measure static balance with performance quantified via balance scores. Five balance tests were conducted: 1) normal stance, eyes open (NS-EO), 2) normal stance, eyes closed (NS-EC), 3) perturbed stance eyes open (PS-EO), 4) perturbed stance, eyes closed (PS-EC), and 5) limit of stability (LOS).

**RESULTS:** A mixed model factorial ANOVA ( $\alpha=.05$ ) showed no significant time x age interaction. Significant age (PS-EO,  $p=.007$ ; PS-EC,  $p=.008$ ) and time (PS-EC;  $p=.011$ ) main effects were identified. Dependent t-tests showed significant balance score improvements in the older adult group for PS-EC from pre to post ( $p=.048$ ,  $Mpre=82.47 \pm 6.31\%$ ,  $Mpost=86.46 \pm 4.32\%$ ) and suggested a trend toward balance improvement for PS-EO pre to post ( $p=.093$ ,  $Mpre=90.01 \pm 3.39\%$ ,  $Mpost=91.73 \pm 1.88\%$ ). Dependent t-tests showed significant increases in preferred RLTS for both older ( $p=.001$ ,  $Mpre=.41 \pm .10$  m/s,  $Mpost=.71 \pm .14$  m/s) and younger ( $p=.031$ ,  $Mpre=.60 \pm .12$  m/s,  $Mpost=.74 \pm .14$  m/s) adults, but was not significant for OGRV for either group.

**CONCLUSIONS:** These data are congruent with previous research indicating proprioceptive function decreases with age. Results further suggest that balance improves in older adults after retro-locomotion training.

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**2061 Board #202 May 28 8:00 AM - 9:30 AM**  
**Return To Baseline Of Postural Control After Treadmill Run At Individual Anaerobic Threshold**

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(No relationships reported)

**PURPOSE:** To verify whether balance ability is affected by treadmill run at individual anaerobic threshold (IAT) intensity in recovery time immediately after exercise (0min post), after 5 minutes (5min post), and after 10 minutes (10min post).

**METHODS:** 18 soccer players ( $21.8 \pm 1.4$  yrs) performed: a) pre-session test to determine subjects' anthropometric measurements and to depict the IAT intensity during an incremental treadmill running test; b) an experimental session to assess subjects' body sway before and after a 30min treadmill run at IAT intensity. Body sway was evaluated by posturographic tests performed before (pre) and after run at 0min post, 5min post, and 10min post both with eyes open (EO) and eyes closed (EC). Mean Radius (R) and mean Velocity (V) of center of foot pressure were recorded.

**RESULTS:** After IAT exercise, R was significantly affected by vision ( $p<0.01$ ) and time ( $p<0.01$ ). R with EO was significantly higher at 0min post vs pre ( $8.3 \pm 2.7$  mm vs  $5.8 \pm 1.5$  mm,  $p<0.01$ ), while no significant differences at 5min post and 10min post vs pre were found. R with EC was significantly higher at 0min post and 5min post ( $9.7 \pm 2.1$  mm and  $8.4 \pm 2.2$  mm) vs pre ( $6.6 \pm 1.9$  mm;  $p<0.01$  and  $p<0.05$  respectively), and no differences between 10min post vs pre were observed. V was significantly influenced by vision ( $p<0.01$ ) and time ( $p<0.01$ ). V values both with EO and EC were significantly higher at 0min post vs pre (EO:  $19.3 \pm 5.6$  mm/s vs  $12.2 \pm 1.8$  mm/s, EC:  $28.0 \pm 7.4$  mm/s vs  $21.5 \pm 6.5$  mm/s,  $p<0.01$  respectively), and these were not significantly different at 5min post and 10min post vs pre values. Both R and V values were significantly higher with EC vs EO ( $p<0.01$ ) at all time points. The ratio between EO and EC was not significantly different between time points both in R and V.

**CONCLUSIONS:** This study confirmed that there was an impairment of postural control after exercise at IAT intensity. In particular, IAT intensity induced higher destabilizing effect when postural trials were performed with EC. Destabilizing effect on postural control vanished within 5min in R (with EO) and V (with EO and EC), and 10min in R (with EC). Finally, removal of vision affected similarly to R and V variables.

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**2062 Board #203 May 28 8:00 AM - 9:30 AM**  
**Postural Instability During Single Limb Stance For Individuals With Previous Ankle Injury.**

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Up to 74% of people who sprain their ankle develop chronic ankle instability (CAI). Despite a history of lateral ankle trauma, some people can remain active without recurrent injury or loss of function (copers). Understanding the differences between copers and CAI patients may elucidate the mechanism present in copers but absent in CAI patients.

**PURPOSE:** To investigate postural instability during single limb stance in CAI, Copers and Controls.

**METHODS:** Twenty four CAI (age  $21.7 \pm 2.8$  yrs), 24 Copers (age  $20.8 \pm 1.5$  yrs), and 24 Controls (age  $21.8 \pm 2.6$  yrs) completed four, single limb, quiet stance trials (2 trials per limb, 30 seconds each). Copers and CAI patients had at least one previous moderate ankle sprain but copers resumed all pre-injury activity without limitation or recurrent injury while CAI patients had recurrent sprains and giving way episodes. Ground reaction forces (GRF), collected at 100HZ, were used to calculate the Center of Pressure (COP) location. GRF accelerations were doubly integrated to obtain estimates of the Center of Mass (COM) location. The distances between the COP and COM in the transverse plane (COP-COM moment arm) were then calculated to identify the peak moment arms in the mediolateral ( $X_{max}$ ), anteroposterior ( $Y_{max}$ ) and resultant ( $R_{max}$ ) directions as well as the mean resultant moment arm ( $R_{mean}$ ) for each trial. Limb averages were then submitted for statistical analysis.

**RESULTS:** Separate two-way ANOVAs (Limb x Group) indicated significant group main effects for  $X_{max}$ ,  $Y_{max}$ , and  $R_{mean}$ . Post hoc analyses revealed that CAI had larger  $X_{max}$  ( $1.21 \pm 0.25$  cm) and  $Y_{max}$  ( $1.16 \pm 0.21$  cm) peak moment arms when compared to controls ( $X_{max}$ :  $1.07 \pm 0.18$  cm,  $Y_{max}$ :  $1.01 \pm 0.16$  cm) (both  $p<0.02$ ) but copers ( $X_{max}$ :  $1.11 \pm 0.22$  cm,  $Y_{max}$ :  $1.08 \pm 0.19$  cm) and controls did not differ for  $X_{max}$  or  $Y_{max}$ . Both CAI and Copers had larger  $R_{mean}$  (CAI:  $0.35 \pm 0.06$  cm, Copers:  $0.33 \pm 0.06$  cm) values when compared to controls ( $0.30 \pm 0.04$  cm) ( $p<0.01$ ) but did not differ from each other.

**CONCLUSION:** The  $R_{mean}$  results indicate that individuals with previous ankle injury (CAI and Copers) have increased postural instability during single limb stance. However, CAI patients' inability to limit peak separations of the COP-COM moment arm may represent the mechanism absent in CAI patients.

Supported by the University of Florida, CHHP Opportunity Fund.

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**2063 Board #204 May 28 8:00 AM - 9:30 AM**  
**A Comparison Of Balance And Proprioception By Gender And Age Group**

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**PURPOSE:** The purpose of this study was to determine if balance and proprioception are different in adolescents during the pubertal years, as compared to adults, or any interaction between gender and age group.

**METHODS:** A sample of convenience was obtained from adults ( $>21$  yrs old) and adolescents (9 - 15 yrs, dependent upon the gender) in the local area. Balance was tested with the single leg balance tests - eyes open (EO) and closed (EC), the Star Excursion Balance Test (SEBT) - anteromedial (AM), medial (M), and posteromedial (PM) directions. Joint position sense was assessed by reproducing a single-leg squat. Leg length (in centimeters) was used adjust the SEBT scores. Subjects completed the tests in a random order.

**RESULTS:** A total of 47 adolescents (12.5 yrs; 28 females and 19 males) and 41 (23.4 yrs; 24 females and 17 males) adults participated in this study. The only significant difference between the adult and adolescent individuals was for the EC test, with the adults averaging  $17 \pm 1$  secs and the adolescents  $25 \pm 10$  (2 - 30 secs for both groups) ( $p=.001$ ).



However, while the majority in both groups had EC times of > 20 secs, the distribution was continuous for the adults but adolescents that scored below 15 secs were distinctly different from the majority. The SEBT scores were different between the groups initially; when corrected for leg length, the average values ranged from .92 to .98 and were not significantly different. There were no differences between the genders, but there were significant interactions ( $p < 0.05$ ) between gender and age group for all three of the dynamic balance tests. The females were consistently better during adolescence and worse for the adults, while the males had poorer balance during adolescence and better when adults. Proprioception was not different for any of the groups and there was a small, but significant ( $r = .24$ ,  $p = .024$ ) correlation between proprioception and EC time.

**CONCLUSIONS:** Contrary to our hypothesis, there were not significant differences in balance and proprioception during adolescence as compared to adults, except for the EC test, which was better for the adolescents. There were individuals who were significantly outside the norm for some of the balance tests, which might suggest that they could be at a greater risk for injuries. Further research will be needed to explore this question.

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**2064 Board #205 May 28 8:00 AM - 9:30 AM**

**Kinematics Of Multi-directional Gait Initiation**

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(No relationships reported)

Turning while initiating gait, or multi-directional gait initiation (MdGI) is a common activity of daily living that challenges the postural control system, as it requires inter-segmental coordination to maintain stability. While forward gait initiation (GI) and turning while walking have been widely studied, performance during MdGI has not been sufficiently evaluated.

**PURPOSE:** To determine if aging and Parkinson's disease (PD) affect the kinematics of MdGI.

**METHODS:** Nine healthy young adults (HYA, age 28.4 ± 4y), nine healthy older adults (HOA, age 56.6 ± 9.7y) and 11 individuals with PD (PWP, age 63 ± 2y) participated in the study. An 8-camera motion capture system was used to capture the kinematic data at 120 Hz. Participants performed five GI trials in each of three directions: 45° medially (crossing in front of the body, C45), 45° laterally (O45) and 90° laterally (O90). Axial rotations in the transverse plane were evaluated for the head, trunk, and pelvis segments at three time instances - swing leg heel off (SWHO), swing leg toe-off (SWTO) and swing leg heel strike (SWHS). Spatio-temporal parameters were calculated for the swing and stance limbs.

**RESULTS:** Group x Segment ANOVA indicated that the PWP exhibited a delayed onset of pelvic rotation during C45 ( $P < 0.05$ ). Also for the C45 condition, the HYA achieved more pelvic rotation than head rotation while the other two groups exhibited more head rotation at SWHS ( $P > 0.05$ ). For O45 and O90, significant group main effects indicated that at SWHS the HYA exhibited greater rotations than both HOA and PWP. HOA produced greater axial rotations than PWP. For the C45 and O45 conditions, PWP had a lower swing leg step velocity than HOA and HYA ( $P < 0.05$ ). Also across all the conditions, the PWP produced consistently shorter step lengths than HYA ( $P < 0.05$ ).

**CONCLUSION:** HOA and PWP exhibit a slower and different turn pattern when compared to HYA during MdGI. The restricted range of motion using a more cautious approach may reflect an increased dependence on visual feedback in the HOA and PWP groups.

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**C-41 Free Communication/Poster - Special Populations**

MAY 28, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**2065 Board #206 May 28 9:00 AM - 10:30 AM**

**Sex Differences In Calf Muscle Hemoglobin Oxygen Saturation In Patients With Intermittent Claudication**

Polly S. Montgomery, Steve M. Blevins, Raha Nael, Azhar Afaq, Kristy Scott, Donald E. Parker, Andrew W. Gardner. *University of Oklahoma Health Science Center, Oklahoma City, OK.*

(No relationships reported)

**PURPOSE:** To compare the exercise performance and calf muscle hemoglobin oxygen saturation (StO<sub>2</sub>) between men and women with intermittent claudication, and to determine whether calf muscle StO<sub>2</sub> explains sex differences in exercise performance.

**METHODS:** Twenty-seven men and 24 women with peripheral arterial disease limited by intermittent claudication were studied. Patients were characterized on calf muscle StO<sub>2</sub> before, during, and after a graded treadmill test, as well as on demographic and cardiovascular risk factors, ankle/brachial index (ABI), ischemic window, initial claudication distance (ICD), and absolute claudication distance (ACD).

**RESULTS:** Women had a 45% lower ACD than men (296 ± 268 meters vs. 539 ± 288 meters;  $p = 0.001$ ) during the treadmill test. Calf muscle StO<sub>2</sub> declined more rapidly during exercise in women than in men, as the time to reach minimum StO<sub>2</sub> occurred 54% sooner in women (226 ± 241 sec vs. 491 ± 426 sec;  $p = 0.010$ ). Additionally, the recovery time for calf muscle StO<sub>2</sub> to reach the resting value after treadmill exercise was prolonged in women (383 ± 365 sec vs. 201 ± 206 sec;  $p = 0.036$ ). Predictors of ACD included the time from start of exercise to minimum calf muscle StO<sub>2</sub>, the average rate of decline in StO<sub>2</sub> from rest to minimum StO<sub>2</sub> value, the recovery half-time of StO<sub>2</sub>, and ABI ( $R^2 = 0.63$ ;  $p < 0.001$ ). The ACD of women remained lower after adjusting for ABI (mean difference = 209 meters;  $p = 0.003$ ), but was no longer significantly lower (mean difference = 72 meters;  $p = 0.132$ ) after further adjustment for the three calf muscle StO<sub>2</sub> variables.

**CONCLUSIONS:** In patients limited by intermittent claudication, women have greater impairment in calf muscle StO<sub>2</sub> during and following exercise than men, and the exercise-mediated changes in calf muscle StO<sub>2</sub> are predictive of ACD.

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**2066 Board #207 May 28 9:00 AM - 10:30 AM**

**The Comparison Of Effectiveness On Balance And Isokinetic Strength Between Ball Exercise And Treadmill Walking In Post-stroke Patients**

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(No relationships reported)

**PURPOSE:** To determine effectiveness of Ball exercise on balance and Isokinetic strength comparing to treadmill walking

**METHODS:** Forteen post-stroke patients were recruited to participate and divided into two groups; Ball exercise group(BG ; n=7, 45.7yrs±12.8) and treadmill walking group (TG ; n=7, 44.3yrs±9.3). In both groups patients were capable of independent walking without any support. Before and after 12 week exercise training. Balance and isokinetic strength were measured by using Berg Balance Scale, Biodex balance system and Cybex 770

**RESULTS:** After 12-week exercise training, points from Berg Balance Scale increased in both group;  $52 \pm 2.94$  to  $52.14 \pm 3.48$  in TG and  $49.42 \pm 4.89$  to  $52.28 \pm 2.87$  in BG. However independent t-test showed that there were significant difference between two groups in amount of changes(post-pre). Isokinetic Strength increased in both groups, but there were not significant difference between groups.

**CONCLUSIONS:** Improving gait ability is one of major goals in exercise for post-stroke patients. It requires improvement of both balance and leg strength. Comparing the effect of two exercise, we recommend post-stroke patient to be participated in various type of exercise, especially in ball exercise that is effective for increasing both balance and leg strength.

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**2067 Board #208 May 28 9:00 AM - 10:30 AM**  
**Cancer Therapies And Cardiovascular Fitness: Testing In A Clinic Setting**

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**PURPOSE:** Physical activity is a critical component of cancer survivorship, both during and after cancer treatment. Current recommendations from the American Cancer Society indicate a minimum of 30 minutes physical activity, 5 days/week to improve health and fitness. However, cancer survivors are often hesitant to begin exercising during or after treatment. Furthermore, some cancer treatments have been linked to alterations in cardiovascular function. This study was initiated to determine whether or not cardiovascular fitness varied by exposure to different types of cancer treatment.

**METHODS:** We conducted a chart review of 49 women ( $52 \pm 2$ y, BMI:  $26 \pm 1$ ) who attended an MD-directed fitness clinic for cancer survivors. Data included demographics, physical activity (PA) levels, and cancer treatment information (treatment type, duration, and time since treatment). Fitness assessments were conducted in-clinic via a modified, 3-minute step test.

**RESULTS:** Participants were diverse in age (30-39y: 14%, 40-49y: 33%, 50-59y: 24%, 60-69y: 24%, 70+y: 4%) and BMI (<20: 2%, 20-24: 40%, 25-29: 26%, 30-34: 24%, 35-39: 5%, 40+: 2%). Overall, 33% were sedentary (SED) and 67% were physically active (ACT:  $4.3 \pm 0.5$  hours/week PA). Cancer diagnoses were breast, ovarian, rectal cancer and Hodgkin's disease. Treatment types included surgery (86%), radiation (49%), herceptin (14%), chemotherapy (57%) and antiestrogen therapy (47%). Overall, 35 individuals (71%) completed the step test. Test completion and heart rate (HR) recovery were not influenced by cancer treatment type, duration, or time since treatment ( $P > 0.05$ ). Similarly, no effect was seen for age, BMI, or resting HR ( $P > 0.05$ ). Physical activity improved both step test completion (ACT: 83% vs. SED: 30%,  $P = 0.02$ ) and duration (ACT:  $176 \pm 6$  vs. SED:  $122 \pm 18$  sec,  $P < 0.001$ ). Significantly, no participants experienced any side effects from performing the step test.

**CONCLUSION:** Cardiovascular fitness was not affected by exposure to different types of cancer therapy. Instead, the key determinant of cardiovascular fitness in our clinic participants was current levels of physical activity. We were able to demonstrate that use of a modified step test to measure cardiovascular function in the clinic setting is feasible, safe, time-efficient and cost-effective.

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**2068 Board #209 May 28 9:00 AM - 10:30 AM**  
**Aerobic Vs. Resistance Exercise In Igfbp-3 In African American Males And Prostate Cancer Cells Growth**

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The value of aerobic exercise (ex) on health benefits have been well investigated while the benefits of resistance ex have been mostly minimized to that of building muscle and improving performance. Aerobic physical activity has been linked to reducing the growth of prostate tumors by altering function of the insulin-like growth factors. Prostate cancer affects blacks disproportionately, and whether aerobic and resistance ex affects the insulin-like growth factor system similarly is not known.

**PURPOSE:** This pilot study investigated the influence of aerobic ex and resistance ex on the concentration of a substance (insulin-like growth factor binding protein-3 [IGFBP-3]) which attenuates the growth of prostate tumor cells.

**METHODS:** Subjects were 14 sedentary black males 18-29 yrs. Subjects were assigned to groups of an aerobic ex ( $n = 7$ ) and resistance ex ( $n = 7$ ). The aerobic ex regime consisted of 7 consecutive days of treadmill jogging at 70% of peak oxygen uptake ( $VO_{2peak}$ ). The resistance ex regime consisted of 7 consecutive days of strength training the major muscle groups of the upper and lower extremity performing 3 sets of 10 repetitions corresponding to 70% 1 repetition maximum. At the beginning and end of 7 days of aerobic/resistance ex, serum samples of the subjects were incubated with cultures of prostate LNCaP tumor cells. The serum concentration of IGFBP-3 and the relative cell growth were measured.

**RESULTS:** Characteristics of age, body weight and height,  $VO_{2peak}$ , % body fat, and maximum leg strength were not significantly different across groups. Baseline serum concentration of IGFBP-3 was similar between the aerobic and resistance ex groups ( $.056 \pm .03$  vs.  $.056 \pm .01$  ng/ml). Further, baseline serum growth rate of the tumor cells were similar between groups ( $.51 \pm .09$  vs.  $.50 \pm .14$  %). We observed the tumor cell growth rate after aerobic and resistance ex tended to be lower (11% and 21%), but the difference was not significant. There was a tendency for similar increases in IGFBP-3 after aerobic and resistance ex.

**CONCLUSION:** Aerobic ex vs. resistance ex showed similar clinical directional findings for and increase in IGFBP-3 and decrement in prostate tumor cell growth rate. This study provides evidence suggesting aerobic ex and resistance ex are equally effective in possibly inhibiting the evolution of prostate cancer.

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**2069 Board #210 May 28 9:00 AM - 10:30 AM**  
**Comparison Of Peak Image Acquisition Characteristics Between Supine Bicycle And Treadmill Exercise Echocardiography**

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(No relationships reported)

Exercise echocardiography (EE) using supine bicycle (SB) or treadmill (TM) is widely used to diagnose coronary artery disease (CAD). Among the two exercise modalities, it is believed that peak exercise workload achieved with EE using SB is less when compared to EE using TM due to a lower peak exercise heart rate. Despite this, the limited studies comparing the two modalities directly have shown that EE with SB has better sensitivity and comparable specificity to EE with TM. The delay in peak exercise imaging acquisition (occasionally >30 seconds) with EE with TM, done at a time when the patient is no longer exercising and cardiac workload is decreasing, may be an explanation of this.

**PURPOSE:** In this study, we aim to compare the exercise workload characteristics at peak image acquisition (IA) between EE with SB and EE with TM in evaluating CAD. Method: We retrospectively assessed peak exercise and peak IA exercise workload of 173 consecutive patients who underwent EE either with SB or TM to evaluate CAD in our institute from January 2007 to August 2008. Of these exercise echocardiograms, 21 were with SB (age  $49 \pm 9$ ) and 152 were with TM (age  $49 \pm 14$ ). Result: At peak exercise patients who underwent EE with TM had higher HR as compared to EE with SB, but comparable rate pressure product, an index of oxygen consumption (RPP; HR x systolic BP). The mean delay in image acquisition of EE with TM was  $11 \pm 4$  seconds (no delay in SB). However, at peak IA, both HR and RPP were comparable between the two tests. (percentage of predicted HR to maximum predicted HR;  $83 \pm 9$  vs  $88 \pm 8$ %,  $P = 0.13$ , RPP;  $2,56 \pm 4.70$  vs  $2.47 \pm 5.37$   $10^3$  bpm-mmHg,  $P = 0.55$ ).

**CONCLUSION:** Our results show that at peak IA there was no difference in HR and there was a trend towards higher systolic BP in EE with SB as compared to EE with TM. This suggests that workload characteristics of EE with SB at actual IA is not inferior to EE with TM for evaluating CAD.

**2070 Board #211 May 28 9:00 AM - 10:30 AM**  
**Exercise And Cardiac Function In Children And Adolescents With Friedrich's Ataxia.**

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(No relationships reported)

Increased relative left ventricular wall thickness (IRWT) frequently occurs in individuals who have the autosomal disorder, Friedrich's Ataxia (FA).

**PURPOSE:** To examine cardiorespiratory function in children and adolescents (13.2±0.6 years, 20.1±3.7 BMI, M=23, F=22) who have FA.

**METHODS:** Cardiac output (Qt), stroke volume (SV), heart rate (HR) and maximum oxygen consumption (VO<sub>2</sub>) were measured at rest and during cycle ergometer tests to volitional exhaustion. Maximum a-VO<sub>2</sub> was calculated by dividing maximum VO<sub>2</sub> by maximum Qt. Cardiorespiratory data were obtained by open circuit spirometry and impedance cardiography.

**RESULTS:** 38 subjects (84%) had relative wall thicknesses that exceeded the index threshold of 0.40 for clinically significant IRWT (0.62±0.14), as determined by resting echocardiography. 7 subjects were without IRWT (0.34±0.04). Resting ejection fraction was (61±07%) in the youths with IRWT and (58±08%) without IRWT. Significant group differences in resting and maximum Qt, SV, HR, a-VO<sub>2</sub> or VO<sub>2</sub> were not observed. Maximum VO<sub>2</sub> was 755±275 mlO<sub>2</sub>/min and maximum a-VO<sub>2</sub> was 08±02 vol% for the entire sample. Cardiac function data for the entire sample is provided in the table.

Cardiac Function			
	Qt (ml/min)	SV (ml)	HR (beats/min)
Rest	6243±/- 2170	63±/-25	101±/-15
Maximum	10182±/- 3949	72±/-25	142±/-23

**CONCLUSION:** Compared to previous studies (Cooper, 1984; Vinet, 2002), maximum Qt, a-VO<sub>2</sub>, and VO<sub>2</sub> were markedly diminished in these youths with FA. SV failed to increase from rest to maximum exercise. The slight increase in Qt (p<0.0001) during exercise resulted almost entirely from the rise in HR (p<0.0001). Failure of SV to increase with strenuous exercise and decreased exercise capacity are often observed in patients who have severe left ventricular dysfunction.

**2071 Board #212 May 28 9:00 AM - 10:30 AM**  
**Changes In Heart Rate Recovery After High Intensity Training In Well-trained Cyclists**

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**PURPOSE:** Heart rate recovery (HRR) after submaximal exercise improves after training. However, it is unknown if this also occurs in already well-trained cyclists.

**METHODS:** Therefore, 14 well-trained cyclists (VO<sub>2max</sub> 60.3 ± 7.2 ml·kg<sup>-1</sup>·min<sup>-1</sup>; relative peak power output 5.2 ± 0.6 W·kg<sup>-1</sup>) participated in an 8 sessions of week high intensity training program. Before and after high intensity training performance was assessed with a peak power output test including respiratory gas analysis (VO<sub>2max</sub>) and a 40km time trial. HRR was measured after every high intensity training session and 40km time trial (HRR<sub>40km</sub>).

**RESULTS:** After the training period relative peak power output improved by 4.7% (P = 0.000010) and mean relative power in the 40km time trial improved by 6.2% (P = 0.000007). Both HRR<sub>HIT</sub> (7 ± 6 beats; P = 0.001302) and HRR<sub>40km</sub> (6 ± 3 beats; P = 0.023101) also improved significantly after the training period. Good relationships were found between improvements in HRR<sub>40km</sub> and improvements in relative PPO (r = 0.73; P < 0.0001) and 40km time trial time (r = 0.96; P < 0.0001).

**CONCLUSIONS:** In conclusion, HRR is a sensitive marker which tracks changes in training status in already well-trained cyclists and has the potential to have an important role in monitoring and prescribing training.

**2072 Board #213 May 28 9:00 AM - 10:30 AM**  
**Left Ventricle Performance by Longitudinal Peak Systolic Strain Measurement In Young Athletes With Bicuspid Aortic Valve**

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Purpose : Strain (S) is a measure of the regional and global heart function. S has a role in the identification of the myocardial dysfunction in presence of valvular disease. Bicuspid Aortic Valve (BAV) is a congenital cardiac disease, common in athletes where the EF maintains normal value . BAV is usually studied for the possible complications of the aortic tract however few data on the behaviour of the Left Ventricle (LV) in young are available. This study aims to evaluate if the measurement of S of LV adds any more information in BAV athletes with normal EF.

**METHODS:** Three groups aged 25 ± 3 (20 trained athletes with BAV, 20 healthy athletes and 20 sedentary healthy subjects) were submitted to an echocardiographic exam evaluating the traditional echo-parameters . From four chamber view, using X-Strain software included in the MyLab 50 echo ( Esa Ote -Italy) the Longitudinal Peak Systolic Strain ( LPSS) at basal and medium-apical segments of Lateral Wall ( LW) and Inter Ventricular Septum (IVS) of LV were calculated ( Fig 1).

**RESULTS:** The S values are within the normal and validated range in all the segments considered without any statistical differences among the three groups. However in BAV athletes, the S of basal segments of LV tends to be particularly lower creating a significant gradient from basal to apical regions (table 1). EF is normal for all groups.

**CONCLUSIONS:** The evaluation of S in LV chamber of young trained BAV athletes confirms the normal LV performance. Despite of this there is a tendency in BAV to show the values of S in LV basal segments lower than in healthy subjects. The clinical implication of this will require further investigations.

Table 1

	S %IVSbasal	S%IVSmed-apic	P	S%LWbasal	S%LWmed-apic	P
BAV	-17.7± 2.7	-21± 3.5	.001	-14.2± 2.2	-18.8± 4.2	.001
Athletes	-19.5 ±5.9	-17.71±3.8	NS	-19.05±4.0	-18.80±3.80	NS

Controls	-18.5±4.8	-17.7±3.96	NS	-20.28±2.9	-19.82 ±4.7	NS
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Legend: BAV (Bicuspid Aortic Valve); IVS (Inter Ventricular Septum); LW (Lateral Wall)

## 2073 Board #214 May 28 9:00 AM - 10:30 AM The Effect Of Acute Vs. Chronic Sodium Citrate Ingestion On 200m Time Trial Swimming Performance.

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(No relationships reported)

Ingestion of sodium bicarbonate is known to improve anaerobic exercise performance, probably via increased buffering of intracellular acidity. Other buffering agents have been used with some success. Sodium citrate is one such substance and has been used without the normal gastro-intestinal discomfort usually associated with sodium bicarbonate ingestion. However, an ideal ingestion protocol (acute vs. chronic) has yet to be determined for swimming.

**PURPOSE:** To determine an ideal sodium citrate ingestion protocol for swimming.

**METHODS:** Seven elite swimmers ingested the daily dose of sodium citrate (0.3g / kg body mass) 1.5hrs before the time trial on the performance day for both acute and chronic treatments. Additionally, for the chronic treatment sodium citrate was ingested each of the 4 days prior to the time trial day. Following a standard warm-up, participants were asked to swim a 200m freestyle time trial. In addition to performance time, measures of blood lactate, heart rate and perceived exertion were recorded at baseline, post warm-up, pre-race and post-race times. Measure of pH was recorded at baseline and pre-race.

**RESULTS:** There was no significant difference in final time between treatments (Acute: 125.4 (SD 7.1) sec, Chronic: 125.8 (SD 7.2) sec, Placebo: 125.7 (SD 8.1) sec,  $p < 0.05$ ). There was a significant increase over time for all treatments in pH (baseline to pre-race), blood lactate (pre-race to post-race), heart rate (pre-race to post-race) and perceived exertion (pre-race to post-race). There was no difference between acute, chronic and placebo at the various time points for blood lactate, heart rate and perceived exertion. There was a significant difference in pH level at the pre-race time point. The chronic and acute loading protocols were both different than placebo but were not different to each other (Acute: 7.46 (SD 0.02), Chronic: 7.47 (SD 0.02), Placebo: 7.41 (SD 0.02),  $p < 0.05$ ).

**CONCLUSION:** While both sodium citrate dose protocols altered blood pH they did not have a significant effect on final swim performance.

## 2074 Board #215 May 28 9:00 AM - 10:30 AM Application Of Athlete Monitoring System To Evaluate The Physical Capacity Of The Soccer Players

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(No relationships reported)

We have evaluated the physical capacity of the soccer players by using athlete monitoring system composed of the flexible patch type sensor module and the monitoring station.

**PURPOSE:** To evaluate the physiological responses during the shuttle run test were monitored and reliability and validity were analyzed for the effective and scientific training.

**METHODS:** To investigate the reliability, reproducibility was verified through test-retest and to evaluate its validity, correlation between results of the test and  $VO_{2max}$ , and relation between changes of the results of the test during pre-season training period, and relation between shuttle run test and performance in actual games were examined. Heart rate was measured, and blood lactate ( $N=13$ ) was obtained before, during, and after the shuttle run test in 27 high school soccer players. And they performed two to three seasonal tests during the pre-season training period, and the results were related to changes of the maximal oxygen uptakes measured in pre and post pre-season training. Additionally, 31 male professional soccer players performed two types of shuttle run test and each result was related to physical performance in matches.

**RESULTS:** The intra-individual difference between test and retest averaged within 5% of distance covered in 1<sup>st</sup> test. During the shuttle run test, heart rate and blood lactate increased ( $p < 0.05$ ) to  $90 \pm 3\%$  of peak heart rate and  $3.4 \pm 1.3$  mmol/L, respectively, after 67<sup>th</sup> repetitions. During the pre-season training period, players ( $N=15$ ) improved ( $p < 0.05$ ) distance covered in the test and maximal oxygen uptake ( $VO_{2max}$ ) by  $4 \pm 1\%$ , equally. In addition, heart rate after 67<sup>th</sup> repetitions at the start decreased ( $p < 0.05$ ) to  $3 \pm 1\%$  of HR peak at the end.

**CONCLUSIONS:** The shuttle run test had high reproducibility and sensitivity, allowing it to be a reliable method to evaluate the physical capacity of the players participated in the intermittent sports.

The  $VO_{2max}$  also increased during the pre-season training period as well as the shuttle run test performance. Especially, since the physiological response after the 67<sup>th</sup> repetition showed similar lactate threshold, we have found that measuring the heart rate right after the 67<sup>th</sup> repetition is as effective and valid as recording the test performance at the last repetition.

## 2075 Board #216 May 28 9:00 AM - 10:30 AM Elite America's Cup Sailors Are Among The Most Powerful Upper Body Trained Athletes

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(No relationships reported)

**BACKGROUND:** Big-boat yacht racing is one of the only able bodied sporting activities where standing arm-cranking ('grinding') is the primary physical activity. However, the physiological capabilities of elite sailors for standing arm-cranking have been largely unreported.

**PURPOSE:** To assess aerobic parameters,  $VO_{2peak}$  and lactate threshold ( $LT_4$ ), and anaerobic performance, torque- and power-crank velocity relationships and therefore peak power ( $P_{max}$ ) and optimum crank-velocity ( $w_{opt}$ ), of America's Cup sailors during standing arm-cranking.

**METHODS:** Thirty-three elite professional sailors performed a step test to exhaustion, and a subset of ten *grinders* performed maximal 7 s isokinetic sprints at different crank velocities, using a standing arm-crank ergometer.

**RESULTS:**  $VO_{2peak}$  was 4.7 (0.5) L/min (range: 3.6 to 5.5 L/min) at a power output of 332 (44) W (range: 235 to 425 W).  $LT_4$  occurred at a power output of 202 (31) W (61% of  $W_{max}$ ) and  $VO_2$  of 3.3 (0.4) L/min (71% of  $VO_{2peak}$ ). The torque-crank velocity relationship was linear for all participants ( $r=0.9$  (0.1)).  $P_{max}$  was 1420 (37) W (range: 1192 to 1617 W), and  $w_{opt}$  was 125 (6) rpm.

**CONCLUSIONS:** These data are among the highest upper-body anaerobic and aerobic power values reported. The unique nature of these athletes, with their high fat-free mass and specific selection and training for standing arm cranking, likely accounts for the high values. The influence of crank velocity on peak power implies that power production during on-board 'grinding' may be optimised through the use of appropriate gear-ratios and the development of efficient gear change mechanisms.

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**2076 Board #217 May 28 9:00 AM - 10:30 AM****Food And Body Composition Of Brazilian Male Swimmers**

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**PURPOSE:** The aim of the present study was to analyze body and diet composition of 19 male brazilian swimmers and compare these variables to the international dietary recommendations for macro and micronutrients.

**METHODS:** The sample was constituted by 19 swimmers (15 + 1,2y). Body composition was determined by body mass index- BMI (kg/m<sup>2</sup>), body circumferences (cm), skinfolds (mm) and body fat percentage was evaluated according to Slaughter. Food consumption (macronutrients and micronutrients) was analyzed and nutritional software Dietwin®.

**RESULTS:** Athletes present the following body composition averages: 17 + 4.1% of body fat; 175 + 6.5 cm of stature; 67 + 10.1 kg of body mass and 22 + 2 Kg/m<sup>2</sup> of BMI. Regarding food consumption, it was observed the following results of swimmers respectively, 3210.1 + 933.7 kcal; carbohydrate content 61.6 + 6.8%; protein content 29.5 + 45%; lipid content of 29.4 + 18.4%. It was also observed low calcium ingestion of 1115.6 + 295.1 mg/day. Regarding fluid replacement it was observed that 90% of the athletes uses carbohydrate supplement (maltodextrin) with 8% concentration but the daily water consumption was 70% lower than the recommendation for high performance activities.

**CONCLUSIONS:** The high consumption of lipids interferes not only in the quality of the feeding as well as in the performance of the athletes. The low ingestion of calcium emphasize the importance of the nutritional intervention in order to improve performance and prevent any future health problem.

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**2077 Board #218 May 28 9:00 AM - 10:30 AM****Pediatric Heart Rate And Vo<sub>2</sub> Relationships Compared To The ACSM Predicted Values**

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(No relationships reported)

**PURPOSE:** To establish a correlation between the observed percent maximal heart rate reserve (%MaxHRR), percent maximal VO<sub>2</sub> reserve (%MaxVO<sub>2</sub>R), and percent of maximal heart rate (%MaxHR) compared to the established adult values by the American College of Sports Medicine.

**METHODS:** 1087 patients (Male 548, Female 539) referred for evaluation of chest pain, syncope and exercise intolerance were evaluated by a maximal exercise test using the James cycle ergometer protocol. The patients were cleared of structural heart disease by echocardiograph and/or physical examination and history. All exercise tests were maximal efforts. Patient demographics were: Age 14.4 years old (±3.4), Height 1.62 meters (±0.14), Weight 59kg (±18.38), and Body surface area 1.61m<sup>2</sup> (±0.30).

**RESULTS:** The maximal heart rate (MHR) was 192 beats per minute (±11). The maximal oxygen uptake, indexed maximal oxygen uptake and respiratory quotient was 2122 ± 681cc/min, 37 ± 7cc/kg/min and 1.14 ± 0.08, respectively. The observed exercise values for %MaxHR were significantly higher than the ACSM predicted values at 40%, 50%, 60%, 80% and 85% Max VO<sub>2</sub> levels. Additionally, %MaxHRR and %MaxVO<sub>2</sub>R were equivalent up to the 80% MaxVO<sub>2</sub> level at which time %MaxHRR was significantly higher.

	40%Max VO <sub>2</sub>	50%Max VO <sub>2</sub>	60%Max VO <sub>2</sub>	80%Max VO <sub>2</sub>	85%Max VO <sub>2</sub>
ACSM predicted %Max HR	55	62	70	85	90
Observed %Max HR	*61 ± 7	*67 ± 7	*75 ± 7	*89 ± 6	*92 ± 5
Observed %Max HRR	30 ± 10	39 ± 11	54 ± 13	*79 ± 10	*85 ± 10
Observed %Max VO <sub>2</sub> R	30 ± 4	41 ± 4	53 ± 4	77 ± 2	82 ± 2

\*P<0.001

**CONCLUSION:** The observed values for %MaxHR are significantly higher in pediatrics compared to the predicted values by the ACSM. Additionally, %MaxHRR and %MaxVO<sub>2</sub>R were equivalent up to the 80% MaxVO<sub>2</sub> level at which time %MaxHRR was significantly higher. When developing an exercise prescription for pediatric patients, development of percent maximal values must be based on pediatric standards.

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**2078 Board #219 May 28 9:00 AM - 10:30 AM****Effect Of Anti-Parkinson Drug Timing On Tissue Oxygen Saturation And Ventilatory Threshold During Treadmill Exercise**

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(No relationships reported)

Treadmill training is recognized as an effective therapy for individuals with Parkinson disease (PD). Treadmill training guidelines and physiological responses are not conclusive in this population especially related to the peaks and valleys of the primary PD medications [dopamine agonists (DA)].

**PURPOSE:** To determine if timing of DA affects the relationships between tissue oxygen saturation (StO<sub>2</sub>), ventilatory threshold (VT) and ratings of perceived exertion (RPE) during treadmill exercise.

**METHODS:** Nine individuals (6M, 3F; mean age 77.3 ± 5.1 years) diagnosed with PD, participating in treadmill training, were recruited. All participants completed one familiarization session along with two data collection sessions; one session at high and one session at low DA efficacy. A ramp treadmill protocol (increased 0.1 mph every 30 seconds with 0% elevation) was conducted to submaximal endpoints corresponding to participants RPE of hard to very hard exertion. Cerebral and skeletal muscle StO<sub>2</sub> measurements were obtained with frequency-domain near infrared spectroscopy (NIRS). The time of initial sustained change in StO<sub>2</sub> from baseline; and mean change in percent StO<sub>2</sub> at RPE of somewhat hard, RPE of hard, and at test end, were identified. VT was assessed using the V-slope method with ventilatory equivalents for O<sub>2</sub> and CO<sub>2</sub> used for confirmation.

**RESULTS:** There was no significant difference in time to initial change in StO<sub>2</sub> (387.89 ± 61.46 vs. 371.22 ± 69.87 seconds), mean change in StO<sub>2</sub> at RPE somewhat hard (-3% ± 1.4 vs. -1.4% ± 1.0), mean change of StO<sub>2</sub> at RPE hard (-4% ± 1.6 vs. -3.5% ± 1.3), or mean change of StO<sub>2</sub> at test end (-5.1% ± 1.9 vs. -4.2% ± 1.6), relative to DA timing at peak vs. valley respectively. Cerebral StO<sub>2</sub> remained stable throughout exercise and was not affected by DA timing. VT was attained at peak DA timing in five individuals however only two of the five attained a VT at valley DA timing. Four individuals did not attain an identifiable VT during either DA peak or valley.

**CONCLUSION:** The results of this study suggest DA timing does not significantly affect changes in StO<sub>2</sub>, either in cerebral tissue or skeletal muscle during submaximal



treadmill exercise. In addition, the use of VT to guide exercise intensity prescription may be of limited value in individuals with PD.

Funded by: Concordia Intramural Research Grant

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**2079 Board #220 May 28 9:00 AM - 10:30 AM**

**Effects Of Cessation Of An Exercise Program On Lean Mass And Physical Performance In Burns.**

Haidy Rivero, Fatemah Emdad, David N. Herdon, Marc G. Jeschke, Ronald Mlcak, Oscar E. Suman, FACS. *Shriners Hospital / University of Texas Medical Branch, Galveston, TX.*

(No relationships reported)

The posttraumatic response to severe burns leads to marked and prolonged skeletal muscle catabolism and weakness. Previous studies have shown that participation in a standard rehabilitation program supplemented with an exercise program results in significant improvements in muscle strength (MST), lean body mass (LBM) and cardiopulmonary capacity (VO2) relative to a standard of care rehabilitation program without exercise.

**PURPOSE:** To determine if in severely burned children, these benefits are maintained 9 to 15 months (18 or 24 months post-burn) after cessation of the exercise program.

**METHODS:** We assessed leg MST, LBM and VO2 in children with  $\geq 40\%$  total body surface area burns. Patients were randomized to a 12-wk hospital rehabilitation program supplemented with an exercise training program (EX; n=44) or to a standard of care home-based rehabilitation program without exercise (SOC; n=34). Leg MST was assessed using dynamometry; LBM was determined using dual-energy X-ray absorptiometry, and VO2 was assessed using indirect calorimetry. Assessments were made 4 to 6 months post-burn, which corresponded with the period immediately before the 12 weeks exercise program, and at 18-24 months post-burn. Results are expressed as means  $\pm$  SEM, and significance accepted at  $p \leq 0.05$

**RESULTS:** MST, LBM, and VO2 significantly increased in the EX group after the exercise program ( $74 \pm 16\%$ ,  $20 \pm 3\%$ , and  $29 \pm 9\%$  respectively). In contrast, in the SOC group, MST and VO2 did not significantly increase ( $26 \pm 7\%$ , and  $5 \pm 22\%$ , respectively), while LBM significantly increased by  $13 \pm 3\%$ . Although, no significant differences were found between the EX and the SOC groups, absolute values for MST, LBM and VO2 at 18-24 months were consistently higher in the EX group

**CONCLUSION:** The effectiveness of an exercise program has been previously demonstrated in burned children. However, after the cessation of the physical activity, these exercise-induced benefits are diminished. Our results suggest the need for establishing long term rehabilitation goals, and continued education in maintaining an active and healthy lifestyle by children with severe burns.

Grant Info: Shriners Hospitals (8760), National Institute for Disability and Rehabilitation Research (H133A70019), National Institutes of Health (R01-HD049471, P50-GM60338, T32GM008256).

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**2080 Board #221 May 28 9:00 AM - 10:30 AM**

**Neck Muscle Training Effects On Balance In Patients With Cervical Spondylosis Related Chronic Neck Pain**

Yi-Jia Lin<sup>1</sup>, Cheng-Hsiu Lai<sup>1</sup>, Meng-Ju Tsai<sup>1</sup>, Yi-Liang Chen<sup>1</sup>, Chia-Hua Kuo<sup>1</sup>, Shih-Wei Chou<sup>2</sup>. <sup>1</sup>Taipei Physical Education College, Taipei, Taiwan.

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(No relationships reported)

Through cervical mechanoreceptors and their connections to sensory systems, neck provides inputs which are responsible to balance. Balance disturbances were found in patients with chronic neck pain, especially in challenging tasks. Neck muscle training help improve neck function in patients with chronic neck pain.

**PURPOSE:** The current study was to evaluate effect of neck muscle training on balance in patients with cervical spondylosis related chronic neck pain.

**METHODS:** 18 patients with chronic neck pain were recruited. X-ray of their cervical spines revealed nonspecific spondylosis. Six of them (age:  $53 \pm 5$  years) had completed 12 times training sessions, including warm-up, stretching, strengthening, and neuromuscular control exercises. A SMART Balance Master was employed to acquire equilibrium scores of sensory organization test (SOT) under 6 conditions, including eyes open & fixed support (EO), eyes closed & fixed support (EC), sway-referenced vision & fixed support (SV), eyes open & sway-referenced support (SS), eyes closed & sway-referenced support (ECSS), and sway-referenced vision & support (SVSS). Visual analog scale (VAS) of neck pain, range of motion (ROM) and isometric strength were measured and compared pre- post- intervention using paired t test.

**RESULTS:** After neck muscle training, neck pain, ROM, and strength were all improved. Equilibrium scores were significantly higher in EO ( $94.3 \pm 1.1$  vs.  $95.6 \pm 1.1$ ), EOSS ( $83.4 \pm 5.8$  vs.  $87.0 \pm 5.0$ ), ECSS ( $61.3 \pm 16.7$  vs.  $70.1 \pm 9.4$ ), and SVSS ( $64.7 \pm 6.0$  vs.  $78.5 \pm 4.4$ ). Visual ratio ( $0.88 \pm 0.05$  vs.  $0.91 \pm 0.04$ ) and vestibular ratio ( $0.65 \pm 0.18$  vs.  $0.73 \pm 0.10$ ) were increased.

**CONCLUSION:** In the patients with cervical spondylosis related chronic neck pain, neck muscle training may help reduce neck pain, improve ROM and strengthen neck muscle, that is, neck function improved. As a result, balance performance was improved in SOT. Visual and vestibular sensory ratio, which reflect the ability to use respective sensory systems, were improved after neck function improved.

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**2081 Board #222 May 28 9:00 AM - 10:30 AM**

**Effect Of Continuous Positive Airway Pressure Treatment On Physical Activity In Obstructive Sleep Apnea Patients**

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(No relationships reported)

Obstructive Sleep Apnea (OSA) is a disorder affecting an estimated 15 million adult Americans, and contributes to an increased risk for hypertension, diabetes mellitus, cardiovascular morbidity and mortality. Excessive daytime sleepiness (EDS), which negatively impacts physical activity (PA) levels, is a cardinal symptom of OSA. Previous reports utilizing subjective measurements have suggested that untreated OSA patients engage in less PA than the average adult. Continuous positive airway pressure treatment (CPAP) has been shown to improve EDS, but its impact on PA has not been examined.

**PURPOSE:** Pilot study to evaluate whether CPAP positively impacts objectively measured PA in newly diagnosed OSA patients under usual care, through a decrease in EDS symptoms.

**METHODS:** Six men (Mean age  $\pm$  SD =  $49.3 \pm 6.6$  years, BMI  $35.1 \pm 5.7$  kg/m<sup>2</sup>) with moderate-to-severe OSA underwent anthropometric measurements and body composition analysis via dual energy x-ray absorptiometry at baseline and following 8 weeks of CPAP treatment. The Actigraph GTIM accelerometer was used to measure PA for 7 consecutive days at baseline and at follow-up.

**RESULTS:** EDS decreased significantly with CPAP treatment from baseline to follow-up, measured by Epworth Sleepiness Scale ( $12.0 \pm 5.2$  vs.  $7.2 \pm 5.0$ ). Baseline steps/day ( $6713 \pm 1549$  steps/day) were in the low active classification and were unchanged at follow-up ( $6385 \pm 1083$ ). Total activity counts also did not change ( $227636 \pm 68003$  vs.  $220169 \pm 40471$ ). Average minutes performing light and moderate intensity PA at baseline were  $121.1 \pm 37.9$  and  $15.3 \pm 5.6$  min, respectively, and did not change with treatment. No subject performed vigorous intensity PA. Body composition measures were unchanged.

**CONCLUSION:** Results suggest that 8-weeks of CPAP treatment did not elicit changes in PA levels despite a decrease in EDS symptoms. Measured objectively, OSA patients engage in low levels of PA, below the recommended amounts. Lack of change in PA may be due to seasonal influences, the relatively short CPAP evaluation period, and adherence to CPAP treatment. More targeted interventional strategies to increase PA in OSA patients may be needed to achieve recommended levels of PA for health enhancement.

Supported by a grant from ResMed Sleep Disordered Breathing Foundation, Poway, CA.

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**2082 Board #223 May 28 9:00 AM - 10:30 AM**  
**Factors Influencing Exercise Capacity in Obstructive Sleep Apnea Syndrome Patients**

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(No relationships reported)

Overweight is a prominent comorbidity associated with obstructive sleep apnea syndrome (OSAS). Previous studies have concluded that exercise capacity is reduced in patients with OSAS; however, these findings have only been determined in the context of overweight or obesity. Therefore, there is uncertainty whether OSAS, in the absence of excess body mass, limits exercise capacity or modifies physiologic responses important to clinical applications of exercise testing.

**PURPOSE:** To evaluate the influence of body fat or OSAS presence as the main contributing factor to low exercise capacity.

**METHODS:** Subjects were sedentary healthy men assigned to groups, according to BMI and OSAS presence: normal weight-OSAS (n = 10), normal weight-noOSAS (n = 17), overweight-OSAS (n = 20) and overweight-noOSAS (n = 22). Unattended home monitoring using a portable diagnostic device was performed to evaluate for OSAS. Body composition was measured with dual-energy X-ray absorptiometry. Subjects completed a maximal ramping cycle test to determine oxygen consumption ( $\dot{V}O_2$ ), minute ventilation (VE), and respiratory exchange ratio (RER).

**RESULTS:** There were no significant VE and RER differences between groups at sub-maximal or peak exercise level ( $p > 0.05$ ). Two-way ANOVA showed that in OSAS subjects, being overweight decreases exercise capacities at peak and sub-maximal exercise levels beginning at 85W. On the other hand, OSAS presence did not influence  $\dot{V}O_2$  levels. Stepwise linear regression using peak  $\dot{V}O_2$  as the dependent variable and selected independent measures as predictors [BMI, central fat (CF), apnea-hypopnea index, resting heart rate and blood pressures] showed that CF itself predicted 45% of the variation in peak  $\dot{V}O_2$ .

**CONCLUSIONS:** Published data has demonstrated that reduced exercise capacity in OSAS patients is largely due to factors associated with the pathophysiology of the disorder. However, our findings suggest that in young, healthy adult males, fat accumulation is responsible for exercise limitations in OSAS patients. Mediating mechanism contributing to decreased  $\dot{V}O_2$  in OSAS patients have yet to be clarified, but these data strongly suggest that decrements in maximal exercise capacity, typically reported in the literature, are a function of excess body fat, rather than OSAS, per se.

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**2083 Board #224 May 28 9:00 AM - 10:30 AM**  
**Intensity And Energy Expenditure Of Sports In Elite Paralympic Athletes With Locomotor Disabilities**

Marco Bernardi<sup>1</sup>, Maria Rosaria Squeo<sup>2</sup>, Fabio Faiola<sup>2</sup>, Federico Egidi<sup>2</sup>, Vincenzo Castellano<sup>3</sup>, Yagesh Bhambhani<sup>4</sup>. <sup>1</sup>Sapienza, University of Rome; Comitato Italiano Paralimpico, Rome, Italy. <sup>2</sup>Sapienza, University of Rome, Rome, Italy. <sup>3</sup>Fondazione Santa Lucia, Rome, Italy. <sup>4</sup>University of Alberta, Edmonton, AB, Canada.  
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(No relationships reported)

**INTRODUCTION:** Evaluating the physiological responses of athletes in the competitive environment is important for designing appropriate training programs.

**PURPOSE:** To examine the relationships between field test (oxygen consumption -  $\dot{V}O_2$ ) and laboratory aerobic fitness performance in elite Italian Paralympic athletes participating in the following five sports: 5k wheelchair distance racing (WR, N = 5), wheelchair basketball (WB, N = 13), wheelchair tennis (WT, N = 3), wheelchair fencing (WF, N = 6) and 5k nordic sit skiing (NS, N = 5).

We hypothesized that during these field tests, athletes would attain average intensity levels close to or higher than their individual ventilatory thresholds (VT).

**METHODS:** Each athlete completed an incremental arm cranking exercise test to determine VT from respiratory gas exchange measurements and  $\dot{V}O_{2peak}$ . In a subsequent session, to assess energy expenditure (EE) in their respective sport (these intensities are usually similar to those of training), field tests were carried out measuring  $\dot{V}O_2$ , carbon dioxide production and heart rate (HR) using a telemetric system.

**RESULTS:** Athletes of the five sport groups showed no differences in functional class (disability level). There were no significant differences in  $\dot{V}O_{2peak}$  values ( $49.8 \pm 6.77$  ml kg<sup>-1</sup> min<sup>-1</sup>), EE ( $11.9 \pm 1.44$  METS) and HR ( $175 \pm 8.4$  beats min<sup>-1</sup>) between WR and NS athletes. All these values were significantly higher compared to the athletes in the other three sport groups ( $\dot{V}O_{2peak}$ :  $35.4 \pm 4.49$  ml kg<sup>-1</sup> min<sup>-1</sup>, EE  $7.3 \pm 0.86$  METS and HR:  $151 \pm 13.4$  beats min<sup>-1</sup>). Work intensities, expressed as percentages of VT and  $\dot{V}O_{2peak}$ , were also significantly higher in WR and NS athletes ( $117.9 \pm 10.94$  %VT and  $82.4 \pm 4.61$  % $\dot{V}O_{2peak}$ ) than in WB, WF and WT athletes ( $103.8 \pm 5.01$  %VT and  $72.7 \pm 5.01$  % $\dot{V}O_{2peak}$ ). The  $\dot{V}O_2$  during the field tests showed strong relationships with both VT ( $R^2 = 0.842$ ) and  $\dot{V}O_{2peak}$  ( $R^2 = 0.898$ ).

**CONCLUSIONS:** These findings suggest that: (1) enhancing the VT and peak aerobic power in these athletes with disabilities would be of considerable importance in improving competitive sport performance; (2) greater aerobic energy demands and intensity levels during both competitive sport and training seem to be effective in increasing both these aerobic fitness variables.

Supported by Italian Ministry of Health (2007-3).

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**C-42 Free Communication/Poster - Supplements I**

MAY 28, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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**2084 Board #225 May 28 8:00 AM - 9:30 AM**  
**Effects Of Fenugreek, Cinnamon, & Curcumin On Post Workout Inflammatory Response.**

Colin D. Wilborn<sup>1</sup>, Lem W. Taylor<sup>1</sup>, Clifffa A. Foster<sup>1</sup>, Trevor Swift<sup>1</sup>, Courtney Burken<sup>1</sup>, Maggie Florez<sup>1</sup>, Chris Poole<sup>1</sup>, Brandon Bushey<sup>1</sup>, Richard B. Kreider, FACSM<sup>2</sup>, Daryn S. Willoughby, FACSM<sup>3</sup>. <sup>1</sup>University of Mary Hardin Baylor, Belton, TX. <sup>2</sup>Texas A&M University, College Station, TX. <sup>3</sup>Baylor University, Waco, TX.  
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(C.D. Wilborn, Indus Biotech, Contracted Research.)

It has been documented that strenuous exercise suppresses cellular immunity leading to increased susceptibility to infections and delayed recovery. As mediators of these phenomena, cytokines released into the circulation have been a recent focus of attention.

**PURPOSE:** To assess the acute effectiveness of fenugreek, cinnamon, & curcumin on blunting inflammatory markers after muscle damage.

**METHODS:** Twenty healthy non-resistance trained male and female subjects were equally divided by gender and assigned to ingested either a proprietary blend of fenugreek, cinnamon, & curcumin (N = 10,  $21 \pm 2.8$  yrs,  $174 \pm 10$  in,  $77 \pm 20$  kg) or placebo (N = 10,  $20 \pm 1.9$  yrs  $175 \pm 14$  in,  $89 \pm 20$  kg). Subjects ingested 450 mg of either active supplement (400mg fenugreek, 25mg cinnamon, 25mg curcumin) or 450 mg of placebo for 14 days prior to the damage bout. Subjects were instructed to warm-up briefly and subsequently perform 24 sets of 10 eccentric knee extensor repetitions with one leg at 30°/s on an isokinetic device. Subjects had their blood drawn at baseline, immediately post, 1hr, 3hr, and 24hr post damage. Serum samples were analyzed for IL 1b, IL1ra, IL6, TNFa and CRP levels using a multiplex bead based assay. Data were analyzed by a

two-way ANOVA with repeated measures ( $p < 0.05$ ).

**RESULTS:** Significant ( $p < 0.05$ ) main effects for time were observed for the inflammatory markers IL 1b, IL1ra, & IL6, although there were no significant ( $p > 0.05$ ) interactions. However, a significant trend for interaction was observed for IL 6 ( $p = 0.06$ ) & IL1ra ( $p = 0.09$ ). Post hoc analysis revealed a significant difference immediately post damage in IL 1ra where active group was significantly lower than the placebo group ( $p < 0.05$ ) and a significant difference at 1hr & 3hr post damage IL6 where active was significantly lower ( $p < 0.05$ ) than placebo.

**CONCLUSION:** These results indicate that the protocol used induced significant ( $p < 0.05$ ) systemic inflammation. The experimental proprietary blend showed some positive anti-inflammatory effects as illustrated by a significantly ( $p < 0.05$ ) lower inflammatory response in IL1ra and IL 6 by 3hr post damage. It is concluded that fenugreek, cinnamon, and curcumin have potential anti-inflammatory properties and that they significantly reduced the onset of inflammation in response to muscle damage.

*This study was funded by Indus Biotech.*

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**2085 Board #226 May 28 8:00 AM - 9:30 AM**  
**Fenugreek Extract Supplementation Has No Effect On The Hormonal Profile Of Resistance-trained Males**

Lem W. Taylor<sup>1</sup>, Colin D. Wilborn<sup>1</sup>, Brandon Bushey<sup>1</sup>, Chris Poole<sup>1</sup>, Cliffla A. Foster<sup>1</sup>, Bill Campbell<sup>2</sup>, Richard B. Kreider, FACSM<sup>3</sup>, Darryn S. Willoughby, FACSM<sup>4</sup>. <sup>1</sup>University of Mary Hardin-Baylor, Belton, TX. <sup>2</sup>University of South Florida, Tampa, FL. <sup>3</sup>Texas A&M University, College Station, TX. <sup>4</sup>Baylor University, Waco, TX.  
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(No relationships reported)

Fenugreek is herb that has several purported uses in animal models. Despite no substantiated claims in human research models, fenugreek has been marketed in dietary products as having anabolic potential for resistance trained athletes.

**PURPOSE:** The purpose of this study was to investigate the potential anabolic effects of fenugreek extract supplementation in conjunction with a controlled resistance training program.

**METHODS:** Forty-five resistance trained males were matched by fat free mass and randomly assigned to ingest in a double blind manner capsules containing 500mg of a placebo (PL) (N = 24, 20.1  $\pm$  2.6 yr, 85.5  $\pm$  13.4 kg, 177.00  $\pm$  6.1 cm) or fenugreek extract (FE) (N = 21, 21.4  $\pm$  2.95 yr, 89.9  $\pm$  18.8 kg, 178.00  $\pm$  6.27 cm). Subjects participated in a supervised 4-day per week periodized resistance-training program for 8 weeks in conjunction with supplementation. Venous blood samples were obtained using standard procedures at baseline (PRE), 4 weeks, and 8-weeks (POST). Serum analyses included cortisol, insulin, leptin, free testosterone, estrogen, and DHT. Statistical analyses utilized a two-way ANOVA with repeated measures for serum hormone responses ( $p < 0.05$ ).

**RESULTS:** A significant interaction ( $p < 0.05$ ) between groups for DHT was observed for PL (PRE: 1187 $\pm$ 482; POST: 1258 $\pm$ 493 pg/ml) and FE (PRE: 1263 $\pm$ 496; POST: 1144 $\pm$ 447 pg/ml) indicating that supplementation resulted in significant decrease in DHT levels. Significant differences in DHT responses from supplementation showed a -9.42% change for the FE group accompanied with a 5.98% increase in the PL group. No significant effects for groups or interactions were observed for the anabolic hormones free testosterone and estrogen ( $p < 0.05$ ). Additionally, no significant main effects for groups or time were observed for the metabolic hormones insulin, cortisol, and leptin ( $p < 0.05$ ).

**CONCLUSIONS:** Supplementation of fenugreek extract resulted in a decrease in serum DHT levels in comparison to placebo. However, other anabolic and metabolic hormone analyses were not affected by supplementation. We conclude that in conjunction with structured resistance training, supplementation of fenugreek extract does not appear to affect hormonal status in resistance trained males and shows no anabolic potential as has been purported.

*This study was Supported by INDUS BIOTECH*

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**2086 Board #227 May 28 8:00 AM - 9:30 AM**  
**Pre-exercise Supplementing Lower Dose Of Soy Peptide Suppresses Serum Creatine Kinase Elevation In Soccer Players**

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(No relationships reported)

Amino acids supplementation is effective not only to improve sport performance but also preservation of athletes' physical conditions. Many studies which investigated effects of amino acids supplementation usually adopt high dose of amino acids, whereas effects of lower dose of amino acids intake are still unclear. Pre-exercise intake of lower amounts of peptide form of amino acids, which can be more rapidly and efficiently absorbed than amino acids itself, may have positive effects on athletes' conditioning especially during in-season.

**PURPOSE:** To investigate the effects of pre-exercise supplementation with lower dose of soy peptide on serum creatine kinase (CK) level and psychological fatigue in soccer players through in-season. **METHOD:** Sixteen Japanese collegiate soccer players volunteered to participate in this study which was carried out in double-blind manner. The subjects were divided into two groups of soy peptide (SP) group (N=8, age; 19.1  $\pm$  0.6 yrs, height; 174.3  $\pm$  4.8 cm, weight; 65.6  $\pm$  3.5 kg), and placebo (PI) group (N=8, age; 19.6  $\pm$  1.4 yrs, height; 172.3  $\pm$  6.3 cm, weight; 66.8  $\pm$  5.9 kg). SP group was instructed to take 4,000 mg/day of soy peptide supplement one hour prior to matches or training sessions for 8 weeks, while PI group was administered placebo which was mainly composed of isocaloric dextrin powders. To assess physical and psychological aspects of the players' condition, serum CK level and profile of mood states (POMS) were utilized as conditioning parameters. These parameters were measured before and during the intervention period.

**RESULTS:** Serum CK level of SP group was significantly lower than that of PI group at the 5<sup>th</sup> week (194  $\pm$  115 vs. 355  $\pm$  143 U/L,  $p < 0.05$ ), and statistically lower trends were also observed at the 1<sup>st</sup> (248  $\pm$  108 vs. 426  $\pm$  235 U/L,  $p = 0.07$ ) and 8<sup>th</sup> week (220  $\pm$  134 vs. 506  $\pm$  411 U/L,  $p = 0.08$ ). There were no significant differences in fatigue scores of POMS.

**CONCLUSION:** Pre-exercise supplementation with 4,000 mg/day of soy peptide can suppress elevations of serum CK level, but did not affect on subjective fatigue level in soccer players through 8 weeks of in-season.

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**2087 Board #228 May 28 8:00 AM - 9:30 AM**  
**Effect Of The Hyperimmune Egg Supplement On Indices Of Mood State And Quality Of Life**

Johannes D. Aartun<sup>1</sup>, Tyler D. Martin<sup>2</sup>, Benjamin M. Carr<sup>3</sup>, Michael J. Webster, FACSM<sup>3</sup>, Timothy P. Scheett<sup>1</sup>. <sup>1</sup>College of Charleston, Charleston, SC. <sup>2</sup>Troy University, Troy, AL. <sup>3</sup>The University of Southern Mississippi, Hattiesburg, MS.  
(No relationships reported)

Hyperimmune egg (HIE) protein is a powdered, pure egg product derived from chicken hens immunized with more than 26 killed pathogens of human origin. Anecdotal evidence suggests HIE supplementation enhances mood and overall quality of life.

**PURPOSE:** The purpose of this project was to determine if supplementation with HIE for 10 days resulted in any alteration in the subscales from the POMS and HRQL.

**METHODS:** Recreationally active males (n=24) aged 23.6  $\pm$  0.8 yrs, height 176  $\pm$  2 cm, mass 69.2  $\pm$  0.6 kg and 17.1  $\pm$  1.5 % body fat were randomly assigned to either HIE (n=12) or an egg protein placebo (PLA) group. Participants abstained from their regular exercise routine for the duration of the study and were supplemented with 4.5 g $\cdot$ d<sup>-1</sup> for 2 d, 9 g $\cdot$ d<sup>-1</sup> for 2 d and 13.5 g $\cdot$ d<sup>-1</sup> for 6 d. POMS and HRQL questionnaires were administered on Days 1, 8, 10 and 12. On days 1, 8 and 10, participants performed an exercise performance test battery. ANCOVA was used to determine significant differences between or within the groups during the 10 d of supplementation with initial differences between groups serving as a covariate. Significance was set at  $\alpha = 0.05$ .

**RESULTS:** Anger/Hostility subscale significantly decreased in HIE from Day 1 to Day 10 (-28%;  $p<0.05$ ). Pain subscale significantly decreased in HIE from Day 1 to Day 12 (-83%;  $P<0.05$ ) and was also significantly lower than PLA on Day 12 (-84%).

**CONCLUSIONS:** The data suggest that oral supplementation of hyperimmune egg for 10 d resulted in positive alterations in the subscales of Pain, Positive Effect, Depression, and Anger/Hostility. These alterations are likely a result of HIE's ability to enhance muscle repair and recovery time from prior exercise.

Support provided by the Undergraduate Research and Creative Activities Program at the College of Charleston, Charleston, SC, and Legacy for Life, LLC, Melbourne, FL.

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**2088 Board #229 May 28 8:00 AM - 9:30 AM**  
**Effect Of Avenanthramide Supplementation On Responses To Eccentric Exercise In Young Women**

Ryan Koenig, Jonathan Dickman, Emily Church, Robert Umfress, Li Li Ji, FACSM. *University of Wisconsin-Madison, Madison, WI.*

(No relationships reported)

Avenanthramides (AVA) are a group of nitrogen-containing diphenolic phytochemicals found exclusively in oats that have exhibited antioxidant and anti-inflammatory potential in vitro and in rodents; however, the effects of chronic AVA consumption in humans have been unexplored.

**PURPOSE:** To investigate the effects of 8 weeks of AVA supplementation on the inflammatory and oxidative responses to a single bout of downhill running in college-aged women.

**METHODS:** Ten women aged 18-29 yr were randomly assigned to receive cookies fortified with either high-AVA (23.5 mg/day) oat flour (O, Ceapro Inc., Canada) or with equal content of wheat flour as a placebo (PL). They were instructed to eat one 115 g cookie per day for 8 wks, during which dietary and physical activity levels were recorded. Before and after the supplementation period, subjects ran on a treadmill at -9% grade at a speed that elicited 75% of their maximal heart rate for 4 x 15 min bouts with 3 rest intervals of 5 min each. Blood samples were collected before and immediately and 24-h post exercise.

**RESULTS:** There was no difference in pain and soreness ratings between O and PL groups post-exercise. During the post-supplementation test, O showed a higher plasma reduced to oxidized glutathione ratio ( $P<0.05$ ) at 24 h post-exercise vs. PL group. Red blood cell (RBC) glutathione peroxidase activity decreased ( $P<0.05$ ) immediately after exercise in O, but not in PL. RBC superoxide dismutase activity was higher ( $P<0.05$ ) in O vs. PL post-exercise. There were trends toward lower plasma tumor necrosis factor (TNF)-alpha levels and white blood cell reactive oxygen species production in O compared to PL immediately and 24-h after exercise.

**CONCLUSIONS:** High-AVA oat supplementation appears to attenuate downhill exercise-induced oxidative stress and blood inflammatory markers in college-aged women.

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**2089 Board #230 May 28 8:00 AM - 9:30 AM**  
**Resveratrol Supplementation, Immunological Indices And Total Antioxidant Capacity In Athletes.**

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(No relationships reported)

Intense exercise can promote biochemical changes, which involve reactions in the immunological system and reactive oxygen species (ROS) generation. Maintenance of cellular redox homeostasis requires a balance between the generation rate of ROS and the capacity of the antioxidant system. Organisms have developed a sophisticated antioxidant system for protection against ROS. Several food components have antioxidant function such resveratrol, a stilbene polyphenol found in grapes and wine, a potent antioxidant through a cytoprotection action.

**PURPOSE:** The aim of the present study was to evaluate the response to resveratrol intake of total antioxidant capacity (TAC) and immunological capacity in young basketball players.

**METHODS:** The athletes ( $n=8$ ;  $17\pm1$  y) ingested resveratrol capsules (25mg) during 30d. For each athlete, a blood sample was obtained before (T0) and after (T1) resveratrol intake. TAC was measured in plasma by scavenging of 1,1-diphenyl-2-picrylhydrazyl (DPPH). Leukocytes (LEU), monocytes (MON), eosinophils (EOS) and lymphocytes (LYM) were analyzed by using an electronic hematology analyzer (Cell-Dyn/ Cobas Vega). Statistical comparison of indices was done by paired t-test. Significant levels were established at  $p<0.05$ .

**RESULTS:** Total body mass and height did not change during the study ( $75\pm10$ kg;  $189\pm9$ cm, respectively). TAC was similar in T0 ( $16.1\pm4\%$  reduction) when compared with T1 ( $17\pm3\%$  reduction). However, immunological cell counts ( $\text{cell}\cdot\mu\text{L}^{-1}$ ) were significantly higher in T0 when compared with T1 after resveratrol intake (LEU-  $6.4\pm1$  to  $5.4\pm2$ ,  $p=0.05$ ; MON-  $0.65\pm0.2$  to  $0.45\pm0.1$ ,  $p=0.007$ ; EOS-  $0.27\pm0.02$  to  $0.18\pm0.02$ ,  $p=0.003$ ; LYM-  $2.4\pm0.4$  to  $2.0\pm0.7$ ,  $p=0.008$ ).

**CONCLUSION:** Resveratrol intake beneficially affects immunological indices reducing inflammatory process, TAC did not change after supplement use, possibly by the strong anti-inflammatory resveratrol function.

Support by: FAPERJ E26/171.257/2006.

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**2090 Board #231 May 28 8:00 AM - 9:30 AM**  
**The Effects Of Propolis Supplementation And Acute Exercise On Inflammatory Makers And Immunity**

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An excessive exercise brings about increase in acute inflammatory caused by chronic heart disease and decrease of function in immunity. The main components of propolis are polyphenol and flavonoid which are known to play a role of antifungal, anti-inflammatory, immune system, and anti-cancer.

**PURPOSE:** To investigate the effects of propolis supplementation and Acute exercise on acute inflammatory makers and immunity in middle aged women.

**METHODS:** Twenty four health women (mean  $\pm$  SE: age  $28.96\pm3.33$ yr, height  $166.96\pm4.06$ cm, weight  $57.42\pm5.28$ kg, body fat  $13.45\pm3.13$ kg) were randomly assigned to three different groups of eight subjects per each (2 weeks propolis supplementation, 2 weeks placebo supplementation, and control group). Blood-sampling was sampled before and 30min of constant, heavy (~70% peak  $\text{O}_2$  uptake) cycle ergometer exercise. Two-way repeated measured ANOVA was used as the statistical analysis and significance was accepted at  $p<0.05$ .

**RESULTS:** The difference of WBC from pre- and post-experiment was significantly different ( $F=113.643$ ,  $p<0.000$ ). WBC within groups was significantly different ( $F=4.420$ ,  $p<0.025$ ). The high sensitive C-reactive protein(hs-CRP) was significantly different from pre- and post-experiment ( $F=69.690$ ,  $p<0.000$ ) and there was interaction between time and groups ( $F=5.352$ ,  $p<0.013$ ). Fibrinogen was significantly different from pre- and post-experiment ( $F=35.293$ ,  $p<0.000$ ). Albumin was significantly different from pre- and post-experiment ( $F=90.284$ ,  $p<0.000$ ), and also significantly different between groups ( $F=9.207$ ,  $p<0.001$ ). Neutrophil was significantly different from pre- and post-experiment ( $F=7.401$ ,  $p<0.013$ ). Lymphocyte was significantly different from pre- and post-experiment ( $F=11.320$ ,  $p<0.003$ ). Eosinophil was significantly different from pre- and post-experiment ( $F=16.323$ ,  $p<0.001$ ).

**CONCLUSION:** Propolis supplementation with maximal exercise is found effective on acute inflammatory makers and immunity.

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**2091 Board #232 May 28 8:00 AM - 9:30 AM**



## Almond Intake Enhances Resistance Against Fatigue In Elite Chinese Endurance Athletes

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(No relationships reported)

**PURPOSE:** To test the effect of almond intake on endurance performance in elite athletes.

**METHODS:** We conducted a randomized, crossover trial with elite male cycling (n=8) and triathlon (n=4) athletes (22 y; BMI: 22.7;  $\dot{V}O_{2max}$ : 69.0 mL/min/kg) by supplementing their diets isocalorically with 75 g almonds (ALM) or sugar cookies (COK) daily for 4 wk with a 2-wk washout period. ALM and COK consumption was divided into 3 portions and consumed prior to each meal. Before and after supplementation, all athletes underwent a 2-h cycling performance test at 60%  $\dot{V}O_{2max}$  and a subsequent 20-min time trial. During each visit, fasted blood was drawn at 0, 60, 125, 135, 155 min of the test and again at 3, 6, 9, and 15 h after exercise. Paired t-tests were performed to assess significance between treatments.

**RESULTS:** Neither ALM nor COK affected body composition or weight. ALM intake increased cycling distance during the 20-min time trial by 5.2% compared to COK (20.81 km,  $P \leq 0.05$ ). ALM intake resulted in a 7% increase in plasma glucose during the 20-min time trial while COK intake was associated with a 9% decrease ( $P \leq 0.05$ ). Plasma nitrogen oxide at 155 min was 78% greater in the ALM than COK group. Plasma total antioxidant capacity before and 15 h after exercise was 23 and 43% higher in the ALM than COK group, respectively ( $P \leq 0.05$ ). The degree of exercise-induced increase in xanthine oxidase activity was 59% lower in the ALM than the COK ( $P \leq 0.05$ ).

**CONCLUSION:** Our results suggest that 4-wk daily supplement of 75 g almonds enhances cycling performance and resistance against fatigue in elite endurance athletes. The potential mechanisms for this action may include improved fuel utilization, oxygen transportation, and antioxidant activity.

Supported by The Almond Board of California.

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### 2092 Board #233 May 28 8:00 AM - 9:30 AM

#### Effects Of Olive Extract Supplementation On Post-exercise Markers Of Muscle Recovery

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**PURPOSE:** Olive extract (OE) is derived from the aqueous fraction of olives and is rich in polyphenols, including the potent antioxidant hydroxytyrosol (HT). Previous studies have shown that olive polyphenols can confer antioxidant protection in vivo, as shown by increased plasma total antioxidant capacity and protection against LDL oxidation. Antioxidants may affect muscle recovery following strenuous exercise. The purpose of this study was to determine if OE supplementation influenced plasma creatine kinase (CK), muscle soreness, and muscle function following heavy aerobic exercise.

**METHODS:** 19 male subjects (21.2±2.9 yr, 23.9±1.7 BMI) underwent 3 treatment phases, consisting of 14-day supplementation periods with either 0 mg OE/d (placebo: PL), 400 mg OE/d (OE-400), or 800 mg OE/d (OE-800), administered in two daily doses providing a total of 8 and 16 mg HT, respectively. The exercise bout included 100 minutes of ergometer cycling at 60%  $\dot{V}O_{2peak}$ , followed by 20 minutes of treadmill running at 70%  $\dot{V}O_{2peak}$ . Plasma CK levels, muscle soreness ratings and peak isometric force (MVC) of the leg-extensors were obtained prior to the supplementation period (BL), pre-exercise, immediately post-exercise (0-PO), 2 hours post-exercise (2-PO) and 24 hours post-exercise (24-PO). A 12-day washout period separated the treatment phases, which were administered in a double-blind design.

**RESULTS:** Following supplementation, total area under the curve (AUC) for HT was significantly greater for OE-800 versus OE-400 and PL. HT AUC was also significantly greater with OE-400 versus PL. Plasma CK levels rose significantly from pre- (273.4±310.6 U/L) to post-exercise (peak at 24-PO: 429.2±381.5 U/L). Muscle soreness also increased from pre- (14.5±9.6 mm) to post-exercise (peak at 0-PO: 50.7±20.0 mm). MVC declined significantly from pre-exercise (574.3±165.3 N) to post-exercise (0-PO: 524.0±169.7 N). No treatment\*time interactions or differences in AUC were observed for muscle recovery variables.

**CONCLUSION:** OE supplementation significantly increased plasma HT concentrations, but did not affect plasma CK levels, muscle soreness or muscle function following heavy aerobic exercise. Further study is required to determine if higher doses of OE elicit positive effects on these variables.

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### 2093 Board #234 May 28 8:00 AM - 9:30 AM

#### The Effects Of Rhodiola Rosea On Human Immune Function And Endurance Performance

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(No relationships reported)

It has been well-documented that high intensity exercise alters immune function in humans and exposes them to a higher risk of bacterial and viral infections following such activity. There are a number of herbal and other supplements which claim to enhance immune function and athletic performance.

**PURPOSE:** Assess the efficacy of the botanical *Rhodiola rosea* to enhance immune function of individuals who participate in intense exercise and also determine its performance-enhancing qualities.

**METHODS:** This was a prospective, double-blind placebo-controlled study (N=15) in which immune parameters (morning cortisol, interleukin 6, and tumor necrosis factor alpha) and aerobic fitness (maximal oxygen uptake) were measured before and 28 days after taking 600 mg standardized 3% rosavin (botanical *rhodiola rosea*) or placebo. Maximal oxygen uptake was measured during a standard maximal exertion treadmill or cycle test; immune parameters were collected at the same time following the exercise test. Data was analyzed by an independent (two-way) t-test between baseline and 25-day post supplement or placebo interval.

**RESULTS:** There was no significant difference among the immune system parameters (cortisol, IL-6, TNF-alpha) between *rhodiola* supplement and placebo. There was no difference in change in maximal oxygen uptake between *rhodiola* supplementation for 28 days and placebo group.

**CONCLUSIONS:** *Rhodiola rosea* herbal supplement did not alter immune parameters and maximal oxygen uptake in elite endurance athletes after 28 days of supplementation.

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### 2094 Board #235 May 28 8:00 AM - 9:30 AM

#### Effects Of Olive Extract Supplementation On Markers Of Oxidative Stress Following Heavy Aerobic Exercise.

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**PURPOSE:** Polyphenol-enriched olive oil has been shown to increase serum antioxidant capacity, reduce lipid peroxidation, and reduce DNA oxidation in humans. Olive extract (OE) is derived from the polyphenol-rich aqueous phase of olives and contains hydroxytyrosol (HT), a potent antioxidant. Reactive oxygen species produced during aerobic exercise may result in oxidative damage to proteins, lipids, and DNA. Therefore, the purpose of this study was to determine if OE supplementation for 2 wk influences biomarkers of oxidative stress following heavy aerobic exercise.



**METHODS:** 19 non-endurance trained males ( $21.2 \pm 2.9$  y,  $23.9 \pm 1.7$  BMI) performed 3 aerobic exercise sessions, each consisting of cycling at 60%  $\text{VO}_{2\text{peak}}$  for 100 min on an electrically-braked ergometer followed by a treadmill run at 70%  $\text{VO}_{2\text{peak}}$  for 20 min. For 2 wk prior to each exercise session, subjects were randomized to consume a placebo (PL), 400 mg OE/d (OE-400) or 800 mg OE/d (OE-800) supplement, administered twice daily in double-blind fashion and providing a total of 8 and 16 mg HT, respectively. Blood samples were obtained prior to supplementation, pre-exercise, immediately post-exercise, and 2- and 24-h post-exercise. Samples were analyzed for plasma HT, serum total antioxidant capacity (TAC, determined by reduction of  $\text{Cu}^{++}$ ), plasma malondialdehyde (MDA) and serum C-reactive protein (CRP). Treatments were separated by a washout period of  $\geq 12$ -d before cross-over.

**RESULTS:** Total area under the curve (AUC) for HT was significantly greater ( $p < 0.05$ ) following supplementation for OE-800 versus OE-400 and PL. HT AUC was also greater with OE-400 versus PL. MDA decreased from pre-exercise ( $0.59 \pm 0.13$   $\mu\text{M}$ ) to 2-h post-exercise ( $0.54 \pm 0.13$   $\mu\text{M}$ ). CRP increased from pre-exercise ( $1.46 \pm 1.01$  mg/L) to 24-h post-exercise ( $3.71 \pm 2.40$  mg/L). TAC was not significantly affected by time. No treatment\*time interactions and no differences in the AUC by treatment were observed for MDA, CRP or TAC.

**CONCLUSIONS:** OE supplementation increased plasma concentrations of HT in a dose-related manner; however, biomarkers of oxidative stress were not altered by OE supplementation in this protocol. This could reflect that the OE dose was too low, or that the timing of measurements may not have been optimal to assess peak antioxidant activity.

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**2095 Board #236 May 28 8:00 AM - 9:30 AM**

**Ginger Supplementation Attenuates Muscle Pain and Dysfunction Following Eccentric Exercise**

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(No relationships reported)

Ginger supplementation has known hypoalgesic and anti-inflammatory effects in rodents, but its effect on inflammation and pain in humans is not well characterized.

**PURPOSE:** The purpose of this experiment was to determine whether 11 days of ginger supplementation would attenuate arm muscle pain, inflammation, and/or dysfunction induced by high intensity eccentric exercise.

**METHODS:** Thirty-four participants were block randomized ( $n=17$  in each condition) to consume 2 grams of either ground ginger or placebo for 11 consecutive days. On Day 8 participants performed 18 eccentric actions of the non-dominant elbow flexors at an intensity of 120% of their concentric one-repetition maximum. Immediately prior to and for 3 days after eccentric exercise, muscle pain intensity, perceived effort, arm range-of-motion (ROM), isometric strength (MVIC), arm volume and plasma prostaglandin E2 were assessed. The ginger and placebo groups were compared on the days when peak responses occurred for the primary outcome measures in the placebo group.

**RESULTS:** Peak pain ratings were 25% lower in the ginger group (9.3 VAS units, a Cohen's d effect size = -0.77 SD;  $p = 0.04$ ). Ginger also attenuated the peak decline in ROM by 35% (a 4.6° difference,  $d = 0.67$  SD;  $p = 0.04$ ). Smaller effect size changes in arm volume ( $d = -0.39$ ), plasma PGE2 ( $d = -0.42$ ), and MVIC ( $d = 0.29$ ) favored the ginger group but did not reach statistical significance.

**CONCLUSIONS:** It is concluded that ginger supplementation attenuates peak muscle pain and the decline in ROM caused by intense eccentric exercise.

Supported by the McCormick Science Institute

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**2096 Board #237 May 28 8:00 AM - 9:30 AM**

**Steamed Ginger Supplementation Reduces Pain Following Eccentric Exercise-induced Injury**

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(No relationships reported)

We recently found that 11 days of supplementation with 2 grams of raw, ground ginger reduced arm muscle pain and disability induced by eccentric exercise. These effects could plausibly be attributed to compounds in ginger such as gingerols and shogaols that act on vanilloid receptors.

**PURPOSE:** To learn whether 11 days of supplementation with ginger treated by steaming, a process known to increase the concentration of shogaols, also influences arm muscle pain, inflammation and/or disability induced by eccentric exercise.

**METHODS:** Raw ginger was ground and heated for 3 hours and 15 minutes at 100°C and dried. Ginger (0.33 gram) and placebo (brown sugar) was placed in hypromellose capsules, shipped in light impenetrable containers from Baltimore to Athens and stored at 5°C. 40 participants were block randomized ( $n = 20$  in each condition) to consume either 6 ginger or 6 placebo capsules daily for 11 consecutive days. On Day 8 participants performed 18 eccentric actions of the non-dominant elbow flexors at an intensity of 120% of their concentric one-repetition maximum (CON1-RM). Before and for 3 days after eccentric exercise, assessments were made of arm volume, arm range-of-motion (ROM), isometric strength (MVIC), and muscle pain intensity and perceived effort (6-20 RPE) responses to three flexions and extensions of the elbow at 50% CON1-RM.

**RESULTS:** Group x Time ANCOVAs controlling for immediate-post eccentric exercise force decline (a marker of injury magnitude; mean  $\pm$  SD decline of  $33.1 \pm 10.1\%$  and  $30.3 \pm 11.9\%$  for the control and ginger groups) showed a significant interaction for pain intensity ( $F(1.648, 60.98) = 3.701$ ) and RPE ( $F(2, 74) = 4.368$ ). Post-hoc tests showed that pain (-12.7 VAS units, -30.6%, Cohen's  $d = 0.77$  SD;  $t(38) = -2.255$ ,  $p = .03$ ) and RPE (-2.0 raw units, -30.6%, Cohen's  $d = 1.06$  SD;  $t(38) = -3.166$ ,  $p = .003$ ) were substantially lower in the ginger group 24-hours after eccentric exercise. ROM was not influenced by the intervention and small effect size differences in arm volume ( $d = 0.28$  SD, 79.4%) and MVIC ( $d = 0.28$  SD, 8.4%) 24-hours after exercise favored the ginger group but did not reach statistical significance.

**CONCLUSION:** Supplementation with steamed ginger reduces muscle pain and perceptions of effort the day after a bout of eccentric exercise.

Supported by the McCormick Science Institute

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**2097 Board #238 May 28 8:00 AM - 9:30 AM**

**Epigallocatechin-3-gallate Advances The Onset Of The Ventilatory Threshold But Does Not Affect Maximal Oxygen Uptake**

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(No relationships reported)

Epigallocatechin-3-gallate (EGCG), a catechin present in green tea, increases endurance performance in animals and promotes fat oxidation during prolonged cycle ergometer exercise in adult humans. Accordingly, we hypothesized that EGCG delays the onset of the ventilatory threshold ( $T_{VE}$ ) and increases maximal oxygen uptake ( $\text{VO}_{2\text{max}}$ ).

**PURPOSE:** To compare  $T_{VE}$  and  $\text{VO}_{2\text{max}}$  after consumption of EGCG and placebo.

**METHODS:** 7 EGCG capsules (135 mg/capsule) and 7 placebo capsules were administered in a randomized, double blind manner to 8 recreationally active young adults (6 males, 2 females, age:  $29 \pm 5$  yr (mean  $\pm$  SE)). One capsule was consumed every 12 hours over 48 hours, and the final capsule consumed 2-hours prior to exercise testing. On

two occasions, separated by a minimum of 14 days,  $T_{VE}$  and  $VO_{2max}$  were determined from breath-by-breath indirect calorimetry data collected during continuous incremental stationary cycle ergometer exercise (20-25 W/min), from rest until volitional fatigue.

**RESULTS:** Contrary to our hypothesis the  $VO_2$  corresponding to  $T_{VE}$  was lower ( $P = 0.04$ ) following consumption of EGCG ( $1.5 \pm 0.1$  L/min) compared with placebo ( $1.7 \pm 0.2$  L/min).  $VO_{2max}$ , maximal heart rate and maximal work rate were unaffected (Placebo:  $3.2 \pm 0.4$  L/min,  $179 \pm 7$  beats/min,  $307 \pm 25$  W vs. EGCG:  $3.3 \pm 0.4$  L/min,  $179 \pm 7$  beats/min,  $297 \pm 29$  W; all  $P > 0.05$ ).

**CONCLUSION:** The onset of the  $T_{VE}$  is advanced by EGCG. EGCG is thought to inhibit catechol-*O*-methyl transferase, an enzyme contributing to the degradation of catecholamines. Delayed degradation of catecholamines could contribute to accelerated glycolysis and decreased blood flow to lactate clearing tissues during incremental exercise. These combined actions may promote earlier lactate accumulation, decreased blood pH, and hence advanced  $T_{VE}$ .

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**2098 Board #239 May 28 8:00 AM - 9:30 AM**

**Effects Of Rice Bran Arabinoxylan Compound On Intense Exercise-induced Secretory Immunoglobulin A Suppression In Rats.**

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( F. Kimura, Daiwa Pharmaceutical Co., Ltd., Contracted Research.)

Secretory immunoglobulin A (SIgA) plays a major role in specific immunity and provides a protection at mucosal surfaces via several mechanisms. Polymeric immunoglobulin receptor (pIgR) on the surface of the epithelial cells combines with immunoglobulin A to form SIgA. Intense exercise causes a functional decline in several components of the immune system. Rice Bran Arabinoxylan Compound (RBAC; Daiwa Pharmaceutical Co., Ltd.) is obtained by reacting rice bran hemicellulose with multiple carbohydrate hydrolyzing enzymes from *Lentinula edodes* mycelia and seems to act as a potent biological response modifier.

**PURPOSE:** To evaluate the effects of RBAC supplementation on the SIgA in rat saliva and on inhibitory effect of intense exercise-induced SIgA suppression.

**METHODS:** Male Wistar rats (8 weeks of age) were assigned to one of the following treatment groups: (1) RBAC-Ex, a RBAC ingested exercised group (n=7); (2) RBAC-Sed, a RBAC ingested sedentary group (n=6); (3) DW-Ex, a distilled water ingested exercised group (n=7); (4) DW-Sed, a distilled water ingested sedentary group (n=6). Rats received RBAC (150 mg/kg body weight) or distilled water orally for two weeks. Their saliva was collected before (0w), after 1 week (1w), 2 weeks (2w) of RBAC intake, and before (pre) and after (post) exercise; the salivary glands were removed after exercise. SIgA concentration in saliva was measured by ELISA, and pIgR mRNA expression in the salivary glands was analyzed by the 7500 Fast Real Time PCR System.

**RESULTS:** Treatment with RBAC significantly increased SIgA concentration (0w:  $6.27 \pm 0.37$  vs. 2w:  $9.82 \pm 1.79$   $\mu$ g/ml,  $p < 0.05$ ), while there was no significant change in the DW groups. SIgA in the RBAC-Ex and DW-Ex groups significantly decreased after exercise compared with before ( $p < 0.05$ ). The expression of pIgR mRNA did not show significant difference between RBAC-Ex and DW-Ex groups.

**CONCLUSION:** RBAC supplementation for two weeks enhances saliva SIgA concentration, and it may be a potent biological response modifier for exercise-induced immune suppression.

Supported by Daiwa Pharmaceutical Co., Ltd.

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**2099 Board #240 May 28 8:00 AM - 9:30 AM**

**Effects Of Rice Bran Arabinoxylan Compound On Gut Immunity In Response To Exhaustive Intense Exercise.**

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(No relationships reported)

**PURPOSE:** The intestinal tract has gut-associated lymphoid tissues response for protecting the host from pathogenic invasion. T and B lymphocytes in the mucosa of the intestinal tract are presumed to promote local immunity in the host. Reportedly, intense exercise results in impairment of normal gut barrier to luminal microorganisms, and results in elevation of circulatory levels of bacterial endotoxin. Rice Bran Arabinoxylan Compound (RBAC; Daiwa Pharmaceutical Co., Ltd.), an enzymatically modified arabinoxylan extracted from rice bran, has a potential to act as a biological response modifier. However, effects of RBAC and strenuous exercise on gut immunity including T and B lymphocytes-mediated immunity have not yet been elucidated.

The purpose of this study was to assess the effects of RBAC supplementation on the gut immunity, particularly T cells and B cells, in response to exhaustive intense exercise.

**METHODS:** Twenty-six male Wistar rats (8 weeks old) were randomized to: (1) RBAC-Ex, RBAC administered (150 mg/kg body weight for two weeks) and exercised (exhaustive treadmill running) group (n=7); (2) RBAC-nEX, RBAC administered and non-exercised group (n=6); (3) DW-Ex, distilled water administered and exercised group (n=7); (4) DW-nEX, distilled water administered and non-exercised group (n=6). The mesenteric lymph nodes were removed after exercise and CD3+CD4+ (T-helper cell), CD3+CD8+ (T-cytotoxic cell), and CD45RA+ (B cell) cells were measured by Flow cytometry analysis.

**RESULTS:** The Flow cytometry indicated that percentage of intestinal CD45RA+ cells tended to higher in RBAC-nEX ( $81.8 \pm 1.2\%$ ) compared with DW-nEX ( $68.0 \pm 2.5\%$ ) ( $p = 0.08$ ). CD3+CD4+ and CD3+CD8+ cells did not show significant differences between RBAC-nEX and DW-nEX groups. CD45RA+ and CD3+CD8+ cells were significantly lower in exercised groups (RBAC-EX or DW-EX) compared with non-exercised groups (RBAC-nEX or DW-nEX) ( $p < 0.05$ ). There were not significant differences of CD3+CD4+ cells among groups.

**CONCLUSIONS:** RBAC supplementation for two weeks indicated possibility to up-regulate B-cell-mediated humoral immunity. Exhaustive intense exercise could impair gut immunity, particularly T-cell- and B-cell-mediated immunity.

Supported by Daiwa Pharmaceutical Co., Ltd.

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**2100 Board #241 May 28 8:00 AM - 9:30 AM**

**Analysis on Ten Kinds Of Elimination Exercise Fatigue Of Traditional Chinese Medicine**

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(No relationships reported)

**PURPOSE:** To examine the pertinence of 10 kinds of familiar tonic traditional Chinese medicines and their elements, and provide some references to choose or farther investigate the efficacy of traditional Chinese medicines in exercise fatigue.

**METHODS:** Our research had measured elements content in the 10 kinds of tonic traditional Chinese medicines with ICP/AES, such as Ca, Mg, Na, K, Fe, Zn, Cu, Cr, Mo, Co, Ni, V, Sr, Mn and Sn; and had measured the elements content of Se and As in 10 kinds of tonic traditional Chinese medicines with the Atomic fluorescence spectrographic. And we carried SAS software to take corresponding analyze to these 10 kinds of traditional Chinese medicines and 17 kinds of elements.

**RESULTS:** The content of K,Na,Ca,Mg was most in the 10 traditional Chinese medicines, the varieties of microelements were most in hairy antler, panax and shorthorned epimedium herb. The content of K was most in medlar, Na and Ca was most in hairy antler, Mg was most in angelica. The distributing of traditional Chinese medicines and elements take on territorial characteristic.

**CONCLUSIONS:** 1.We can principium divide these elements into 4 comparative concentrative assemble parts according to the compactness of superposition in the 10 traditional Chinese medicines and the elements. 2.The function of the 10 traditional Chinese medicines and the elements showed some characteristic of coherence in their content and their relative traditional Chinese medicine attribution channel theory, and it might be one of the important birth reasons of "assemble parts". 3.The function of the elements in the traditional Chinese medicines relate to their variety,quantity and their state. The conclusion shows that we should take the all and the one into general account before choose traditional Chinese medicines., and it's very important.

**2101 Board #242 May 28 8:00 AM - 9:30 AM**  
**Effects Of An Energy Drink On Performance Of Varsity Hockey Players.**

Stephanie K. O'Neill, Jonathon R. Fowles, Rene J.L. Murphy. *Acadia University, Wolfville, NS, Canada.*  
*(No relationships reported)*

A number of varsity athletes may use commonly available stimulant supplements as a means to attempt to improve performance in their sport.

**PURPOSE:** To assess the effects of consuming 250 ml of a commercially available energy drink or a placebo on game type performance in varsity hockey players.

**METHODS:** 20 varsity hockey players (Mean±SD; 22.1±1.1 years, 181.3±4.8 cm, 88.2±7.2 kg, 11.2±3.6% body fat, and 17.2±1.2 years of playing experience) volunteered to participate in a double blind, placebo controlled study. Participants reported to the arena at 4pm and received either a placebo drink or the energy drink. At 4:30pm, they performed a Reed Repeat skating test and then participated in a ~60 min standardized hockey practice led by 3 coaches. The last 20 min was a scrimmage and their performance was rated from best to worst by 3 coaches blinded on the treatment received. Following the on-ice tests, the players removed their hockey gear and performed a 60 sec Bosco jump test. 48 hours later, after following the same diet as on the first testing day, the players performed the exact same procedures following consumption of the other treatment drink.

**RESULTS:** There were no significant ( $p<0.05$ ) changes in Reed Repeat skate test fastest time on ice, on-ice drop off, fatigue index and total time, or in ranks during practice/scrabble, or in Bosco jump test peak height, relative power and fatigue index between energy drink and placebo treatments. Because some ( $n=7$ ) were regular users of energy drinks, we also analyzed the results between users and non-users. There was a trend ( $p=0.088$ ) indicating that users performed better according to the coaches' ranks when consuming the energy drink while non-users tended to be ranked lower when consuming the drink.

**CONCLUSION:** Compared to a placebo, consumption of a commercially available energy drink 30 min prior to a hockey practice does not improve or harm performance for approximately 2 hours in varsity hockey players.

**2102 Board #243 May 28 8:00 AM - 9:30 AM**  
**Effects Of Rooibos Tea, Bottled Water, And A Carbohydrate Beverage On Blood And Urinary Measures Of Hydration After Acute Dehydration.**

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 ( A.C. Utter, Reddrex Inc, Eagle, Idaho, Contracted Research.)

**PURPOSE:** Rooibos tea contains polyphenol antioxidants, including flavonoids and phenolic acids that are potent free radical scavengers and has purported benefits for accelerated rehydration. The objective was to evaluate the effects of three different drinks (rooibos tea, bottled water, and a carbohydrate beverage) on blood and urinary markers of hydration after acute dehydration in collegiate wrestlers.

**METHODS:** Twenty three athletes were recruited and followed a randomized, cross-over design with 3 different study arms comparing the effectiveness of rooibos tea, carbohydrate (6% or 60 grams l<sup>-1</sup>), or bottled water (placebo) in promoting rehydration after a 3% reduction in body mass. Urine specific gravity (U<sub>sg</sub>), urine (U<sub>osm</sub>) and plasma osmolality (P<sub>osm</sub>), and plasma volume were measured pre- and post- dehydration and at 1-h after rehydration. Statistical analyses utilized a 3 (conditions) x 3 (times) repeated measures analysis of variance to test main effects.

**RESULTS:** Significant interaction effects were found for P<sub>osm</sub> and U<sub>osm</sub> both of which remained in negative balance after 1-h rehydration in the rooibos tea and water trials. No significant interaction effects were found for either urine U<sub>sg</sub> or plasma volume shift.

**CONCLUSIONS:** The findings of this study demonstrate that a carbohydrate/electrolyte solution was more effective in promoting rehydration than either rooibos tea or plain water in collegiate wrestlers after a 3% reduction in body mass and a rehydration period of 1-h when consuming 100% of their body weight loss.

*Supported by a grant from Reddrex Inc, Eagle, Idaho.*

**2103 Board #244 May 28 8:00 AM - 9:30 AM**  
**Hyperhydration In Resting Trained Males: Effects Of Solutions With Differing Concentrations Of Sodium**

Hal W. Goforth, Jr., FACSM, Nicholas Koreerat. *Point Loma Nazarene University, San Diego, CA.*  
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*(No relationships reported)*

Hyperhydration of euhydrated resting athletes using hyperosmotic saline solutions is rarely studied. Hyperosmotic saline solutions are often studied for rehydration.

**PURPOSE:** To compare the retention of 3 hyperosmotic saline solutions and ability to increase total body water of resting athletes.

**METHODS:** Nine aerobically trained, male subjects; age 21 + 1.5 yr, 177 +5.8 cm, 74 +8.2 kg, and 14 +2.9 % body fat, gave informed consent to participate in a repeated-measures, single-blinded, cross-over design study. Subjects were randomly assigned to group A,B, or C. Treatment order was; A,B,C; B,C,A, or C,A,B. Trials were 3hr conducted > 3da apart. Subjects followed behavioral/dietary guidelines 72hr before testing. Urine density (1.015-1.040) verified euhydration status. The base solution for treatments made from a 50% diluted sports drink, contained; 100mg Na, 90mg K, and 7g CHO. NaCl was added to make 3 saline solutions: S30-30 mmol/L (0.91g NaCl) (the full strength sports drink); S60-60 mmol/L (1.8g NaCl), and S90- 90 mmol/L (3.6g NaCl). Treatment volume (1.4±0.14L) was determined as 3% of subjects estimated total body water. Urine output, urine density, plasma osmolality, Hct, and Hb were measured hourly. Subjects remained seated except to empty bladders.

**RESULTS:**

VOLUME RETAINED, URINE OUTPUT and PLASMA OSMOLALITY			
Treatment Group	1hr	2hr	3hr
S30 n=9 (%) Retained	66+13	16+21	(-) 6+24
Urine Output (mL)	471+166	684+137	308+166
Plasma (mOsm)	269+6	270+5	272+4
S60 n=9 (%) Retained	80+9*	39+17*	25+178*

Urine Output (mL)	274+110*	555+139*	197+78*
Plasma (mOsm)	274+6*	287+22*	281+3*
S90 n=9 (%) Retained	80+9*	49+18*	35+21*
Urine Output (mL)	279+127*	411+158*	191+83*
Plasma (mOsm)	288+6*	282+5*	288+9*

(\*) Significantly different from S30 trials,  $p < 0.01$ .

Urine Density decreased over time but did not differ between treatments.

Hct and Hb values did not change significantly, indicating a constant red cell volume.

**CONCLUSION:** Drinking 1.4L of a 30mmol/L Na solution (equal to a sports drink with the most Na) produced a net loss of body water. Drinking 1.4L of the 60 and 90mmol/L solutions allowed subjects to retain 25% (341mL) and 35% (479mL), and may be ergogenic for some athletes.

**2104 Board #245 May 28 8:00 AM - 9:30 AM**  
**Effects Of Electrolytes In Drinks Ingested Before And During Cycling Time Trials**

Maurie J. Luetkemeier<sup>1</sup>, John R. Stofan<sup>2</sup>, Roshan Patel<sup>2</sup>. <sup>1</sup>*Alma College, Alma, MI.* <sup>2</sup>*Gatorade Sports Science Institute, Barrington, IL.*  
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( M.J. LUETKEMEIER, Gatorade Sport Science Institute, Consulting Fee.)

**PURPOSE:** To determine whether the addition of electrolytes to drinks consumed before and during exercise improves cycling time trial performance.

**METHODS:** Healthy, active males (n=7; mean age=38.8±5.1 years, weight=75.1± 6.1 kg, %fat=12.7±5.3%, OBLA=215 ±38 Watts) participated in 4 randomly ordered conditions combining 1 of 2 pre-exercise drink formulations with 1 of 2 during-exercise drink formulations. Each condition consisted of a 2-h drinking phase followed immediately by a cycling time trial designed to last ~90-min. The 2 pre-exercise drinks (13-ml/kg BW) were either (W) flavored water or (E) flavored water containing 9.62 g/L of Gatorlytes electrolyte mixture (Na=2.18 g/L, K=1.10 g/L, Osm=300 mOsm/L). The during-exercise drinks (17-ml/kg BW) were either (w) a 6% carbohydrate beverage or (e) a 6% carbohydrate beverage plus electrolytes (Na=0.83 grams/L, K=0.375g/L). Thus, the 4 conditions were Ww, We, Ew, and Ee, which were tested using 1-way ANOVA for effects on primary outcomes of time-trial performance, fluid balance and change in relative plasma volume (PV).

**RESULTS:** Urine rates during the drinking phase were higher for Ww and We (9.43± 3.15 ml/min) than for Ew and Ee (5.98±ml/min) leading to a greater positive fluid balance (input - output) for Ew and Ee (+199± 280ml) vs. Ww and We (-109±365 ml). Fluid balance differences were largely attributed to disparity in urinary free water clearance between Ew and Ee (0.5±1.8 ml/min) vs. Ww and We (4.2±2.3 ml/min). Change in PV from blood samples taken before and after the drinking phase was greater for Ew and Ee (1.5±10.0 ml) than for Ww and We (-4.6±6.9 ml). This difference in PV was not assoc. with s.d's. in HR, SV, CO or BP. Cycling time was slower ( $p < 0.05$ ) for Ww (90.1± 6.0 min) compared to times for Ew (85.4±6.2 min), We (87.0±5.7 min) and Ee (87.6±6.2 min), which were not different among each other ( $p > 0.05$ ).

**CONCLUSION:** Pre-exercise administration of a drink containing a 300 mOsm/L electrolyte mixture caused a reduction in urine output leading to a higher fluid balance and PV. Cycling time trial performance lasting ~90-min was improved in conditions where electrolytes were added to the drink either before or during exercise but there was no additional improvement in performance when electrolytes were added to both the before and during-exercise drinks.

**C-43 Free Communication/Poster - Sweat Composition and Electrolyte Balance**

MAY 28, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

**2105 Board #246 May 28 9:00 AM - 10:30 AM**  
**Evaluation Of Artificial Sweat In Athletes With Spinal Cord Injuries**

Robert C. Pritchett<sup>1</sup>, Matt J. Green, FACSM<sup>2</sup>, Phillip Bishop<sup>3</sup>, Kelly Pritchett<sup>1</sup>, Yang Zhang<sup>3</sup>. <sup>1</sup>*Central Washington University, Ellensburg, WA.* <sup>2</sup>*University of North Alabama, Florence, AL.* <sup>3</sup>*The University of Alabama, Tuscaloosa, AL.* (Sponsor: Matt Green, FACSM)

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(No relationships reported)

**PURPOSE:** Athletes with spinal cord injury (SCI) often experience high heat storage due to reduced sweating capacity below the spinal injury. Spray bottles (SB) maybe used to apply mist for evaporative cooling during breaks in competitions. This study examined the efficacy of spray bottle during rest breaks.

**METHODS:** Seven participants, four female and three males, (mean ± SD age 24 ± 4.1 yr, weight 56.2 ± 7.0 kg, upper-body VO<sub>2</sub> peak 2.4 ± 0.6 L·min<sup>-1</sup>) volunteered for the study. Participants were paraplegic athletes (T3 to T12/L1) with both complete and incomplete lesions. Participants arm-cranked using a ramp protocol in an environment of 21°C ± 1.5°C and 55 ± 3 % rh once using a SB during 1-min rest between seven-minute stages of increasing intensity and once without the SB (CON).

**RESULTS:** Mean total work was similar ( $p = 0.86$ ) for the SB and CON (2495.7 ± 914.6 kJ vs. 2407.1 ± 982.3 kJ, respectively). Likewise, the mean work times were similar between trials (27 ± 6 min and 26 ± 7 min for SB and CON, respectively). Furthermore, there were no significant differences detected between trials for skin temperature, rectal temperature, esophageal temperature ( $p > 0.05$ ). There were also no significant differences detected for RPE between trials ( $p > 0.05$ ).

**CONCLUSIONS:** Application of artificial sweat via a spray bottle was ineffective in attenuating the onset of uncompensable heat strain during high intensity arm exercise under the conditions of this study. However, even in absence of physiological changes, participants commonly commented positively regarding perceived cooling from the spray bottle.

**2106 Board #247 May 28 9:00 AM - 10:30 AM**  
**Suitability Of The Megaduct Sweat Collector For Sweat Mineral Analysis**

Matthew R. Ely, Brett R. Ely, Troy D. Chinevere, Samuel N. Cheuvront, FACSM. *USARIEM, Natick, MA.*

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(No relationships reported)

Regional arm sweat collection for electrolyte and mineral analysis during exercise is typically made using polyethylene arm bags. The arm bag technique is able to collect a high volume of sweat in a relatively short amount of time, but encapsulation and hidromeiosis are concerning for local sweat electrolyte and mineral secretion. The Megaduct sweat collector may be a suitable alternative as its construction and small size avoids encapsulation and hidromeiosis. However, the Megaduct's small surface area covers fewer

sweat glands, thus the time taken to obtain an appropriate volume of sweat may be too slow to reflect dynamic changes in sweating rate or composition.

**PURPOSE:** To compare the time required to obtain the minimal volume of sweat (0.5 ml) needed for a broad panel mineral analysis using the arm bag and Megaduct sweat collection techniques.

**METHODS:** Eighteen heat-acclimated subjects walked 100-min (treadmill, 425 W) in a hot environment (45°C, 20% rh). Ten subjects wore the Megaduct sweat collector while eight were fitted with a polyethylene arm bag. To perform a broad panel sweat mineral analysis at least 0.5 ml of sweat must be collected. Therefore, we compared the amount of time required to collect 0.5 ml of sweat using each of the Methods Megaduct and arm bag.

**RESULTS:** The minimum sweat volume required for broad panel sweat mineral analysis requires approximately 60 min using the Megaduct but less than 5 min using the arm bag. Collection time was significantly ( $p < 0.05$ ) longer in the Megaduct.

**CONCLUSION:** Regional sweat collection from the forearm using the arm bag required less than 10% of the time needed for the Megaduct to reach the minimum volumes for a broad panel mineral analysis. Because collection durations in excess of 30-min may produce independent errors in electrolyte and mineral sweat content, we conclude that the commercial Megaduct sweat collector is an inferior alternative to the arm bag technique for broad panel sweat mineral analysis during exercise-heat stress.

(Funded by MRMC PRMRP #033015)

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## 2107 Board #248 May 28 9:00 AM - 10:30 AM Comparison Of Regional Patch Collection Vs. Whole-body Washdown For Measuring Sweat Sodium Loss During Exercise

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( J.R. Stofan, PepsiCo, Salary.)

**BACKGROUND:** Whole-body washdown (WBW) is the criterion method to determine whole-body (WB) sweat sodium ( $\text{Na}^+$ ) loss, while regional skin surface (REG) collections overestimate  $\text{Na}^+$  loss. Validation of REG against WBW would improve the accuracy of REG, particularly for use in field studies.

**PURPOSE:** Make simultaneous WBW and REG sweat collections during exercise to generate regression equations to predict WB sweat [ $\text{Na}^+$ ] from single- and 5-site REG sweat patch collections.

**METHODS:** Athletes (10 men, 10 women;  $37 \pm 10$  yr) cycled (75% max heart rate) in a plastic isolation chamber for 90 min in the heat. Prior to exercise, the subject and bike were washed with deionized water. After the onset of sweating, sterile patches were attached to the forearm, back, chest, forehead, and thigh, and removed upon saturation with sweat. After exercise, the subject and bike were washed with 5L of ammonium sulfate solution to ensure collection of all WB  $\text{Na}^+$  loss and determine the volume of unevaporated sweat. Total sweat loss was calculated from the change in pre-to post-exercise nude body mass, corrected for fluid intake and urine and respiratory water losses. The 5-site REG sweat [ $\text{Na}^+$ ] was calculated using an equation weighted for local sweat rate and body surface area. REG and WBW [ $\text{Na}^+$ ] were measured using flame photometry. Regression analyses, standard error of estimates (SEE, mEq/L), and intraclass correlation coefficients (ICC) were used to determine the most accurate and reliable REG sites for predicting WBW sweat [ $\text{Na}^+$ ].

**RESULTS:** Sex did not influence the relation between REG and WBW. Average sweat loss and fluid intake were 1.4 and 1.1 L, respectively (-0.3% net D body mass). The 5-site REG and WBW sweat [ $\text{Na}^+$ ] were  $61 \pm 27$  mEq/L and  $38 \pm 18$  mEq/L, respectively ( $p < 0.05$ ). The regression equation for predicting WB sweat [ $\text{Na}^+$ ] from the 5-site REG method was  $y = 0.63x - 0.26$  (overestimated WBW by 59%;  $R^2 = 0.92$ , SEE = 25, ICC = 0.61). The best single REG site for predicting WB sweat [ $\text{Na}^+$ ] was the thigh (overestimated WBW by 7%;  $y = 0.69x + 9.9$ ,  $R^2 = 0.90$ , SEE = 10, ICC = 0.90), followed by the forearm (overestimated WBW by 40%;  $y = 0.53x + 9.8$ ,  $R^2 = 0.90$ , SEE = 22, ICC = 0.70).

**CONCLUSION:** Although the REG method overestimates WBW sweat [ $\text{Na}^+$ ], these correction equations can be used to accurately and reliably predict WB sweat [ $\text{Na}^+$ ] from REG sweat samples collected in the field.

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## 2108 Board #249 May 28 9:00 AM - 10:30 AM Sweat Losses During A Soccer Match Played In Hot Conditions

Susan M. Shirreffs, FACSM<sup>1</sup>, Ronald J. Maughan, FACSM<sup>1</sup>, S. Sadi Kurdak<sup>2</sup>, Kerem T. Özgün<sup>2</sup>, Jiri Dvorak<sup>3</sup>, Gülfem Ersöz<sup>4</sup>. <sup>1</sup>Loughborough University, Loughborough, United Kingdom. <sup>2</sup>Çukurova University, Adana, Turkey. <sup>3</sup>FIFA/FMARC, Zurich, Switzerland. <sup>4</sup>Ankara University, Ankara, Turkey.

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(No relationships reported)

Soccer is a global sport played in a wide range of environmental conditions. Large inter-individual sweating responses of soccer players during training and match play have been reported, but there are no data on these losses during match play in hot conditions.

**PURPOSE:** To investigate sweat losses in soccer players, 19 adult male players were studied in one full FIFA regulation match in hot conditions: 35°C, 37%rh, heat index 36°C. By virtue of their home location, 8 players were acclimated (A) and 11 were unacclimated (UA) to the conditions. At the time of testing all players were regularly training with and playing for their University club team.

**METHODS:** In the 30min before the start of a match, absorbent patches were placed on the right forearm, thigh, chest and back of players. These remained in place for the 1st half of the match. Players were weighed nude within 30 min before and 15 min after the end of the match. All urine passed between body mass measurements was collected. Drink bottles were weighed to determine volume consumed. The sweat volume lost was estimated from body mass change, urine volume and drink volume consumed. Sweat sodium (Na) concentration was determined by flame photometry and an overall concentration determined as the mean of the four patches. Salt loss was estimated by assuming that all Na loss was sodium chloride. Comparisons between A and UA players were by unpaired t-test.

**RESULTS:** Results are summarised in the Table.

A (n=8); UA (n=11)	P value	Mean	SD	Median	Min	Max
Body mass loss (kg)	0.533	1.44; 1.60	0.63; 0.41	1.43; 1.65	0.55; 0.80	2.40; 2.30
Body mass loss (%)	0.682	2.1; 2.3	0.9; 0.7	2.3; 2.4	1.1; 1.1	3.4; 3.4
Drink consumed (ml)	0.084	930; 1280	170; 510	960; 1150	690; 660	1140; 2440
Sweat loss (ml)	0.049	2.33; 2.87	0.70; 0.40	2.48; 2.68	1.13; 2.48	3.10; 3.55
Sweat Na conc (mmol/l)	0.777	31; 32	13; 12	29; 32	18; 15	55; 54
Sweat salt loss (g)	0.363	4.4; 5.6	2.7; 2.8	4.0; 5.0	1.5; 2.3	9.2; 11.2

**CONCLUSION:** Sweat volume was greater in the UA players, but due to the drinking practices there was no difference in body mass loss between groups. Sweat sodium and salt losses were not difference between groups.



**2109 Board #250 May 28 9:00 AM - 10:30 AM**  
**Effects Of Exercise At Moderate Altitude On Sweat Composition And Sweat Rate**

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(No relationships reported)

**PURPOSE:** To examine the physiological effects of exercise at altitude on the ability of the sweat gland to regulate sodium, potassium, and osmolality as well as sweat rate.

**METHODS:** Six healthy, active subjects (age =  $20.3 \pm 1.1$  yrs,  $\text{VO}_2$  max =  $2.91 \pm .7$  l/min, weight =  $62.15 \pm 10.7$  kg.) were asked to complete four 30-minute cycle ergometer exercise bouts at a relative workload (60% of a  $\text{VO}_2$  max) at sea level (SL1), upon acute exposure 3400 m (ALT1), two weeks following acclimatization at 3400m (ALT2), and upon return to sea level (SL2). The subjects also performed two 30-minute cycle ergometer exercise tests at an absolute workload (60% of  $\text{VO}_2$  max of SL1) at ALT1 and ALT2. All tests were performed in a temperature controlled environment (temperature= 82°F and humidity = 41%). Sweat was collected with sweat pads applied to forehead, forearm, chest, and back bilaterally during each exercise period. The sweat was then analyzed for sodium and potassium concentration (Flame Photometer) and osmolality (Microsmometer).

**RESULTS:** Sweat rates and total sweat loss did not change significantly at ALT1 or ALT2. The average sodium potassium ratio also showed no significant variation between tests. The average osmolality, sodium, and potassium concentrations were significantly higher at ALT1 than SL1, and osmolality was still significantly higher at ALT2 than SL1, but lower than ALT1.

**CONCLUSION:** Results from this study suggest that altitude has an effect on sweat content rather than sweat rate or loss. The significant increase in osmolality indicates a possible increase in water reabsorption at the sweat gland. Altitude induced dehydration is a possible mechanism for the increased reabsorption.

**2110 Board #251 May 28 9:00 AM - 10:30 AM**  
**Gender Differences In Fluid And Electrolyte Balance During Endurance Exercise**

Thijs M.H. Eijssvogels, Dick H.J. Thijssen, Maria T.E. Hopman, FACSM. *Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands.*

(No relationships reported)

Maintaining a proper fluid and electrolyte balance is essential during endurance exercise, as dehydration impairs aerobic exercise performance and more rapidly increases core body temperature during exercise. However, little is known about gender differences in fluid and electrolyte balance during endurance exercise.

**PURPOSE:** To compare fluid intake, body weight changes, sodium concentration ( $[\text{Na}^+]$ ) and plasma volume changes between men and women during a four day walking event.

**METHODS:** Ninety-nine volunteers (21-82 years) participated in our study and walked 30 (n=35, 63% men), 40 (n=36, 53% men), or 50 km (n=28, 57% men) per day for 4 consecutive days. Prior to the event and immediately after finishing on each day, body weight was measured and venous blood was taken to analyze sodium concentrations. Dehydration was defined as >2% body weight loss, while hyponatremia was identified as  $[\text{Na}^+] > 145$  mmol/L. Subjects reported their fluid intake using a diary.

**RESULTS:** Maximum ambient temperature was relatively stable over the walking days (17.6°C - 20.5°C). On the first day, gender differences were seen for changes in  $[\text{Na}^+]$  (M=+1.5 mmol/L; F=-0.5 mmol/L,  $p < 0.05$ ), body weight loss (M=-1.3%; F=-0.9%,  $p < 0.05$ ) and fluid intake (M=2.9; F=3.8 mL/hour/kg,  $p < 0.005$ ). A significant difference (Chi-test,  $p < 0.001$ ) in the incidence of dehydration (M=18; F=5), and hyponatremia (M=15; F=0) between men and women supported these findings. On subsequent days, no important gender differences were found (fluid intake, change in  $[\text{Na}^+]$ , body weight loss), while the incidence of dehydration (n=5, 2 and 5, respectively) and hyponatremia (n=3, 1 and 1, respectively) was markedly decreased.

**CONCLUSION:** Dehydration was observed in 23% of our participants on day 1. More importantly, our data indicate that men are more sensitive to develop dehydration than women, likely explained through gender differences in fluid ingestion. Despite comparable ambient conditions on consecutive days, prevalence of dehydration dropped markedly, while gender differences disappeared.

**2111 Board #252 May 28 9:00 AM - 10:30 AM**  
**Exercise-associated Hyponatremia In A Cold Weather Ultraendurance Race**

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(No relationships reported)

Exercise-associated hyponatremia is the occurrence of hyponatremia during prolonged physical activity and is defined by a serum sodium concentration < 135 mmol/L.

**PURPOSE:** To investigate change in sodium level and its cause during the Susitna 100, a cold weather ultraendurance race.

**METHODS:** Thirty six athletes in the 2000 and 2002 Susitna 100 participated in the study. Subjects were weighed and had blood drawn for sodium concentration and hematocrit pre- and post-race. Arginine vasopressin (AVP) was measured in 2002. Race dietary analysis determined fluid intake. Subjects were split into three groups for statistical analysis: normonatremic 2000, hyponatremic 2000, and 2002. ANOVA compared the three groups and paired t tests evaluated pre- and post-race measurements.

**RESULTS:**

	Normonatremic 2000	2002	Hyponatremic 2000
Pre-race $\text{Na}^+$ (mmol/L)	$138.8 \pm 2.9$	$140.8 \pm 1.2 \dagger$	$137.0 \pm 1.7$
Post-race $\text{Na}^+$ (mmol/L)	$136.8 \pm 1.2$	$138.4 \pm 2.2 *$	$132.9 \pm 1.9 *$
Δ Body mass (kg)	$-1.9 \pm 2.4 *$	$-1.2 \pm 1.2 *$	$-0.8 \pm 1.0$
Δ Hematocrit	$-1.8 \pm 4.2$	$-2.0 \pm 2.0 *$	$-2.6 \pm 3.8$
Δ Plasma volume	$9.0 \pm 20.0$	$9.0 \pm 9.2$	$12.4 \pm 19.3$
Fluid/h (L)	$0.4 \pm 0.2$	$0.3 \pm 0.1 \dagger$	$0.5 \pm 0.2$

$\dagger p < 0.05$  2002 vs. normonatremic and hyponatremic

$*$   $p < 0.05$  pre-race vs. post-race

The normonatremic group maintained sodium levels with post-race values  $\geq 135$  mmol/L. Sodium decreased significantly in 2002, but no athletes were hyponatremic. Sodium decreased significantly with post-race values < 135 mmol/L in the hyponatremic group. All three groups exhibited signs of fluid overload, including minimal weight loss, decreased hematocrit, and increased plasma volume. Fluid overload indicators were largest in the hyponatremic group. Fluid consumption was greatest in the hyponatremic group. In 2002, AVP increased significantly pre- ( $2.6 \pm 0.7$  pg/ml) to post-race ( $6.0 \pm 4.6$  pg/ml).

**CONCLUSION:** Exercise-associated hyponatremia occurs in a cold weather ultraendurance race, and appears to be the result of fluid overload. The fluid overload may have been

caused by excessive fluid consumption and the inappropriate secretion of AVP.

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**2112 Board #253 May 28 9:00 AM - 10:30 AM**

**Exercise-associated Hyponatremia: The Effects Of Carbohydrate And Hydration Status On IL-6, Adh, And Sodium Concentrations**

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(No relationships reported)

Exercise-associated hyponatremia (serum sodium < 135 mmol/L) is a rare, but serious condition that has been identified in those engaging in prolonged, physical activity conducted in the heat.

**PURPOSE:** The purpose of this study was to evaluate the effect of hydration status and glycogen level on plasma IL-6, ADH, and sodium concentrations during and after prolonged exercise in the heat.

**METHODS:** Ten male participants completed four trials: a glycogen depleted, euhydrated condition (DE); a glycogen depleted, dehydrated condition (DD); a glycogen loaded, euhydrated condition (LE); and a glycogen loaded, dehydrated condition (LD) consisting of cycling 90 minutes at 60% VO<sub>2</sub> max in a 35°C environment followed by a 3-h rehydration (RH) period. During RH, subjects received either 150% of fluid lost (DD & LD) or an additional 50% of fluid lost (DE & LE). Exercise and RH blood samples were analyzed for glucose, IL-6, ADH, and Na<sup>+</sup>. Sweat and urine samples were analyzed for [Na<sup>+</sup>].

**RESULTS:** Post-exercise to post-rehydration [Na<sup>+</sup>] changes for LD, DD, DE and LE were -6.85, -6.7, -1.45 and 0.10 mM, respectively. Post-exercise [IL-6] for DD, LD, DE, and LE were 5.4, 4.0, 3.7, and 3.49 pg/mL, respectively. Post-exercise [ADH] for LD, DD, DE, and LE were 21.5, 12.8, 7.6, and 1.9 pg/mL, respectively. The number of hyponatremic measurements for all RH samples was 5, 5, 20, and 10 for LD, DD, DE, and LE, respectively.

**CONCLUSION:** Despite our glycogen and hydration manipulations, no regulatory effects of IL-6 and ADH on plasma sodium were observed. The timing of fluid intake did alter plasma sodium since euhydration during exercise combined with an additional 50% intake during RH, and a post-exercise RH volume of 150% of fluid lost both resulted in sodium concentrations below initial levels.

Supported by a grant from the Gatorade Sports Science Institute.

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**D-24 Free Communication/Poster - Altitude and Hypoxia**

MAY 28, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**2113 Board #1 May 28 2:00 PM - 3:30 PM**

**Finger Temperatures In Hypoxia And Normoxia In A Neutral And Cold Environment**

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(No relationships reported)

Little is known about the combined effects of cold and altitude on the risk for cold injuries, while in most situations cold and altitude co-exist. The cold induced vasodilation (CIVD) test assesses the risk for cold injuries.

**PURPOSE:** To determine the differences in finger skin temperature between hypoxic and normoxic circumstances in a cold and a thermoneutral climate.

**METHODS:** Six healthy, well-trained male subjects (24±3 years) participated in the experiment. All subjects participated in four experimental conditions: normobaric normoxia in a cold (10°C) climate (NNC), normobaric normoxia in a neutral (22°C) climate (NNN), normobaric hypoxia (14.1% O<sub>2</sub>) in a cold climate (NHC) and normobaric hypoxia in a neutral climate (NHN). In each condition subjects performed a CIVD-test in which the right middle finger was immersed for 30 minutes in 5°C water. Skin temperature of the middle finger was determined.

**RESULTS:** Mean finger skin temperature between minute 10 and 30 (NNC: 9.7±1.8, NNN: 12.4±1.7, NHC: 8.7±1.0, NHN: 10.9±1.2 °C) was significantly lower in the cold compared to the thermoneutral conditions and significantly lower in the hypoxic compared to the normoxic conditions in the same environment.

Onset time of CIVD was not different between normoxia and hypoxia and was significantly longer in NNC.

Minimal skin temperature (NNC: 6.6±0.9, NNN: 9.0±0.9, NHC: 6.2±0.4, NHN: 8.2±1.4 °C) was significantly lower in the cold compared to the thermoneutral conditions. No differences were observed between normoxic and hypoxic conditions.

**CONCLUSION:** CIVD reaction was earlier and at higher skin temperatures in thermoneutral compared to cold conditions. Mean skin temperature was lower under hypoxic compared to normoxic conditions.

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**2114 Board #2 May 28 2:00 PM - 3:30 PM**

**Normobaric Hypoxic Pre-acclimation And Ascent Of Mount Kilimanjaro By A 69.5-year-old Man: A Case Study**

Ken Kambis<sup>1</sup>, Michio Yasukawa<sup>2</sup>, Reina Chamberlain<sup>1</sup>, Erica Jackson<sup>1</sup>, Alastair Connell<sup>1</sup>. <sup>1</sup>The College of William & Mary, Williamsburg, VA. <sup>2</sup>Senshu University, Kanagawa, Japan.

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**PURPOSE:** Normobaric Intermittent Hypoxic Exposure (NIHE) pre-acclimation to high altitude is known to reduce risk of Acute Mountain Sickness (AMS) during subsequent exposure to higher altitudes. Little is known about NIHE pre-acclimation of older adult mountaineers nor the efficacy of NIHE pre-acclimation in reducing risk of AMS. The purpose of this study is to evaluate the protective effect of pre-acclimating a 69.5-year-old male using NIHE prior to a climb of Mount Kilimanjaro.

**METHODS:** RT, a 69.5 y.o., 178 cm tall, 76.2 kg, healthy male informed volunteer, participated in this IRB approved study. RT was exposed to simulated altitudes of 2438 m to 5486 m in increments of 1000 m for periods of 3-4h/d for 15d prior to air travel to Africa to climb Mount Kilimanjaro (5895 m). Prior to and after each exposure the subject completed the Environmental Symptoms Questionnaire (ESQ), Lake Louise Consensus Score (LLS), and Profile of Mood States (POMS). Every 15 minutes of each exposure, SpO<sub>2</sub> was measured as was mood state and heart rate. On d15 of NIHE, RT was exposed to simulated altitudes equivalent to each altitude of the 8 campsites on the Western Approach (Lemosho) Route of Mount Kilimanjaro after which he remained at 5486 m for 3h. During the Kilimanjaro climb, the ESQ and LLS were completed evenings and mornings at each camp. SpO<sub>2</sub>, Heart Rate, and altitude were also recorded at each camp as well as on the summit. Two months after RT returned to sea level (SL), he was again exposed over a 3h period to the 8 Lemosho Route simulated campsite altitudes for data comparison to the d15 NIHE values.

**RESULTS:** During pre-acclimation SpO<sub>2</sub> was reduced from d1 at 2486 m to d15 at 5486 m ( $r = -0.863$ ,  $P < 0.01$ ). No change in mood state or ESQ AMS-C was noted throughout the 15d pre-acclimation period. During the climb, SpO<sub>2</sub> decreased with altitude as expected and AMS-C was higher only on d7 (summit day) of the climb. When the NIHE values at the 8 Lemoshu Route simulated campsite altitudes were compared to d15 data 2 months after RT's return to SL, increases in AMS-C (Wilcoxon signed-rank test;  $P < 0.05$ ) were noted at 3505 m to 5246 m.

**CONCLUSIONS:** Pre-acclimation with NIHE reduces risk of AMS-C in healthy older adults preparing for strenuous high altitude exertion.

*Supported by: The Foundation for Aging Studies and Exercise Science Research*

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**2115 Board #3 May 28 2:00 PM - 3:30 PM**

**Normobaric Hypoxic Simulated Altitude Reduces Appetite but Not Smell Identification**

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*(No relationships reported)*

**PURPOSE:** It has long been known that extended exposure to high altitude environments can result in significant weight loss involving both fat tissue and skeletal muscle mass. The exact mechanism of this anorectic response to altitude exposure is poorly understood. Included in the complex array of cognitive appetite stimuli is the sense of smell. There is little information concerning the effect of simulated high altitude on hunger/appetite or the ability to smell different odors. Therefore, the purpose of this study is to determine the effect of intermittent hypoxic exposure to simulated high altitude on hunger/appetite and on the ability to identify odors.

**METHODS:** 30 healthy informed volunteer male and female subjects were recruited from the William & Mary student body. In single-blind fashion, subjects in this IRB approved study were placed in either a sea level (SL Control;  $n = 15$  [Age:  $20.4 \pm 0.2$  yrs; Height  $171.9 \pm 1.9$  cm; Weight:  $70.3 \pm 3.0$  kg]) or simulated high altitude (HA Treatment;  $n = 15$  [Age:  $20.1 \pm 0.4$  yr; Height:  $174.9 \pm 2.3$  cm; Weight:  $72.7 \pm 3.5$  kg]) 4300 m group. Within 7d of familiarization and after recording resting data and food intake diary, all subjects were exposed to their respective group altitude for 4h. Prior to and after each exposure, subjects were administered the University of Pennsylvania Brief Smell Identification Test (B-SIT), the 3-Factor Eating Questionnaire (Stunkard & Messick, 1984), the Environmental Survey Questionnaire (ESQ), and the Lake Louise Consensus Score for Acute Mountain Sickness (LLS).

**RESULTS:** There was no difference in caloric consumption between each group prior to testing. Hunger increased ( $P = 0.008$ ) in the SL group while no change in hunger occurred in the HA group ( $P = 0.136$ ). After 4h exposure, ESQ (AMS-C) scores were higher in the HA group ( $P < 0.05$ ) than the SL group. SpO<sub>2</sub> remained the same in the SL group pre- ( $98.5 \pm 0.2\%$ ) and during ( $98.7 \pm 0.2\%$ ) exposure while in the HA group, SpO<sub>2</sub> decreased from  $98.7 \pm 0.2\%$  pre-exposure to  $82.7 \pm 0.2\%$  ( $P < 0.001$ ) during exposure.

**CONCLUSION:** 4300 m normobaric simulated altitude IHE for 4h decreases hunger/appetite but does not affect ability to identify odors.

*Supported by: The Foundation for Aging Studies and Exercise Science Research and Senshu University*

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**2116 Board #4 May 28 2:00 PM - 3:30 PM**

**Mitochondrial Substrates Modification By Skeletal Muscles After Caloric Restriction Due To Chronic Hypoxia**

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*(No relationships reported)*

Prolonged exposure to hypobaric hypoxia leads to alterations in muscle function. Mitochondrial oxidative capacities seem to be affected differently depending on muscle phenotype. However, little is known concerning the impact of chronic hypoxia on fuel sensitivity from mitochondria of slow and fast-twitch skeletal muscles.

**PURPOSE:** To determine both effects of ambient hypoxia on the pattern of substrates preferential utilization by mitochondria from glycolytic extensor digitorum longus (EDL) and oxidative soleus (SOL).

**METHODS:** Three experimental groups of rats were constituted: hypoxic (H : exposed 3 weeks to a simulated altitude of 5500 m in an hypobaric chamber), normoxic (N), and N pair fed (PF) to dissociate the respective effects of hypoxia and associated caloric restriction. PF animals received a food supply equivalent to the amount consumed by H rats. We measured in situ ADP (2 mM)-stimulated, mitochondrial respiration rates from skinned fibers in presence of increasing concentrations of palmitoyl-carnitine (Palm-C)+malate (Mal) for both muscles, pyruvate (Pyr)+Mal for SOL, and glycerol-3-phosphate (G3-P) for EDL. Because fibers oxygen uptake (V<sub>s</sub>) followed Michaelis-Menten kinetics in function of substrates level, V<sub>s</sub> and K<sub>m</sub> (mitochondrial sensitivity) were calculated for each substrate.

**RESULTS:** V<sub>G3P</sub>, K<sub>mG3P</sub> as well as V<sub>Palm-C</sub> in EDL muscle remained not altered in H and PF rats. V<sub>Palm-C</sub> in SOL of PF animals was lower when compared with both N and H rats (-16% and -24%,  $p < 0.05$ , respectively), while K<sub>mPalm-C</sub> were not affected by experimental conditioning. V<sub>Pyr</sub> was also reduced in SOL of PF animals in comparison with N and H rats (-14% and -16%,  $p < 0.05$ , respectively). K<sub>mPyr</sub> was decreased in the same way both in H and PF rats (-25% and -23%,  $p < 0.01$ , respectively), indicating a higher sensitivity for Pyr mainly due to caloric restriction. Then, both maximal capacities to oxidize Palm-C and Pyr seem to be influenced independently by anorexia and O<sub>2</sub> availability in SOL.

**CONCLUSION:** Maximal Palm-C and Pyr utilization by mitochondria was decreased by caloric restriction and increased by hypoxia alone in SOL. Moreover, the present experiment suggests for the first time that the hypoxia-induced caloric restriction also enhanced the mitochondrial sensitivity for Pyr in SOL.

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**2117 Board #5 May 28 2:00 PM - 3:30 PM**

**Overnight Hypoxia Attenuates Glucose Response In Glucose Tolerance Test In Relatives Of Type 2 Diabetics**

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*(No relationships reported)*

Insulin resistance of skeletal muscle, resulting in impaired glucose transport, is a common feature in patients with Type 2 diabetes (T2D) and in their healthy first-degree relatives. In addition to insulin, muscle contraction and hypoxia are the major stimuli to glucose transport in the skeletal muscle.

**PURPOSE:** To determine the effects of acute and chronic intermittent exposure to normobaric hypoxia on the blood glucose concentration and on the insulin sensitivity in oral glucose tolerance test (OGTT).

**METHODS:** In the acute cross-over overnight hypoxia study, patients with T2D ( $n = 11$ ), relatives of T2D (REL,  $n = 14$ ) and endurance athletes (ATH,  $n = 8$ ) were randomized (single-blind) either to hypoxic (FIO<sub>2</sub> = 0.153 ~ 2500 m) or normoxic 12-h exposure for the first night, and to opposite 12-h exposure for the second night. In the morning, arterial oxygen saturation (SpO<sub>2</sub>%) was measured, and subjects moved into a normoxic room for a 30-min rest, after which an OGTT was performed. In the chronic intermittent hypoxia study, ATH ( $n = 12$ ) slept and stayed 12-h daily for two weeks in hypoxic rooms, accomplishing daily activities and regular training in ambient normoxia at sea level. Plasma glucose (PG) and serum insulin were determined in OGTT, area under the curve (AUC) for glucose concentration was calculated, and insulin sensitivity (ISI<sub>est</sub>) was estimated from demographic parameters and values obtained from OGTT.

**RESULTS:** Acute overnight hypoxia: SpO<sub>2</sub>% reduced in all groups (mean $\pm$ SD; T2D:  $97 \pm 3$  vs.  $91 \pm 3$ , REL:  $98 \pm 4$  vs.  $94 \pm 7$ , ATH:  $97 \pm 3$  vs.  $91 \pm 6$ ; all  $p < 0.001$ ). In T2D and in ATH, hypoxia did not influence fasting PG or insulin concentrations, or their responses in OGTT, but ISI<sub>est</sub> improved in ATH ( $0.18 \pm 0.14$  vs.  $0.22 \pm 0.14$ ,  $p < 0.01$ ). In REL, PG decreased both in the fasting state ( $4.60 \pm 0.24$  vs.  $4.41 \pm 0.34$ ,  $p < 0.05$ ) and at 120-min ( $5.34 \pm 0.97$  vs.  $4.83 \pm 1.03$ ,  $p < 0.05$ ), AUC decreased ( $864 \pm 107$  vs.  $813 \pm 112$ ,  $p < 0.01$ ) and ISI<sub>est</sub> improved ( $0.16 \pm 0.04$  vs.

0.19±0.07, p<0.01). Chronic two weeks hypoxia: AUC decreased (702±73 vs. 654±67, p=0.06) and ISI<sub>est</sub> improved with 20 % (0.18±0.04 vs. 0.22±0.04, p<0.01).

**CONCLUSION:** Hypoxia improves insulin sensitivity and stimulates glucose disposal in relatives of T2D and in athletes, independent of exercise, but not in patients with T2D.

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**2118 Board #6 May 28 2:00 PM - 3:30 PM**

**New Altitude Device Alters Markers Of Glucose Metabolism Using Cyclic Hypobaric Hypoxia**

Anne L. Friedlander<sup>1</sup>, Scott Rubinstein<sup>2</sup>, Andrew R. Hoffman<sup>2</sup>, Omer Shah<sup>2</sup>, Jill A. Fattor<sup>1</sup>. <sup>1</sup>Stanford University, Palo Alto, CA. <sup>2</sup>VA Palo Alto Health Care System, Palo Alto, CA. (Sponsor: Barry Braun, FACSM)

(No relationships reported)

In humans, chronic hypoxia increases dependence on glucose as a substrate in men and increases insulin sensitivity in men and women over time. In rats, intermittent hypoxic exposure improves oral glucose tolerance test (OGTT) response and, when combined with exercise training, increases GLUT4 protein expression more than exercise training alone. Cyclic Variations in Altitude Conditioning (CVAC) is a novel technology that provides whole-body exposure to rapidly fluctuating intermittent hypobaric hypoxia (IH).

**PURPOSE:** To test the hypothesis that markers of glucose metabolism would be changed with CVAC IH, two groups of sedentary, middle-aged men were exposed to 10 weeks (40 min/d, 3d/wk) of either IH or sham (SH) sessions.

**METHODS:** IH subjects (age:48±6, weight:86±12 kg, BMI:27.1±3, n=11) experienced cyclic pressures (approximately 200 cycles/20 min) simulating altitudes initially ranging from sea level to 10,000 ft (week 1) and progressing to 20,000 ft (by week 5). SH subjects (age:50±4, weight:89±15 kg, BMI:27.5±3, n=10) were exposed to slowly-fluctuating pressures up to 2,000 ft (all subjects blinded to elevation). Physical function and blood markers of metabolic syndrome risk factors were measured at baseline, 3, 6 and 10 wks.

**RESULTS:** Two IH subjects were dropped from analysis for failure to progress past 10,000 ft (unable to equalize ears, IH: n=9). Body weight and physical activity remained stable throughout 10 weeks for both groups. There was a group-by-time interaction in fasting glucose concentration (IH: 96±9 to 90±7 mg/dl, SH: 94±7 to 97±9 mg/dl, p<0.03). The reduction in blood glucose response to oral glucose tolerance test [area under the curve (AUC)] was greater in IH compared to SH following 10 weeks of CVAC exposure (p<0.05). There was no change in fasting insulin or in the insulin response during the OGTT for either group. Functional measures (strength, timed walk test and step test) also did not change over 10 weeks in IH or SH.

**CONCLUSION:** Ten weeks of CVAC IH exposure reduces glucose concentration in middle-aged men at risk for metabolic syndrome.

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**2119 Board #7 May 28 2:00 PM - 3:30 PM**

**Effects Of Hypoxia On Muscle Energy Metabolism During Exercise**

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(No relationships reported)

Recently, high-altitude training has been used for improving the performance of athletes participating in not only endurance events but also relatively short-distance events. However, the effects of high-altitude training on muscle energy metabolism have not been clarified.

**PURPOSE:** This study aimed to determine the characteristics of muscle energy metabolism during exercise under conditions of acute hypoxia.

**METHODS:** Six subjects (age: 27-31 years) performed dynamic knee-extension exercise while lying supine on a super-conducting magnet under conditions of normoxia (F<sub>O2</sub> = 20.9%) and hypoxia (F<sub>O2</sub> = 13.0%). The workload was increased every 2 min until exhaustion. Quadriceps femoris muscle energy metabolism and oxygen kinetics were measured using <sup>31</sup>P-phosphorus magnetic resonance spectroscopy (<sup>31</sup>P-MRS) and near-infrared spectroscopy (NIRS). The muscle oxygen consumption (VO<sub>2mus</sub>) was estimated by the decreasing rate of oxygenated hemoglobin during temporal arterial occlusion. The pulmonary oxygen uptake (VO<sub>2pul</sub>) was also measured by the Douglas bag method.

**RESULTS:** The values of muscle phosphocreatinine (PCr), muscle pH, VO<sub>2mus</sub>, and VO<sub>2pul</sub> significantly reduced at identical submaximal workloads under hypoxic conditions as compared to the corresponding values under normoxic conditions (p < 0.05). The muscle PCr at exhaustion was almost entirely depleted under both conditions, and these values did not significantly differ between the 2 conditions. However, the muscle pH, VO<sub>2mus</sub>, and VO<sub>2pul</sub> values at exhaustion were significantly lower during hypoxia than during normoxia (p < 0.05).

**CONCLUSIONS:** The data of muscle PCr and pH at exhaustion suggest that glycolytic system contributes to a greater extent under hypoxic conditions than normoxic conditions during high-intensity exhaustive exercise. The results of this study suggest that as compared to normoxic conditions, hypoxic conditions cause a reduction in the muscle aerobic energy supply and an increment in the anaerobic energy supply during exercise at identical workloads.

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**2120 Board #8 May 28 2:00 PM - 3:30 PM**

**The Effects Of Exercise And Atmospheric Oxygen Concentration In Normobaric Environment On The Free Radical Generation And Antioxidant Potential In Mice**

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(No relationships reported)

Oxidative stress induced by both reactive oxygen species (ROS) has been shown to be associated with chronic pathological events.

**PURPOSE:** The present study investigates the nature in which the exercise and the atmospheric oxygen concentration in normobaric condition have influence over the lactate, the free radical generation and antioxidant potential in blood, both of which are important oxidative stress.

**METHODS:** The experimental subjects were male Balb/c mice within 12 hours of birth. They were randomly divided into four groups: normoxia control group (NC, 21% O<sub>2</sub>), hypoxia control group (HC, 13% O<sub>2</sub>), normoxia exercise group (NE, 21% O<sub>2</sub>), and hypoxia exercise group (HE, 13% O<sub>2</sub>). Each of the exercise groups was subjected to travel 16 to 20 meters per minute for the duration of 30 to 45 minutes per day, 3 days per week, for 10 to 20 weeks, beginning on the 10<sup>th</sup> week of experimental conditions. Lactate concentration was measured before and immediately after exercise from tail vein blood with Lactate Pro. Free radicals generation was determined using dROM method and antioxidant potential was determined by BAP test.

**RESULTS:** Basal blood lactate levels were similar in the all groups and were increased by exercise. However, the increase was lower in the exercise group. The increase was much smaller in the HE group. Higher concentrations of free radicals were found in the NC group and the HE group than in the HC group and the NE group and further the NC group generated more free radicals than the HC group. Furthermore, the NE group had more antioxidant potential than the other three groups. Additionally, among both normoxia and hypoxia groups, the exercise groups had more antioxidant potential than their respective control groups. Free radical generation was more prominent in the HE group. Interestingly, there was only a small increase in the blood lactate levels and a marked increase in antioxidants in the HE group after exercise. However, the free radical concentration was very high in the same group.

**CONCLUSION:** Exercise and hypoxia influenced oxidative stress positively. However, exercise in the low oxygen concentration environment increased free radical generation. To understand more about the actual mechanisms of how each factor influences the oxidative stress, more research should be conducted.

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**2121 Board #9 May 28 2:00 PM - 3:30 PM**



## Trained Women Demonstrate Greater Preservation Of Peak Exercise Capacity During Acute Hypoxia Than Trained Men

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The lower hemoglobin concentration and consequent lower arterial oxygen content in women compared to men may result in gender differences in the physiological response to acute hypoxia. However, very few reports of direct gender comparisons in the physiological response to acute hypoxia are available to date and indirect comparisons between studies exclusively of men or women are largely equivocal.

**PURPOSE:** To determine the effects of acute normobaric hypoxia on cardiovascular hemodynamics at rest and during maximal exercise in endurance trained men and women.

**METHODS:** Peak exercise capacity ( $W_{peak}$ ) at sea level (SL) and normobaric hypoxia (NH, 12.8%  $F_{iO_2}$ , ~3900 m) was determined for 20 male ( $26 \pm 1$  yr,  $56.6 \pm 1.2$  ml/kg/min  $VO_{2peak}$ , mean  $\pm$  SE) and 15 female ( $25 \pm 1$  yr,  $45.3 \pm 1.2$  ml/kg/min  $VO_{2peak}$ ) trained cyclists and triathletes at least 48 h apart. At rest and during exercise, heart rate (HR), stroke volume (SV), and cardiac output (Q) were measured continuously by noninvasive impedance cardiography while arterial oxygen saturation ( $SaO_2$ ) was measured by pulse oximetry.

**RESULTS:** HR, SV, and Q at rest did not change from SL to NH in men or women and both genders demonstrated similar reductions in  $SaO_2$  at rest ( $96 \pm 1$  to  $85 \pm 1\%$ ,  $p < 0.05$ ).  $W_{peak}$  was significantly reduced from SL to NH in both men ( $325 \pm 8$  to  $250 \pm 6$  W,  $p < 0.05$ ) and women ( $245 \pm 7$  to  $201 \pm 6$  W,  $p < 0.05$ ), but the relative decrease in  $W_{peak}$  from SL to NH was significantly greater in men than women ( $-22.7 \pm 0.9$  vs.  $-17.5 \pm 1.5\%$ ,  $p < 0.05$ ). Peak Q was similarly reduced in both genders from SL to NH ( $-9.5 \pm 3.6\%$ ,  $p < 0.05$ ), while peak SV did not change and peak HR was reduced in men more than women ( $-7.3 \pm 0.7\%$  vs.  $-4.9 \pm 0.8\%$ ,  $p < 0.05$ ).  $SaO_2$  at peak was similarly reduced in men ( $94 \pm 1$  to  $71 \pm 2\%$ ,  $p < 0.05$ ) and women ( $94 \pm 1$  to  $72 \pm 2\%$ ,  $p < 0.05$ ) from SL to NH.

**CONCLUSION:** Endurance trained women appear to be more capable of preserving peak exercise capacity during acute NH than endurance trained men despite similar decrements in Q and  $SaO_2$ .

Supported by the World Anti-Doping Agency

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### 2122 Board #10 May 28 2:00 PM - 3:30 PM Erythrocytes And Stress Responses During Repeated Intermittent Normobaric Hypoxia

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(No relationships reported)

Altitude training (chronic hypoxia; CH) and/or intermittent normobaric hypoxia (IH or live high train low; LHTL) are considered to be effective strategy to improve endurance capacity of athletes. It is well known that exposure to hypoxia induces erythrocyte with relate to exercise performance. However, stress reactions during these altitude training may also seriously compromise physical conditions of athletes.

**PURPOSE:** To examine the changes in erythrocyte and stress responses in endurance athletes during repeated live high-train low in a normobaric hypoxic room.

**METHODS:** Twelve-male college long distance runners and triathletes participated in this study approved by the Human Ethics Committee of Sendai University in accordance with the Declaration of Helsinki. They were divided into a normoxic (N, n=6) or a hypoxic group [two 7-night blocks of hypoxia, interspersed with 7 nights of normoxia (H, n=6)]. H group subjects stayed in a normobaric hypoxic room (15.4%  $O_2$ ; 2500m) in a for 10-12h a day at night. Subjects were undergone the hematological tests for erythrocyte (RBC, Hb Hct, reticulocyte, EPO) and stress responses (WBC, subset count and stress hormone) before, during and after the experimental period. Also, resting erythrocyte parameters, white blood cell subsets and stress hormones were measured before (pre) and 1st, 3rd and 7th day at each series.

**RESULTS:** Erythropoietin (EPO) and Reticulocyte (Ret) as erythrocyte was stimulated by hypoxia. RBC, Hb and Hct of H group at the end of experiment (RBC;  $536 \pm 27$   $10^4/\mu$ l, Hb;  $16.5 \pm 0.4$  g/dl, Hct;  $48 \pm 1.4\%$ ) tendency to increase from pre values (RBC;  $521 \pm 19$   $10^4/\mu$ l, Hb;  $15.8 \pm 0.4$  g/dl, Hct;  $46.9 \pm 1.3\%$ ). WBC subsets and epinephrine and norepinephrine as stress hormone were increased by hypoxia.

**CONCLUSIONS:** It was concluded that repeated intermittent normobaric hypoxia was stimulate the erythrocyte. Also, Stress responses as WBC subsets and/or stress hormone may be relate the improvement of exercise performance in athletes.

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### 2123 Board #11 May 28 2:00 PM - 3:30 PM Effect Of Sodium Bicarbonate Ingestion During Altitude Acclimatization On High-altitude, Short-duration, Cycling Performance

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(No relationships reported)

**PURPOSE:** Acute altitude exposure induces hyperventilation which, in turn, results in respiratory alkalosis. In an attempt to restore blood pH, the kidneys enhance the rate of bicarbonate excretion which may reduce the buffering capacity of the blood and, thus, the performance in exercises that generate large amounts of lactic acid. Consequently, bicarbonate supplementation during altitude acclimatization may restore the buffering capacity of the blood and enhance exercise performance more so than supplementation at sea level. The purpose of this study, therefore, was to evaluate the effect of sodium bicarbonate ingestion during an 8-hour altitude acclimatization period on subsequent short-duration, high-intensity cycling performance at an altitude of 10,000 ft.

**METHODS:** Following 3 to 5 accommodation trials, four time-trials (TT) were conducted on ten trained males under the following conditions: normobaric/placebo (NPO); normobaric/sodium bicarbonate (NSB); hypobaric/placebo (HPO); and hypobaric/sodium bicarbonate (HSB). All trials were performed in a hypobaric altitude simulator. The TT included completing 360 revolutions as fast as possible on a cycle ergometer at a resistance equal to  $\approx 5.5\%$  body weight.

**RESULTS:** The rate of urinary bicarbonate excretion was significantly ( $p = .005$ ) higher during the hypobaric ( $1.264 \pm 1.05$  mg $\cdot$ min $^{-1}$ ) versus the normobaric ( $.324 \pm .37$  mg $\cdot$ min $^{-1}$ ) acclimatization period. Pre- to post-exercise increment in serum lactate concentration was larger ( $p = .03$ ) by  $4.08 \pm 2.6$  mmol $\cdot$ L $^{-1}$  in HSB TT compared to HPO TT but the difference between the Normobaric TTs ( $2.58 \pm 1.5$  mmol $\cdot$ L $^{-1}$ ) was not significant. No significant differences between placebo and SB ingestion trials under both hypobaric and normobaric conditions were found for pre- to post-exercise drop in serum bicarbonate concentration. Additionally, no significant difference was observed between placebo and SB ingestion trials for performance time under normobaric conditions (NPO:  $305.0 \pm 47.7$  sec; NSB:  $304.9 \pm 44.8$  sec) but a significant difference resulted under hypobaric conditions (HPO:  $352.5 \pm 55.1$  sec; HSB:  $341.2 \pm 58.1$  sec;  $p = .02$ ).

**CONCLUSIONS:** SB ingestion improved cycling performance under hypobaric conditions but not under normobaric conditions.

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### 2124 Board #12 May 28 2:00 PM - 3:30 PM Effect Of Normobaric Different Oxygen Concentration On Anaerobic Energy Release During Supramaximal Exercise In Cyclists

Norio Saga, Tomoki Nagata, Shizuo Katamoto, Hisashi Naito, Mitsutoshi Kurosaka, Ikumi Kobayashi, Ryo Kakigi, Noriko Ichinoseki-Sekine.



*Juntendo University, Chiba, Japan.*

*(No relationships reported)*

**PURPOSE:** The purpose of this study was to clarify the critical level of inspired oxygen concentration for increased anaerobic energy release during supramaximal cycling exercise under normobaric condition.

**METHODS:** Eight collegiate cyclists volunteered to participate in this study. They underwent three exercise tests. First, they performed a maximal incremental cycling exercise test to determine their maximal oxygen uptake ( $\text{VO}_2$  peak). Second, 12 submaximal cycling tests were performed to establish the  $\text{VO}_2$ - workload  $\times$  cadence relationship for determining the oxygen demand of supramaximal cycling. Finally, the subjects performed six 40-second Wingate anaerobic tests (WAnT) to determine the anaerobic energy release under different inspired oxygen conditions (20.94(sea level), 16.4, 15.4, 14.5, 13.6, and 12.7%  $\text{O}_2$ ) using a Douglas bag. Anaerobic energy release was evaluated by oxygen deficit accumulated over 40-second.

**RESULTS:** The mechanical power output during WAnT was almost the same between sea level and hypoxic conditions. However,  $\text{VO}_2$  during WAnT was significantly lower in 14.5, 13.6 and 12.7%  $\text{O}_2$  compared with sea level. The absolute values and percentages of anaerobic energy release were significantly higher in 13.6%  $\text{O}_2$ , and in 13.6 and 12.7%  $\text{O}_2$  compared with sea level, respectively ( $P < 0.05$ ).

**CONCLUSIONS:** The results suggest that anaerobic energy release in 40-second supramaximal cycling could be increased when the subjects exercise under hypoxic condition of oxygen concentrations below 14.5%  $\text{O}_2$ , which correspond to the altitude of 3000m.

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**2125 Board #13 May 28 2:00 PM - 3:30 PM**

**The Effect Of Sleeping In A Normobaric Hypoxic Tent For One Week Upon Sleep Quality**

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*(No relationships reported)*

**PURPOSE:** To examine the chronic effects (8 nights) of sleeping in a normobaric hypoxic tent (10 hours.night<sup>-1</sup>) in Great Britain International athletes from a range of sports (Rowing, Running, Kayaking; n = 12; age: 26.2  $\pm$  3.7 years; stature: 184.4  $\pm$  7.3 cm; body mass: 74.4  $\pm$  6.9 kg).

**METHODS:** the Leeds Sleep Evaluation Questionnaire (LSEQ) combined with Wristwatch Actigraphy (WA) was used to examine subjective and objective markers of sleep quality and compare these to baseline sleep.

**RESULTS:** Data were considered on a case by case basis revealing a heterogeneous response, with some individuals experiencing negative effects. As a group, there were no significant differences in sleep quality between baseline and night 1 sleep for any measurement. Sleep latency was significantly shorter on night 8 in the tent compared to night 1 ( $P < 0.05$ ). Other WA data revealed that behavioural aspects of sleep such as sleep fragmentation continued to be negatively affected in some individuals despite chronic exposure to NH.

**CONCLUSIONS:** Sleep quality in a hypoxic tent, is altered in some individuals, and is not universally improved following 8 nights. This may have significant consequences for recovery from training in some individuals.

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**2126 Board #14 May 28 2:00 PM - 3:30 PM**

**Muscle Deoxygenation And Electromyographic Activity During Isolated Muscle Exercise In Hypoxia**

Keisho Katayama<sup>1</sup>, Yutaka Takeuchi<sup>1</sup>, Yasuhide Yoshitake<sup>2</sup>, Osamu Fujita<sup>1</sup>, Kohei Watanabe<sup>1</sup>, Hiroshi Akima<sup>1</sup>, Koji Ishida<sup>1</sup>. <sup>1</sup>Nagoya University, Nagoya, Japan. <sup>2</sup>National Institute of Fitness and Sports, Kanoya, Japan. (Sponsor: Jerome A. Dempsey, FACSM)

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*(No relationships reported)*

It is well known that acute hypoxia significantly increased the rates of development of exercise-induced muscle fatigue. It is hypothesized that muscle deoxygenation is accelerated during exercise in hypoxia, and that this would be related to the rate of increase in electromyographic (EMG) activity as an index of motor unit recruitment.

**PURPOSE:** The aim of the present study was to elucidate the changes in muscle deoxygenation and EMG activity during isolated muscle exercise in hypoxia and the relationship between the changes in deoxygenation and EMG activity.

**METHODS:** Seven healthy male subjects performed intermittent, unilateral, isometric, submaximal quadriceps muscle contractions [60% maximal voluntary contraction (MVC), 5 sec of contraction/5 sec of rest] while breathing normoxic ( $\text{FIO}_2=0.21$ ) or hypoxia ( $\text{FIO}_2=0.11-0.12$ ) gas mixture. MVC was obtained before and at the end of each minute of submaximal exercise until exhaustion, defined as the inability to exert or maintain 60% of rested MVC. The change in muscle deoxygenation was measured by near-infrared spectroscopy. Surface EMG and muscle deoxygenation were simultaneously recorded from the vastus lateralis muscle.

**RESULTS:** The deoxygenation index (deoxygenated Hb/Mb - oxygenated Hb/Mb) during exercise in hypoxia was larger ( $P < 0.05$ ) than that in normoxia. The rate of increase in iEMG during exercise in hypoxia was greater ( $P < 0.05$ ) than in normoxia. The rate of percent reduction of MVC in hypoxia was larger ( $P < 0.05$ ) than normoxia. To clarify the relationship between parameters during exercise in hypoxia and normoxia, the magnitude of the changes in deoxygenation index and iEMG at end of first three minutes during submaximal exercise were calculated individually as the difference between those obtained in hypoxia and normoxia (delta = hypoxia - normoxia). A significant positive correlation was observed between delta deoxygenation index and delta iEMG at the second ( $r=0.71$ ,  $P < 0.05$ ) and third ( $r=0.75$ ,  $P < 0.05$ ) minutes during exercise.

**CONCLUSIONS:** These results suggest that the rates of rise of muscle activity and development of fatigue during submaximal isolated muscle exercise in acute hypoxia are linked to the magnitude of muscle deoxygenation.

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**2127 Board #15 May 28 2:00 PM - 3:30 PM**

**Oxygen Transport In Kenyan Runners**

Nicole Prommer<sup>1</sup>, Stefanie Thoma<sup>2</sup>, Lennart Quecke<sup>1</sup>, Thomas Gutekunst<sup>1</sup>, Christian Voelzke<sup>1</sup>, Nadine Wachsmuth<sup>1</sup>, Andreas Michael Niess<sup>2</sup>, Walter Schmidt<sup>1</sup>. <sup>1</sup>University of Bayreuth, Bayreuth, Germany. <sup>2</sup>University of Tübingen, Tübingen, Germany. (Sponsor: Juergen Steinacker, FACSM)

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*(No relationships reported)*

It is assumed that the excellent performance of Kenyan runners is mainly due to a high running economy in connection with high  $\text{VO}_{2\text{max}}$ . To explain underlying physiological reasons research mainly focused on muscular oxygen consumption.

**PURPOSE:** To investigate basic factors of oxygen transport, i.e. total hemoglobin mass (tHb-mass), blood volume (BV) and heart size in elite Kenyan runners and adaptation processes of these parameters during a sojourn at lowland.

**METHODS:** Ten Kenyan runners (group K; competing between 1.500m and marathon) living and training at moderate altitude (~2100m) performed a 6-weeks lasting training camp at 350m in Germany. Training (volume ~210km/week) was similar to that normally performed in Kenya. tHb-mass and BV were determined using the optimized  $\text{CO}$ -rebreathing method on the first day after arrival to Germany and weekly during their whole stay. In addition BV and haemoglobin concentration [Hb] were also examined before departure at altitude.  $\text{VO}_{2\text{max}}$  was determined in three field tests and running economy in a laboratory test on a treadmill. 11 German elite runners served as a control group (group G).

**RESULTS:** The Kenyan runners had a significantly lower body mass (K 57.2  $\pm$  7.0kg; G 66.5  $\pm$  6.3kg) and BMI (K 18.5  $\pm$  0.9; G 20.4  $\pm$  0.9). Relative  $\text{VO}_{2\text{max}}$  did not differ between the

groups (K 71.5 ± 5.0 ml/kg/min; G 70.7 ± 3.7 ml/kg/min) and absolute VO<sub>2</sub>max did not change during the 6 weeks at low altitude. Relative tHb-mass (K 14.2 ± 1.0g/kg; G 14.0 ± 0.7g/kg) and BV (K 101.9 ± 4.5ml/kg; G 99.6 ± 5.8ml/kg) were similar in both groups but continuously decreased in K during the stay at lowland (absolute tHb-mass from 813 ± 90g to 767 ± 90g, p < 0.001; BV from 5828 ± 703ml to 5513 ± 708ml, p < 0.01). [Hb] tended to decrease (-0.7 ± 0.7g/dl) when commuting altitude but did not differ at sea level between the groups (K 15.4 ± 1.0g/dl, G 15.5 ± 1.2g/dl). The relative heart volume was slightly lower in the Kenyans (K 14.0 ± 1.5ml/kg; G 15.2 ± 2.0ml/kg). Running economy was higher (p < 0.05) in K at speeds of 18km/h and above and can partly be attributed to the smaller calve circumference (p < 0.001) and lower BMI (p < 0.001).

**CONCLUSIONS:** The excellent running performance of Kenyans is not due to an improved oxygen transport system but due to a lower demand of oxygen at higher speeds compared to German runners.

Supported by BISP, No. VF070121/05-06.

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**2128 Board #16 May 28 2:00 PM - 3:30 PM**  
**Interaction Of 4% Hypohydration And 3,048 M Altitude On Aerobic Exercise Performance**

John W. Castellani, FACSM, Samuel N. Cheuvront, FACSM, Stephen R. Muza, FACSM, Charles S. Fulco, Robert W. Kenefick, FACSM, Beth A. Beidleman, Michael N. Sawka, FACSM. *USARIEM, Natick, MA.*

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Body water deficits (3-4% of body weight) degrade aerobic exercise performance in temperate and hot environments. Hypoxia will induce body water deficits (hypohydration, HYP), however, the effects of HYP on aerobic exercise performance at high altitude has not been reported.

**PURPOSE:** Determine effects of HYP (~4% body weight loss) on aerobic exercise performance at sea-level (SL) and high-altitude (ALT, 3,048 m). We hypothesized that HYP and ALT would each degrade exercise performance relative to SL-euhydrated (EUH) conditions and combining HYP and ALT would further degrade performance more than one stressor alone.

**METHODS:** Seven men (25 ± 7 yr; 82 ± 11 kg; mean ± SD) completed 4 separate experimental trials. Trials were: a) SL-EUH; b) SL-HYP; c) ALT-EUH; and d) ALT-HYP. The day before each trial, subjects walked for ~2.5 h in the heat (50°C) either with (EUH) or without (HYP) fluid replacement. In HYP, exercise continued until 4% of body weight was lost. Subjects maintained hydration status overnight and the following morning entered a hypobaric chamber where they completed submaximal exercise (cycle ergometry) at 45% VO<sub>2</sub>max (20 min) and 60% VO<sub>2</sub>max (10 min) immediately followed by a 30-min performance time-trial (TT) at an ambient temperature of 27°C. Performance was assessed by the total amount of work (kJ) completed during the TT.

**RESULTS:** Total TT work (kJ, mean ± SD) for each trial was: SL-EUH (334 ± 64), SL-HYP (278 ± 87, p < 0.05 vs. SL-EUH), ALT-EUH (293 ± 33, p = 0.06 vs. SL-EUH), and ALT-HYP (227 ± 95, p < 0.05 compared to the other 3 trials). The change in performance, relative to the SL-EUH, trial was -18.6 ± 12.2% for SL-HYP, -11.0 ± 10.4% for ALT-EUH, and -33.7 ± 22.3% for ALT-HYP. Individual performance changes, relative to SL-EUH, demonstrated that 6/7 volunteers did worse during ALT-EUH, while 7/7 subjects did worse during SL-HYP and ALT-HYP. The total work during ALT-HYP was significantly lower (P < 0.05) vs. the other trials.

**CONCLUSION:** These data support the hypothesis that moderate body water deficits and high-altitude degrade aerobic performance, and that when these two stressors are combined, aerobic performance is degraded in an additive manner. These findings demonstrate the importance of maintaining euhydration on sustaining aerobic exercise performance at high-altitude.

Author's opinion: not govt. policy

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**2129 Board #17 May 28 2:00 PM - 3:30 PM**  
**Green Tea Supplementation Improves Cycling Time-trial Performance At Simulated Altitude**

Michael D. Pugh<sup>1</sup>, Robert D. Sawyer<sup>2</sup>, Dustin C. Loftis<sup>2</sup>, Charles A. Gremillion<sup>2</sup>, James S. Williams, FACSM<sup>2</sup>. <sup>1</sup>The University of Texas Southwestern Medical Center at Dallas, Dallas, TX. <sup>2</sup>Texas Tech University, Lubbock, TX.

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(No relationships reported)

Reactive oxygen species (ROS) or free radicals are unstable molecules that have been implicated in the processes of muscle damage and fatigue. Previous studies have shown that both exercise and hypoxia associated with altitude exposure result in increased production of ROS. Catechins in green tea extract (GTE) are powerful antioxidants capable of scavenging ROS and possibly preventing muscle damage and fatigue.

**PURPOSE:** To determine the effects of GTE supplementation on endurance performance and ROS production during exercise at simulated altitude.

**METHODS:** Ten recreationally-active (VO<sub>2</sub>max = 51.4 ± 1.2 ml/kg/min; 23.1 ± 1.5 yrs) male subjects first completed a maximal graded exercise test (GXT) on a cycle ergometer followed by three time-trial (TT) performances. The first TT served as a practice session and was followed by two experimental TT performances at simulated altitude (2500 m). The experimental TT performances were randomized and all TT performances were separated by 48 hrs. Based on the maximal power output achieved on the GXT, each subject was assigned a specific amount of work (joules) to be completed as fast as possible during the experimental TT performances. Subjects ingested GTE or placebo capsules 1 hr prior to the experimental TT performances and a blood sample was obtained before the GTE or placebo ingestion and 60 min after the TT performance for the determination of ROS (malondialdehyde-MDA).

**RESULTS:** Cycling TT performance was significantly faster (p < 0.01) at simulated altitude with GTE supplementation compared to placebo (28.9 ± 22.2 sec). Nine of the ten subjects demonstrated an improvement in time. Mean power output for the subjects was also significantly higher at simulated altitude (p < 0.01) with GTE supplementation compared to placebo (6.97 ± 3.93 W). No significant differences (p > 0.05) were found in plasma MDA levels between conditions or time.

**CONCLUSION:** Supplementation with GTE improves cycling TT performance at simulated altitude however; the improvement in TT performance does not appear to be related to MDA levels.

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**2130 Board #18 May 28 2:00 PM - 3:30 PM**  
**Normobaric Hypoxia Exposure During Sleep Produces Sleep-Specific Ventilatory Acclimatization At High Altitude**

Stephen R. Muza, FACSM, Charles S. Fulco, Beth A. Beidleman, Juli E. Jones, Rob N. Demes, Janet E. Staab, Paul B. Rock, Allen Cymerman. *USARIEM, Natick, MA.*

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(No relationships reported)

Sea-level (SL) residents have used repeated exposures to normobaric hypoxia (NH) during sleep to induce ventilatory acclimatization prior to rapid ascent to high altitude (HA). However, few reports have verified whether ventilatory acclimatization resulting from sleeping in NH is retained during subsequent HA exposure.

**PURPOSE:** To determine if ventilatory acclimatization induced during NH is present during HA exposure.

**METHODS:** Two groups of SL residents having similar resting end-tidal partial pressure of CO<sub>2</sub> (PetCO<sub>2</sub>), peak oxygen uptake (~47 ml/kg/min), and age (~24 yr) slept for ~6.5 hrs/night for 7 consecutive nights in portable rooms under blinded NH (n=14) or sham (n=8) conditions. Ambient % O<sub>2</sub> for the NH group was progressively reduced by ~0.30% O<sub>2</sub> each night from ~16.2% O<sub>2</sub> (2200 m equivalent) on the 1<sup>st</sup> night to ~14.4% O<sub>2</sub> (3050 m) on the 7<sup>th</sup> night. The sham group remained at ≥20.5% O<sub>2</sub> (150 m). Within 25 hrs of treatment end, all were exposed to HA (Pikes Peak, CO; 4300 m). At SL before and within 1 hr after treatment end, and in the first 24 hrs of HA, resting arterial oxygen saturation (SaO<sub>2</sub>) and PetCO<sub>2</sub>, and

steady-state exercise and sleep SaO<sub>2</sub> were measured.

**RESULTS:** (Mean±SE) Over 7 nights during sleep, NH SaO<sub>2</sub> decreased ( $p<0.05$ ) from  $92\pm1$  to  $88\pm1\%$ , but sham SaO<sub>2</sub> remained at  $96\pm1\%$ . From before to after treatment, SL resting PetCO<sub>2</sub> decreased ( $p<0.001$ ) for the NH group ( $39.1\pm0.8$  to  $34.9\pm0.7$  mmHg) but not for the sham group ( $39.1\pm0.7$  vs  $38.3\pm1.0$  mmHg). Within the first 5 hrs of HA, there were no between-group differences (NH vs sham) in resting PetCO<sub>2</sub> ( $33.5\pm0.7$  vs  $33.1\pm1.0$  mmHg), SaO<sub>2</sub> ( $83\pm2$  vs  $83\pm1\%$ ) or exercise SaO<sub>2</sub> ( $74\pm1$  vs  $73\pm2\%$ ). First night sleep SaO<sub>2</sub> in HA was higher ( $p=0.031$ ) for NH than for sham ( $78\pm1.3$  vs  $73\pm1.5\%$ ).

**CONCLUSION:** These results indicate that ventilatory acclimatization induced by sleeping in NH is present at HA during sleep but not during the awake state. Thus, sleeping in NH at SL may not induce functionally useful ventilatory acclimatization for subsequent rapid ascent to high altitude. Funding: US Army MRMCA ATO IV.MD.2006.01. Authors' views; not official U.S. Army or DoD policy.

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## **D-25 Free Communication/Poster - Clinical Medicine I - Musculoskeletal**

MAY 28, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### **2131 Board #19 May 28 3:30 PM - 5:00 PM**

#### **Muscle Activation Of The Contralateral Leg During An Acute Achilles Tendon Rupture**

Gretchen D. Oliver<sup>1</sup>, Christopher P. Dougherty<sup>2</sup>. <sup>1</sup>University of Arkansas, Fayetteville, AR. <sup>2</sup>The Agility Center Orthopedics, Bentonville, AR. (Sponsor: Charles Riggs, FACSM)

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(No relationships reported)

**PURPOSE:** To describe muscle activation of the contralateral (non-injured) leg during an acute Achilles tendon rupture.

**METHODS:** Electromyographic (EMG) data were collected on the following muscles: medial hamstring (semimembranosus and semitendinosus), biceps femoris, gluteus medius, gluteus maximus, and the gastrocnemius when the subject was performing a round-off dismount type of maneuver in which she sustained an Achilles tendon rupture.

**RESULTS:** EMG data analysis suggested that the subject fell into a knee valgus flexed hip position on the contralateral leg immediately following the injury. VMO activity indicated a position of knee valgus, while the shutdown of the gluteus medius and gluteus maximus indicated the patient's hip was falling into hip collapse. The lateral hamstring activity indicated an attempt to catch the falling pelvis and that the medial hamstrings were most likely caught in the reflex arc of the gluteals.

**CONCLUSIONS:** A compensatory theory was postulated by the researchers. "Lazy Leg Syndrome", where the injury occurred subsequent to the muscle activation that we described. The decreased EMG activity in the contralateral limb (lazy leg) predisposed the Achilles injury by requiring the tendon to rapidly absorb the extra force that would have been distributed throughout the kinetic chain because the proximal muscles of the lazy leg did not generate force sufficient to maintain control. If the decreased EMG activity in the contralateral limb occurred subsequently to the rupture, the resultant kinetic chain activity displays the way the body adapts due to a traumatic injury of the lower extremity. Reproduction of the muscular pattern of activity in landing maneuvers and subsequent training intervention may reveal targeting muscle groups that have been shown to fail early. Targeting the muscle groups through training interventions may have an impact on injury reduction patterns.

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### **2132 Board #20 May 28 3:30 PM - 5:00 PM**

#### **Surgical Versus Conservative Treatment Of Acute Glenohumeral Dislocations For Preventing Recurrent Dislocations: A Systematic Review**

Jihong Park<sup>1</sup>, Nicole L. Cosby<sup>2</sup>, Jay Hertel, FACSM<sup>2</sup>. <sup>1</sup>Brigham Young University, Provo, UT. <sup>2</sup>University of Virginia, Charlottesville, VA.

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(No relationships reported)

**PURPOSE:** To perform a systematic review to determine the numbers needed to treat (NNT) and relative risk reduction (RRR) associated with arthroscopic surgical repair versus conservative therapy in reducing recurrence rates among patients with acute traumatic shoulder dislocations.

**METHODS:** We searched MEDLINE, SPORT Discus, and CINAHL from inception to September 2008 using combinations of the terms *shoulder, glenohumeral, instability, dislocation, acute, traumatic, rehabilitation, strengthening, surgery, surgical, repair, reconstruction, arthroscopic, and arthroscopy*. Selected articles were from peer-reviewed journals written in English. All articles were studies that compared arthroscopic surgical repair versus conservative therapy for reducing recurrence rates among patients recovering from acute traumatic glenohumeral dislocations. Nine studies met the inclusion criteria and were independently rated by 2 reviewers using the Physiotherapy Evidence Database (PEDro) scale. PEDro scores ranged from 4 to 8 out of 10. The total number of subjects and the number of recurrent dislocations within each group were used to calculate NNT and RRR for each study. The results were also pooled across studies. The average follow-up time for the studies included in the pooled results was 25.4 months.

**RESULTS:** All 9 studies clearly demonstrated that the arthroscopic surgical procedure was more effective than conservative treatment in reducing the risk of recurrence among acute traumatic glenohumeral dislocators. The pooled NNT to benefit was 1.8 (95% CI = 1.6 to 2.1), indicating that 2 individuals would need to be treated surgically, rather than conservatively, in order to prevent one recurrent glenohumeral dislocation. The pooled RRR for prevention of recurrent dislocation was 84.1% (95% CI = 75.0% to 89.8%) in favor of those who received surgical treatment versus conservative treatment.

**CONCLUSIONS:** The use of arthroscopic surgical repair over conservative treatment in patients with acute traumatic glenohumeral dislocations is supported with a Strength of Recommendation Taxonomy level of evidence of 1 and a grade A recommendation.

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### **2133 Board #21 May 28 3:30 PM - 5:00 PM**

#### **The Biomechanical Impact Of Hyaluronic Acid In Knee Osteoarthritis Patients: A Randomized, Double-blind, Placebo-controlled Study.**

Joseph E. DeCaria, Robert J. Petrella, FACSM, Manuel Montero-Odasso, Dalton Wolfe, Bert Chesworth. *The University of Western Ontario, London, ON, Canada.*

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(No relationships reported)

**PURPOSE:** To determine how Hyaluronic acid (HA) impacts clinical outcomes and gait function in knee osteoarthritis (OA) patients.

**METHODS:** Nineteen mild-moderate knee OA patients were randomized to receive 3 consecutive weekly knee injections of 2ml Suplasyn (20mg HA) or 1.2 ml placebo (P) (0.01mg HA). Clinical outcomes were assessed using the WOMAC OA Index and gait characteristics were determined with GAITRite software.

**RESULTS:** Means and standard deviations are presented thus, Mx (SD). The patient population was 72.21 (6.61) years old, 167.47(9.26) cm tall and weighed 81.54 (12.68) kg. Eight patients received HA and 11 patients received P. Treatment effects were determined by comparing week 1(W1) to week 4(W4) outcomes, using 1-tail Wilcoxon signed-ranks tests for within group, and 1-tail Mann-Whitney tests, for between groups comparison. At W1 the HA groups normal walking velocity (NWV) = 112.17 (19.42) cm/s and

fast walking velocity (FWV) = 152.58 (28.48) cm/s. By W4 their NWV = 120.24 (22.14) cm/s ( $p=.025$ ) and FWV = 157.58 (30.39) cm/s ( $p=.164$ ). At W1 the P groups NWV = 108.81 (24.55) cm/s and FWV = 141.54 (31.86) cm/s. By W4 their NWV = 117.76 (22.77) cm/s ( $p=.03$ ) and a FWV = 143.40 (32.05) cm/s ( $p=.297$ ). No significant difference existed at either W1 or W4 between the two groups regarding both NWV and FWV ( $p>.05$ ). At W1 WOMAC pain, stiffness, and function scores for the HA group were 11.25 (4.17), 5.75 (1.39), and 42.63 (13.64), respectively, and by W4 were 8.50 (2.98) ( $p=.008$ ), 4.50 (1.07) ( $p=.021$ ), and 32.50 (13.18) ( $p=.014$ ), respectively. For the P group, W1 WOMAC scores for pain, stiffness and function were 11.55 (2.21), 5.73 (1.42), and 45.36 (6.19), respectively, and by W4 were 11.00 (3.13) ( $p=.297$ ), 5.27 (1.49) ( $p=.130$ ), and 39.73 (9.32) ( $p=.038$ ), respectively. The HA group showed greater improvement in WOMAC scores, but they were not significantly different from P scores at W4 for pain ( $p=.152$ ), stiffness ( $p=.272$ ), and function ( $p=.129$ ).

**CONCLUSIONS:** At one week post-treatment modest improvement in clinical symptoms and gait function may be experienced in knee OA patients treated with 3 consecutive HA injections. These improvements may indicate the progressive nature of the onset of HA treatment in knee OA patients, and provide preliminary evidence for greater improvements expected at 3 and 6 months follow up.

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**2134 Board #22 May 28 3:30 PM - 5:00 PM**  
**Relationship Between Functional And Mechanical Ankle Instability In Physically Active Individuals**

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(No relationships reported)

Individuals suffering lateral ankle sprains can develop functional ankle instability (FAI) and/or mechanical ankle instability (MAI). While some consider these to be two separate entities under the umbrella of chronic ankle instability, the relationship between FAI and MAI remains unclear.

**PURPOSE:** The purpose of this investigation was to evaluate the relationship between functional and mechanical ankle instability in physically active individuals.

**METHODS:** Eighty college aged physically active individuals (male=50, female=30,  $19.81 \pm 1.42$  yrs,  $176.5 \pm 9.9$  cm,  $74.77 \pm 15.31$  kg) from a large Division 1 institution were recruited for this study. All subjects had unilateral FAI. FAI was defined as a history of at least two ankle sprains and a score of less than or equal to 27 on the Cumberland Ankle Instability Tool (CAIT). The contralateral limb had no history of ankle injury. Anterior displacement (mm) and talar tilt ( $^{\circ}$ ) testing was performed using a joint arthrometer to measure MAI. Individuals were tested bilaterally and the maximum value attained during talar tilt and anterior displacement was used for statistical analysis. Dependent t-tests were used to compare the anterior displacement and talar tilt between the FAI and uninjured ankle. Two Pearson product moment correlations were used to examine the relationship between FAI and MAI, one for anterior displacement and one for talar tilt.

**RESULTS:** We found no significant difference between the FAI and uninjured ankle for anterior displacement ( $t_{1,79} = 1.66, p = .10$ ) or talar tilt ( $t_{1,79} = -.07, p = .95$ ). Additionally, no significant correlations were identified between the CAIT score for the FAI limb and anterior displacement ( $r = .18, p = .12$ ) or talar tilt ( $r = .09, p = .42$ ).

**CONCLUSION:** Functional and mechanical ankle instability appears to be two discreet entities. This study suggests FAI can occur independently from MAI. In addition, individuals with a greater degree of FAI do not possess more MAI.

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**2135 Board #23 May 28 3:30 PM - 5:00 PM**  
**The Effect Of Time On Navicular Height With Low-Dye Arch Taping**

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Low-Dye arch taping is primarily used as a short term intervention for athletes who present with low navicular height. This technique is designed to help support the medial longitudinal arch in the foot and maintain a proper height.

**PURPOSE:** Therefore, the purpose of this study was to determine the efficiency of a modified low-Dye arch taping across a 30 second time period.

**METHODS:** Twenty-one healthy physically active men and women (age  $23.52 \pm 4.75$  years, height  $152.07 \pm 45.02$  cm, body mass  $72.90 \pm 25.17$  kg) with a navicular drop of 10mm or greater volunteered to participate. A certified athletic trainer applied the modified low-Dye arch taping directly to a clean, dry foot surface. A second certified athletic trainer measured navicular height three times within 30 seconds while standing on one foot.

**RESULTS:** Data were analyzed using a 1x3 repeated measures ANOVA for time. There was a significant ( $p<0.05$ ) decrease in navicular height between time 1 ( $29.63 \pm 6.22$ ) and time 3 ( $29.01 \pm 6.01$ ). The results of this study indicate that navicular height decreased within 30 seconds of having the medial longitudinal arch taped.

**CONCLUSION:** Therefore, modified low-Dye arch taping may lose efficiency quickly following only weight bearing activities. Future research should investigate longer times, greater activity levels and different taping techniques.

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**2136 Board #24 May 28 3:30 PM - 5:00 PM**  
**Gleno Humeral Internal Rotation Deficiency In The Over Arm Throwing Athlete.**

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(No relationships reported)

Glenohumeral Internal Rotation Deficiency (GIRD) is considered pathologic when the loss of shoulder internal rotation (IR) is not compensated by an increase in external rotation (ER). There is a greater presence of GIRD in baseball players vs. controls (C) but the measurement of GIRD remains indistinct. In this study, GIRD was defined by 2 variables: a loss of IR in the dominant (D) arm compared with the non dominant (ND) arm, and a loss of IR as compared to normative data ( $60^{\circ}$  IR,  $90^{\circ}$  ER).

**PURPOSE:** To measure the occurrence of GIRD among Division II collegiate baseball players (BB) and the possible clinical implications this may define.

**METHODS:** Supine goniometric measurements (ER, IR) were performed on BB ( $n=10$ , Age:  $20.1 \pm 1.1$ , Ht:  $1.83 \pm 0.09$  m, Wt:  $83.2 \pm 13.7$  kg, Body Fat (BF):  $13.2 \pm 5.7$ , Yrs BB Experience:  $15 \pm 3.4$ , %) and compared to C ( $n=5$ , Age:  $22.8 \pm 3.5$ , Ht:  $1.72 \pm 0.04$  m, Wt:  $84 \pm 7.4$  kg, Yrs BB Experience:  $4.8 \pm 3.3$ , % BF:  $18.6 \pm 3.9$ ). In this study GIRD was determined using the formula:  $[(60^{\circ}/90^{\circ}) - (IR/ER \text{ ratio})] = \text{positive value}$ . BB vs. C and D vs. ND comparisons were made using paired T-tests.

**RESULTS:** Difference was found in both IR and ER D vs. ND only in BB ( $p=0.01$  and  $p=0.01$  respectively). This finding leads to the conclusion that GIRD, as a %, was evident in the D shoulder of BB ( $+2.3 \pm 19.1$ ). Difference was found in the % GIRD D vs. ND shoulders of the BB ( $2.3 \pm 19.1$  vs.  $-30.1 \pm 33.2$ ,  $p=0.009$ ).

**CONCLUSION:** The occurrence of GIRD among BB may be clinically revealed as anterior rotator cuff instability that may lead to superior labral anterior posterior lesions (SLAP). The measure of GIRD proposed, may expedite the evaluation of the over-arm throwing athlete in terms of exercising corrective measures to avoid potential SLAP lesions.

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**2137 Board #25 May 28 3:30 PM - 5:00 PM**  
**Effects Of Intraarticular Injection And Therapeutic Exercise In Patients With Idiopathic Adhesive Capsulitis**

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(No relationships reported)

Idiopathic adhesive capsulitis or frozen shoulder is a painful condition that progressively restricts all planes of movement in the shoulder. It is the leading cause of shoulder pain and dysfunction in middle-aged and older adults.

**PURPOSE:** To compare the impact of therapeutic interventions consisting of only intraarticular corticosteroid injection to intraarticular injection combined with therapeutic exercise in patients with idiopathic adhesive capsulitis.

**METHODS:** Subjects (n=19) with idiopathic adhesive capsulitis were randomly assigned to one of two therapeutic interventions: Group 1 (n=9, age=52.3±6.5yrs) received intraarticular injections and therapeutic exercise and Group 2 (n=10, age=59.3±10.5yrs) received only intraarticular injections. Both groups were injected with intraarticular corticosteroids (20mg Triamcinolone; 10cc of saline and 10cc of 1% Lidocaine) every other week for 8 wk (4 total). Group 1 also participated in daily therapeutic exercise 2 times a day for 8 wk. Shoulder Range of Motion (S-ROM; flexion, extension, abduction, internal rotation and external rotation), Visual Analogue Scale (VAS), and Modified Shoulder Pain and Disability Index (M-SPADI) were measured before and after the 8-wk protocol. Paired samples t-tests were used to determine improvement in each group.

**RESULTS:** For Group 1, improvements ( $p<.05$ ) in S-ROM (flexion 28.6%; abduction 46.8%; internal rotation 116.5%; external rotation 67.1%), VAS (62.5%), and M-SPADI (72.4%) were observed after treatment. For Group 2, S-ROM (flexion 12.3%; abduction 23.7%; internal rotation 10.0%), VAS (34.9%), and M-SPADI (55.7%) improved ( $p<.05$ ) after treatment. However, no differences were found between Group 1 and Group 2 for the therapeutic interventions.

**CONCLUSIONS:** These results suggest that these therapeutic interventions can be successful and clinically significant in improving the function of the shoulder and for relieving pain. The small sample size may have contributed to the lack of statistical significance between groups. Future studies should examine if a therapeutic exercise program could effectively restore shoulder range of motion and improve shoulder strength to allow individuals to return their normal daily activities compared to untreated or injection groups.

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**2138 Board #26 May 28 3:30 PM - 5:00 PM**

**Hamstring Training On Stabilizing Knee Joints With Anterior Drawer Instability**

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(No relationships reported)

**PURPOSE:** In order to find out an effective training mode, we compare the effects of three different hamstring muscle training modes on muscle strength and knee joint stability.

**METHODS:** To investigate how different modes of thigh muscles strengthening exercises emphasizing the knee internal rotators can be as effective as possible in improving static and dynamic stability of the knee, twenty young men with knees of anterior drawer laxity compared to his contralateral side were randomly assigned to three experimental groups: plate-loaded squat press (SP), plate-loaded kneeling leg curl with internal rotation (KLCIR), and kneeling leg curl (KLC). Static stability, agility, and isokinetic strength were measured before and after six-week training. The control group with stable knees received no training.

**RESULTS:** The results demonstrate that the knee with anterior drawer laxity is less agile than its sound side and this vulnerability appeared to be improved after six-week SP and KLCIR training. The isokinetic strength of the knee internal rotator increased in SP and KLCIR group. We found that the KLCIR, emphasizing the knee internal rotators, improves significantly in both static and dynamic stability as the SP group. The improvement of agility in KLCIR is very likely due to the increased strength of internal rotators. As far as an ACL rehabilitation program is concerned, KLCIR can surely be either an advanced or an alternative mode to SP.

**CONCLUSION:** This current study revealed that the static anterior drawer laxity of knee can be compensated by hamstring strengthening exercise in all three training modes. We also found that the knee with anterior drawer laxity features poorer agility than its sound side, and such a vulnerability is very likely to be amended in either SP or KLCIR training mode. KLCIR and SP, both emphasizing knee internal rotators, revealed significant improvements in both static stability and agility, but KLCIR was more effective in internal rotator strengthening. As far as an ACL rehabilitation program is concerned, KLCIR can surely be either an advanced or alternative mode to SP.

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**2139 Board #27 May 28 3:30 PM - 5:00 PM**

**Quantitative Assessment Of The Effect Of Prolotherapy On Patients With Cervicogenic Cephalic Syndrome**

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Cervicogenic headache has the greatest potential of losing physical function when compared with the other groups of headache disorders. Dizziness and/or unsteadiness are also common symptoms associated with neck pain in patients with cervical pathology. In addition to headache, dizziness and/or dysequilibrium, cervical lesions may also result in ophthalmic, olfactory and/or throat complaints. Collectively, we introduce the term "cervicogenic cephalic syndrome" (CCS). We also conduct a quantitative assessment to evaluate the treatment effect of prolotherapy on patients with CCS.

**PURPOSE:** To access the effect of prolotherapy on the neck function of patients with CCS.

**METHODS:** forty-five subjects, 23 males and 22 females, with chronic neck pain were recruited. An electronic instrument of combined goniometer and muscle test will be used to measure flexibility and isometric strength of neck. The sensory organization test (SOT) will conducted to assess the balance control of subjects. During the SOT, subjects will be exposed to 6 combinations of visual and support surface conditions as follows: (1) eyes open and fixed support (EO), (2) eyes closed and fixed support (EC), (3) sway-referenced vision and fixed support (SV), (4) eyes open and sway-referenced support (SS), (5) eyes closed and sway-referenced support (ECSS), and (6) sway-referenced vision and support (SVSS).

**RESULTS:** The average age were 38.0±14.8, and 39.6±12.1 years old, in male and female respectively. The average duration of symptoms in male patients are 9.3±9.9 and female patients 3.7±4.1 years. The ROM of cervical spine are increased in left and right lateral flexion after treatment ( $p<0.05$ ). The isometric strength increased in left lateral flexion and rotation after treatment ( $p<0.05$ ). After treatment, the subjects showed increased postural stability in the EC and SS conditions of SOT. The visual and somatosensory ratios are also increased after treatment. The ankle strategy improved in the SV and ECSS conditions of SOT.

**CONCLUSION:** prolotherapy is effective in treating patients with CCS. SOT could be a quantitative assessment tool of neck function.

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**2140 Board #28 May 28 3:30 PM - 5:00 PM**

**The Effect Of Seat Height On VMO/VL Ratio During Cycling**

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(No relationships reported)

Patellofemoral pain syndrome is one of the most frequently seen knee problems. Different cycling protocol could provide various VMO selective training effect.

**PURPOSE:** The purpose of this study was to compare the effect of 90, 95 and 100% seat height on VMO and VL activation during cycling.

**METHODS:** Subjects were 6 healthy male without any musculoskeletal or neurological diseases. The intervention included cycling with three different seat height. The seat



height was adjusted to 90, 95 and 100% of the leg length of each subject. The leg length was measured from the greater trochanter to the floor with the subject standing straight-legged on barefoot. The seat height is the distance from the top of seat to pedal at the lowest level. Before testing, all subjects performed stretching of 5 muscle groups, including quadriceps, hamstrings, calf muscles, hip flexor and gluteus maximus. Amplified surface electrodes were placed over VMO and VL of the right leg during maximum voluntary isometric contraction (MVIC) and also different cycling conditions. EMG data was collected by Biopac systems, MP150. The VMO and VL EMG of 90, 95 and 100% seat height was calculated as %MVIC. The warm-up was cycling at 1 kp/85 rpm for 5 minutes on a stationary ergometer. The three tests were done on the same stationary ergometer at 1.5 kp/85 rpm for 5 minutes. The order of the three interventions was randomly decided, and there was a two-day-interval between each. The data was determined statistically using one-way analysis of variance. The level of significance was set at 0.05.

**RESULTS:** Six healthy male subjects (age  $23.5 \pm 1.6$  years, height  $172.9 \pm 5.1$  cm, weight  $65.4 \pm 7.4$  kg) completed all trial. There were no significant ( $p > 0.05$ ) difference among 90, 95 and 100% seat height for VMO, VL %MVIC and VMO/VL ratio. The VMO (%MVIC) for three cycling conditions (90, 95 and 100% seat height) were  $38.6 \pm 31.2$ ,  $43.1 \pm 24.7$  and  $34.8 \pm 18.7\%$  ( $p = 0.85$ ). The VL (%MVIC) for three cycling conditions were  $29.7 \pm 4.4$ ,  $39.4 \pm 9.8$  and  $38.1 \pm 15.5\%$  ( $p = 0.28$ ). And the VMO/VL ratio for three cycling conditions were  $134.8 \pm 113.7$ ,  $114.8 \pm 76.1$  and  $90.0 \pm 19.2\%$  ( $p = 0.63$ ).

**CONCLUSIONS:** The results do not demonstrated that decreases in seat height during cycling can change the VMO and VL ratio effectively. Adjustment of seat height is not an appropriate way of VMO selective training during cycling.

**2141 Board #29 May 28 3:30 PM - 5:00 PM**

**Ankle Joint Laxity Is Decreased In Patients With Moderate Knee Osteoarthritis**

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Changes in knee joint alignment associated with progressive knee osteoarthritis (OA) results in altered joint mechanics during walking gait, as well as deficits in other measures of functional activity. It is believed that changes in ankle joint motion may also contribute to the gait and functional activity deficits observed.

**PURPOSE:** To evaluate the ankle joint mechanical stability in patients with knee OA.

**METHODS:** Fifteen subjects with knee OA (5 males and 10 females, age= $60.3 \pm 10.2$ yr., mass= $93.9 \pm 18.3$ kg, ht= $167.23 \pm 9.5$ cm) were matched by gender, age, and weight to 15 healthy controls (5 males and 10 females, age= $59.6 \pm 12.6$ yr., mass= $83.5 \pm 19.2$ kg, ht= $169.7 \pm 12.6$ cm). Standardized radiographs of all knees for each subject were performed to determine study eligibility as well as to quantify knee OA severity using a standardized scoring system. Mechanical ankle joint stability was assessed in all subjects with an instrumented arthrometer. The arthrometer measured ankle-subtalar joint motion for anterior/posterior displacement (mm) during loading at 125 N and inversion/eversion rotation (degrees of ROM) during loading at 4000 N-mm. Separate 2 x 2 (group x side) mixed model ANOVAs were performed for all dependent measures.

**RESULTS:** There were significant group x side interactions for: anterior and posterior displacement ( $P < .05$ ). The subjects with knee OA had significantly less anterior ( $7.4 + .51$ mm) and posterior ( $2.2 + .31$ mm) ankle displacement compared to values observed in the healthy group (anterior  $10.5 + .51$ mm, posterior  $4.2 + .31$ mm), as well as compared to their unaffected extremity (anterior  $9.5 + .48$ mm, posterior  $2.6 + .25$ mm). There were significant main effects for group on inversion rotation and eversion rotation ( $P < .05$ ). The knee OA group had significantly less inversion ( $25.4^\circ + 1.6$ ) and eversion ( $13.1^\circ + 1.1$ ) rotation compared to the healthy group ( $31.1^\circ + 1.6$ ,  $20.2^\circ + 1.3$ ).

**CONCLUSION:** Knee OA subjects demonstrated significant decreases in anterior and posterior displacement as well as inversion and eversion rotation compared to healthy controls. These impairments may be the result of alterations in ankle joint alignment secondary to structural changes at the knee. Deviations in ankle joint mechanics must also be considered when addressing functional deficits in patients with knee OA.

**2142 Board #30 May 28 3:30 PM - 5:00 PM**

**The Relationships Between Range Of Motion, Performance, And Club Head Speed In Older Female Golfers**

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(No relationships reported)

Research on range of motion (ROM) of the trunk, shoulder and hip in older amateur female golfers is limited. It is unknown if club head speed (CHS) is related to these physical characteristics or golf performance.

**PURPOSE:** The aims of this study were to: 1) determine the relationships between ROM, performance, and CHS in older amateur female golfers; and 2) evaluate the relationship between ROM and CHS in two age groups of older golfers, middle and senior.

**METHODS:** Twenty-eight healthy, amateur female golfers [mean age  $\pm$  SD (range),  $63.7 \pm 7.8$ , (49-86 years)] who swung right-handed were measured for trunk, hip, and shoulder rotation passive ROM with inclinometers. Trunk rotation was measured in sidelying using dual inclinometers and pelvic stabilization. Hip rotation was measured prone with the contralateral hip in  $30^\circ$  of abduction and pelvic motion prevented. Shoulder rotation was measured supine with the shoulder placed in  $90^\circ$  of abduction and scapula motion prevented. CHS was recorded with a ground level radar device. Each golfer used her driver of choice and swung from a standardized golf mat and tee. A self-report questionnaire was given to record performance data for both 9-hole and 18-hole games and driving distance. ICC values were calculated for repeated passive ROM measures. Relationships between ROM, performance, and CHS were examined with a Pearson product moment correlation coefficient analysis using SPSS v. 16.0.

**RESULTS:** The ICC values for intratester measures were 0.82, 0.88 (trunk: right, left), 0.81, 0.83 (shoulder: internal, external), and 0.95, 0.92 (hip: internal, external). A significant relationship ( $r = 0.85$ ,  $p < 0.01$ ) between CHS and driving distance was found. There were also inverse correlations ( $r = -0.49$  to  $-0.80$ ,  $p < 0.01$ ) between age, 9-hole score, 18-hole score and CHS. In the middle age group ( $\leq 60$  years of age), left hip external rotation was inversely correlated with CHS ( $r = -0.70$ ,  $p < 0.05$ ). No significant correlations were identified between ROM and CHS in the senior group ( $> 60$  years of age).

**CONCLUSIONS:** The ability to produce a greater club head speed was associated with better golf performance and increased driving distance. Club speed was shown to decline with age. Assessment of hip flexibility should be considered for rehabilitation and training programs in older female golfers.

**2143 Board #31 May 28 3:30 PM - 5:00 PM**

**The Use Of Transcranial Magnetic Stimulation In The Assessment Of Quadriceps Activation: A Pilot Study**

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Percutaneous electrical stimulation has commonly been used to assess quadriceps activation, yet the discomfort associated with electrical stimulation may limit the populations that can be studied. Transcranial magnetic stimulation (TMS) has been reported as a non-painful, effective intervention for increasing quadriceps activation by stimulating descending cortical tracts, yet no research has determined if TMS can be used to assess muscle activation.

**PURPOSE:** To determine the relationship of quadriceps central activation ratio (CAR) derived from the TMS (CAR<sub>TMS</sub>) and the quadriceps CAR derived using percutaneous electrical stimulation with the superimposed burst method (CAR<sub>SB</sub>) in participants with partial meniscectomies.

**METHODS:** Ten participants (6 M, 4 F;  $36.8 \pm 16.4$  yrs;  $177.4 \pm 11.9$  cm;  $92.32 \pm 28.9$  kg;  $35.29 \pm 36.5$  weeks post partial meniscectomy) participated in this study. TMS stimulation did not produce an increase in knee extension force in 3 participants, who were excluded from analysis. Participants first performed 3 CAR<sub>SIB</sub> trials followed by 3 CAR<sub>TMS</sub> trials at 70° of knee flexion. The 3 CAR<sub>SIB</sub> and 3 CAR<sub>TMS</sub> trials were averaged for data analysis. A Spearman's rank correlation was performed to determine the relationship between CAR<sub>SIB</sub> and CAR<sub>TMS</sub> scores. Wilcoxon signed ranks tests were used to analyze differences between means and a Bland-Altman plot was used to determine the limits of agreement (LOA) between the measures.

**RESULTS:** The data were not normally distributed. The median CAR<sub>SIB</sub> (71%; Range 51.6 - 84.1) was significantly lower than the CAR<sub>TMS</sub> (92.%; 82.1 - 95.1;  $Z = -2.34$ ,  $P = .018$ ). The relationship between the CAR<sub>SIB</sub> and the CAR<sub>TMS</sub> was not statistically significant ( $p = .714$ ,  $P = .071$ ). The mean between measure difference score was  $21.7 \pm 11.01$ , with the LOA between -32 and 43.72. All point estimates were contained within the LOA and above 0.

**CONCLUSIONS:** CAR<sub>TMS</sub> was found to estimate significantly higher volitional activation values compared to CAR<sub>SIB</sub>. The LOA would be considered large for these measurements, which may indicate that CAR<sub>SIB</sub> and CAR<sub>TMS</sub> are not measuring the same characteristics of muscle activation. A CAR<sub>TMS</sub> measurement could not be elicited in 30% of this population, which could be a limitation of this technique.

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**2144 Board #32 May 28 3:30 PM - 5:00 PM**  
**Grip Norms And Reliability Of The Hand Grip ForceMap System**

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Strength testing of the injured hand and forearm is of considerable interest to patients, treating physicians, therapists, and insurance companies. While, over the past many years, traditional parallel-bar dynamometers have made a significant and positive contribution to medical grip strength evaluation, these devices are now less than optimal for the comprehensive analysis of overall grip and finger function. The ForceMap grip force mapping system utilizes tactile array technology to assess the complex grip capability/capacity of a human hand.

**PURPOSE:** This study's aim was to evaluate the reliability of the hand grip ForceMap system and to establish max grip force (MGF) and force distribution norms (D1-thumb; D2-index; D3-middle; D4-ring; D5-little finger; N/cm<sup>2</sup>) for healthy adults.

**METHODS:** Adults (Female n=28;  $38.9 \pm 11.0$  yrs;  $165.3 \pm 6.7$  cm;  $69.8 \pm 13.0$  kg; Male n=28;  $34.2 \pm 13.0$  yrs;  $181.3 \pm 8.0$  cm;  $86.4 \pm 15.1$  kg) completed trials of maximal grip on the ForceMap system with the elbow at 90 degrees flexion. The ForceMap system is comprised of a high resolution tactile array sensor mounted to a 5 x 15 cm solid Delrin cylinder (grip map transducer) that is interfaced to an amplifier/processor and laptop computer. The ForceMap system provides visual and numerical assessment of grip force including the palm and individual digits both statically and dynamically (100 hz). The reliability of the ForceMap was determined using a Pearson Correlation Coefficient (r), Intra-class Correlation Coefficient (ICC) and a Bland-Altman Plot (BAP) of repeated trials of the male dominant hand MGF.

**RESULTS:** Female norms dominant hand: MGF=  $471.2 \pm 119.6$  (N); D1=  $29.0 \pm 9.4$ ; D2=  $23.6 \pm 8.3$ ; D3=  $25.0 \pm 5.6$ ; D4=  $20.8 \pm 6.3$ ; D5=  $14.9 \pm 6.6$  (N/cm<sup>2</sup>). Male norms dominant hand: MGF=  $820.9 \pm 210.5$  (N); D1=  $34.5 \pm 9.1$ ; D2=  $29.5 \pm 8.3$ ; D3=  $34.3 \pm 8.8$ ; D4=  $26.9 \pm 9.0$ ; D5=  $23.2 \pm 9.2$  (N/cm<sup>2</sup>). Male dominant hand MGF:  $r = 0.92$  and ICC=0.92. The BAP plot revealed that 100% of the differences between trials were within  $\pm 2$  standard deviations of the mean difference.

**CONCLUSION:** Given the ability of the ForceMap system to reliably assess grip force along with the establishment of grip force and force distribution norms, it appears the ForceMap system is a viable means for detailed grip assessment.

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**2145 Board #33 May 28 3:30 PM - 5:00 PM**  
**Influence Of Bicycle Seat Design On Perceived Comfort And Stability During Non-stationary Bicycling**

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(No relationships reported)

It has been reported that bicycle seat discomfort influences over half of all bicyclists following short and long distance rides. Although researchers have provided insightful information regarding factors that influence seat pressure it is well documented that pressure and comfort may not always be related. A study that assesses how seat design influences perceived comfort and stability in male and female cyclists may help seat manufacturers and clinicians who aim to reduce cycling discomfort without compromising stability.

**PURPOSE:** To examine the interaction between three different seat designs and perceived comfort and stability in male, female, experienced and novice cyclists.

**METHODS:** Fifty-seven volunteers, comprising male experienced (13), male novice (19), female experienced (12) and female novice (13) cyclists rode three times over a 350 m flat course pedaling at 80 rpm at 118 W. Three different seat designs (standard, partial, and complete cut-out) were randomly interchanged. The comfort level of the crotch, sit bones, overall seat and handlebar areas, as well as stability were assessed with continuous visual analogue scales.

**RESULTS:** Subjects reported 29.2% and 37.1% greater levels of crotch comfort on the complete cut-out seat than the standard and partial cut-out designs, but reduced stability compared to the other two seats. Males reported greater comfort for the standard seat than females for crotch, sit bone, overall seat and hand comfort. Males reported greater comfort for the partial cut-out seat compared to females for crotch and hand comfort. Experienced cyclists perceived the crotch (male 23.8% and female 44.4%) and the overall seat (male 12.8% and female 36.1%) areas to have greater comfort than novice subjects for the partial cut-out seat.

**CONCLUSIONS:** It is recommended that experienced and novice male cyclists use either the standard or partial cut-out seat, experienced female cyclists use the partial cut-out seat and novice female cyclists use either the standard or partial cut-out seat. The major drawback of the complete cut-out seat was the perception of decreased stability.

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**2146 Board #34 May 28 3:30 PM - 5:00 PM**  
**On Tackling And Tackling-related Injuries In International Soccer; A Gender Comparison**

Donald Kirkendall, FACSM, Colin Fuller, Philippe Tscholl, Jiri Dvorak. FIFA Medical Assessment and Research Centre, Zurich, Switzerland.  
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(No relationships reported)

Tackling is the most dangerous aspect of soccer and the cause of the majority of traumatic injuries. Rates of injury can be reported as per 1000 hr or per 1000 events that often show dissimilar results.

**PURPOSE:** to compare 2 methods of reporting rates for international male and female soccer players.

**METHODS:** We compared the injury rates in international men's and women's soccer tournaments to compare tackling and tackling-related injuries. We reanalyzed our tackling data from AJSM (2004) and BJSM (2007) to obtain rates (and 95% CI) per 1000 hr and per 1000 events for a direct gender comparison. All tackles during 123 of 128 matches of the 1998 World Cup, 1999 U-17 World Cup and the 2000 Olympics (men-total = 8572 tackles) and 24 matches from the 1999 and 2003 Women's World Cup, 2000 and 2004 Olympics, and the 2002 and 2004 U-19 Women's World Championship (total = 3531 tackles) were categorized according to established parameters. 200 injuries were recorded for both men and women. Rates (and 95% CI) were determined per 1000ph and per 1000 tackling events.

**RESULTS:** While the ranking of tackling preference was similar for men and women, men left their feet to make a tackle more often than women (44% vs. 35%,  $p < 0.05$ ). The overall injury rates per 1000 ph between genders were not different (49.3 and 42.7 for men and women respectively), yet the injury rate per 1000 events was significantly higher

for the men (23.3 vs 9.6,  $p < .05$ ). There were few gender differences in injury rates per 1000 player-hours. However, when compared per 1000 events, numerous gender-related differences were seen with the male rate exceeding the female rate in most cases. For both genders, leaving the feet to make a tackle resulted in a higher injury rate.

**CONCLUSIONS:** The two different methods of reporting rates show significant differences when comparing males and females. Similar incidences of injuries per time were found, but higher frequencies of injuries per tackle were found in men. These data illustrate a fundamental difference in the men's and women's game. Men leave their feet more to tackle than women and that may contribute to the higher rate of injury per tackle in men.

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**2147 Board #35 Abstract Withdrawn**

**2148 Board #36 May 28 3:30 PM - 5:00 PM**

**The Physical Demands And Challenges Of Participating In Marching Band**

Gary Granata<sup>1</sup>, Dan Benardot, FACSM<sup>2</sup>. <sup>1</sup>*PerformWell, LLC, New Orleans, LA.* <sup>2</sup>*Georgia State University, Atlanta, GA.*

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(No relationships reported)

Marching band is a physical activity that has been largely overlooked in sports medicine research and practice. The visual design of today's marching band shows, which is mainly influenced by competitive drum and bugle corps, places high physical demands on the individual performer. Repetitive use injuries, normally associated with traditional athletics, appear to be on the rise in both marching band and drum corps participants.

**PURPOSE:** To document the physical demands, challenges and injury prevalence that results from marching band participation.

**METHODS:** 172 (74 female, 98 male, age 15.5 + 1 yrs) members of the Avon High School Marching Band (Avon, IN) completed an anonymous questionnaire that addressed the physical demands and injuries resulting from regular participation in a marching band. The Avon Marching Band competes in Bands of America's highest division and has won numerous national and state titles.

**RESULTS:** Responders indicated that, as a result of either rehearsal or performance, 17.4% (N=30) indicated they were always tired, 43.6% (N=75) were frequently tired and 38.4% (N=66) were occasionally tired. They also reported that 24.4% (N=42) had experienced episodes of faintness or nausea after marching band participation, and 51.7% (N=89) experienced heat-related illness. Nearly all responders (95.3%; N=164) experienced sore or stiff muscles following marching band rehearsal or performance; 38.9% (N=67) reported an injury that was a direct result of marching band participation; 24.6% (N=44) had a previous injury that was worsened by marching band participation; and 27.6% (N=39) reported seeing a physician to diagnose a marching injury or injury worsened by participation. Marching band related injuries were the cause of missing rehearsal or performance in 7.5% (N=13) of responders.

**CONCLUSIONS:** This initial survey of health and injury issues associated with marching band participation suggests an activity-related injury rate that is similar to competitive sport. As a result, more attention should be given to the development of preventative strategies that could successfully reduce fatigue and injury in marching band participants.

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**2149 Board #37 May 28 3:30 PM - 5:00 PM**

**The Bioknotless Suture Anchor For The Treatment Of Shoulder Instability: Clinical Results**

Jeremy Statton, Troy Diehl, Paul Favorito. *Wellington Orthopedics and Sports Medicine, Cincinnati, OH.*

(No relationships reported)

**PURPOSE:** Arthroscopic treatment of symptomatic shoulder instability has become a well accepted procedure. Knotless suture anchors are one type of implant utilized for capsulolabral repair and have several advantages compared to other available devices. The use of these anchors, however, has been associated with unfavorable outcomes. The purpose of this study is to report our results of arthroscopically treated shoulder instability with a knotless, bioabsorbable suture anchor.

**METHODS:** We identified and contacted patients who underwent arthroscopic capsulolabral repair of the shoulder with the BioKnotless anchor (DePuy Mitek, Raynham, Massachusetts). All patients had a minimum follow up of 2 years. Patient evaluation included a subjective questionnaire, physical exam, radiographs, and an MRI if indicated. All patients completed validated shoulder and health measurement outcome tools including the Simple Shoulder Test, the Short Form 12 Health Survey (SF-12), and the Western Ontario Shoulder Instability Index (WOSI).

**RESULTS:** Eight patients were evaluated. The mean age was 28.9 years. There were 6 males and 2 females. The mean time to follow up was 33.6 months. No patients had any episodes of recurrent instability. When compared to the contralateral shoulder, patients lost an average of 2.5° of forward flexion, 6.3° of external rotation, and 11.3° of internal rotation. No patients had instability on physical exam as determined by apprehension, relocation or load and shift testing. Radiographic examination revealed no evidence of osteolysis, chondrolysis or degenerative changes. The mean WOSI score was 65.2% (out of 100%). The mean Simple Shoulder Test score was 10.4 (out of 12). The mean physical component to the SF-12 was 51.0 (population mean 52.5) and the mental component was 55.5 (population mean 53.1).

**CONCLUSIONS:** Patients did report some level of disability of the shoulder determined by the WOSI, Simple Shoulder Test, and SF-12 scores. There was no radiographic evidence of osteolysis or glenohumeral arthritis. None of the patients reported any recurrence of instability. When properly utilized, the Bioknotless anchor remains a viable and safe option for successful treating symptomatic shoulder instability.

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**2150 Board #38 May 28 3:30 PM - 5:00 PM**

**Assessing Person-environment Interaction Using The Movement And Activity In Physical Space (maps) Score In Orthopedic Knee Patients**

Brian G. Ragan<sup>1</sup>, Stephen Herrmann<sup>2</sup>, CaraLynn Scott<sup>3</sup>, Minsoo Kang<sup>4</sup>. <sup>1</sup>*Case Western Reserve University, Cleveland, OH.* <sup>2</sup>*Arizona State University, Mesa, AZ.* <sup>3</sup>*University of Northern Iowa, Cedar Falls, IA.* <sup>4</sup>*Middle Tennessee State University, Murfreesboro, TN.* (Sponsor: Barbara Ainsworth, FACSM)

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(No relationships reported)

**PURPOSE:** The purpose of this study was to determine the validity and reliability of the Movement and Activity in Physical Space (MAPS) score. MAPS is a quantifiable functional outcome measure that incorporates physical activity data from accelerometers and environmental factors evaluated through GPS to assess person-environment interaction.

**METHODS:** Sixteen participants (age = 28.9±12.0 years) were matched into two groups; post-surgical knee ( $n=8$ ; <7 days after surgery = 4.1±2.8 days) and non-surgical control ( $n=8$ ). Step count (volume - MAPS<sub>v</sub>) and activity count (intensity - MAPS<sub>i</sub>) were obtained using accelerometry. Travel and activity locations were recorded using GPS. Participants wore Atigraph accelerometers and LandAirSea GPS receivers on their waist for three days, one week and two months following knee surgery. Step counts and GPS data were combined to produce a MAPS<sub>v</sub> score. Activity count and GPS data were combined to produce a MAPS<sub>i</sub> score. MAPS scores were compared with the five subscales of the Knee Injury and Osteoarthritis Outcome Score (KOOS), a self-report functional knee scale.

**RESULTS:** The reliability for MAPS scores over three days was acceptable (ICC[1, 1] = .84 - .89). MAPS<sub>v</sub> was correlated with all KOOS subscales. MAPS<sub>i</sub> was correlated with all of the KOOS subscales except pain ( $r = .48$ ;  $p = 0.06$ ). There were significant group differences for MAPS<sub>v</sub> ( $t_{9,9} = -3.60$ ;  $p = .007$ ; post-surgical = 14.2 ± 9.7, control = 57.3 ± 32.5) and MAPS<sub>i</sub> ( $t_{10,8} = -3.22$ ;  $p = .013$ ; post-surgical = 480 ± 344, control = 2143 ± 1419) immediately following surgery. At two months, there was a significant time-group interaction for MAPS<sub>v</sub>,  $F(1, 12) = 4.60$ ,  $p = .05$ , but not for MAPS<sub>i</sub>,  $F(1, 12) = 3.42$ ,  $p = .09$ .

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## D-26 Free Communication/Poster - **Combative Sports/Martial Arts**

MAY 28, 2009 1:00 PM - 6:00 PM  
ROOM: Hall 4F

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### 2151 Board #39 May 28 2:00 PM - 3:30 PM **Physiological Demands Of A Taekwondo Combat**

Adriana del Pilar Urbina-Bonilla<sup>1</sup>, Dario Mendoza Romero<sup>2</sup>, Yolman Sanchez Patiño<sup>2</sup>. <sup>1</sup>Universidad del Rosario, Bogota, Colombia. <sup>2</sup>Universidad UDCA, Bogota, Colombia.  
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(No relationships reported)

Although taekwondo (TKD) is the most popular martial art in the world, it has not been researched extensively. Some studies report the physiological profile of TKD athletes, but the functional demands of a TKD combat are unknown.

**PURPOSE:** To determinate the physiological demands of a TKD combat.

**METHODS:** Five women from the Colombian TKD team (21 ± 2.92 years; 55.8 ± 5.45 kg; 1.64 ± 2.68 m) in their precompetitive season gave their informed consent for the study. They performed a simulated combat: three 2-minutes rounds with 1-minute rest intervals. In the first and second rounds, they did intermittently movements of defense/attack (10/15s round 1 and 10/10s round 2); and in the third round, they did their higher effort to attack during the whole round. Oxygen consumption (VO<sub>2</sub>) and respiratory quotient (R) were measured during combat using a portable gas analyzer system (Metamax II). Blood lactate levels (LAC) were measured in capillary blood using Accutrend. Maximal VO<sub>2</sub> (VO<sub>2</sub> max) were measured following endurance Bangsbo test protocol and using gas analysis. Comparisons between rounds and rest periods were made with one way ANOVA for repeated measures and Holm-Sidak method for pairwise comparisons.

**RESULTS:** VO<sub>2</sub> max were 46.99 ± 2.68 ml.kg<sup>-1</sup>.min<sup>-1</sup>. Combat VO<sub>2</sub> expressed as VO<sub>2</sub> max percentage were above than 85% during the 3 rounds (85.1 ± 8.5; 85.9 ± 8.5 and 85.3 ± 4.8%, respectively, p=0.916), and were above the anaerobic threshold of each athlete (p<0.05). In contrast, during rest periods VO<sub>2</sub> significantly decreased (57.1 ± 8.3 and 55.8 ± 12 %, for the first and second rests respectively) (p<0.01). R values during rounds and rests were between 1.09 and 1.12. LAC were 2.3±0.4 mmol/l in rest and significantly increased (p<0.013) during combat to reach 6.3±2.4; 8.8±2.8 and 9.8±3.1 mmol/l for the 3 rounds respectively.

**CONCLUSIONS:** VO<sub>2</sub> max of female TKD athletes were similar to the reported in other studies (43.6 ± 6.1 ml.kg<sup>-1</sup>.min<sup>-1</sup>)(1). TKD combat may be considered as a lactic anaerobic (high intensity) intermittent work because the VO<sub>2</sub> were higher than 85% and above anaerobic threshold; R were always above 1.09; and LAC were higher than 6.3 mmol/l. TKD athletes should have high aerobic capacities that permit a better recovery during rest periods.

1.Cetim C, Karatosum H, Baydar ML, Kosarcian K. Saudi Med J 2005; 26: 848-850.

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### 2152 Board #40 May 28 2:00 PM - 3:30 PM **Effect Of Knee-protected Tai Chi Aerobic For Community-dwelling Middle-aged Adults**

Li-Lan Fu, Yu-Tzu Liu. National Taiwan Sport University, Taoyuan, Taiwan.  
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(No relationships reported)

Knee-Protected Tai Chi Aerobic (KPTCA) was modified from Tai Chi Aerobic with reduction in the balance challenge, and lower extremity impact. Lots of studies proved the benefit of Tai Chi in middle-aged or elderly people, but the effects of the KPTCA in middle-aged were unclear.

**PURPOSE:** To detect how the KPTCA training influence the functional performance of the community dwelling middle-aged.

**METHODS:** Volunteers were recruited from community in Taoyuan. One-hour group KPTCA was held three times weekly for 8 weeks. Three functional evaluations were executed before/after whole training course. Assessment of functional dynamic balance used Four Square Step Test, which asked subject to step as fast as possible in a special sequence. Time (seconds) taken to complete the test was recorded. Maximal isometric strengths of bilateral knee extensors/flexors were measured by hand-held dynamometer. Subjects were asked to perform an isometric contraction (lb) for 3 seconds. Aerobic capacity was measured by six-minute walk test (6-MWT) which asked subjects to walk at a regular pace, covering as great a distance as possible in the allotted time. The total distance covered in meters was measured and recorded. All data were analyzed using paired t tests (p < 0.05).

**RESULTS:** Twelve middle aged adults finished all training and assessments. The demographic data of all subjects were age: 50.1 ± 5.2 y; BMI: 24.8 ± 2.6 kg/m<sup>2</sup>. Compared with baseline, subjects showed statistically significant improvement in body mass (61.2 ± 4.7 vs. 59.9 ± 4.6 kg), dynamic balance test (6.9 ± 1.0 vs. 6.4 ± 0.9 s), flexors strength (right knee 34.4 ± 10.4 vs. 41.3 ± 8.5 lb and left knee 34.4 ± 11.7 vs. 40.9 ± 7.0 lb) and 6-MWT (561.7 ± 41.5 vs. 582.2 ± 45.0 m)(all p < 0.05) after training. But no statistically significant improvement was found in the knee extensors (right knee 50.9 ± 12.6 vs. 52.3 ± 8.0 lb and left knee 50.3 ± 12.1 vs. 54.4 ± 7.1 lb) and the HR<sub>rest</sub> (78.5 ± 11.5 vs. 79.0 ± 10.1 bpm)(all p > 0.05) after training.

**CONCLUSIONS:** These results indicated that the KPTCA is effective in improving dynamic balance, lower extremity flexor strength, and aerobic capacity in community-dwelling middle-aged adults. These improvements may increase the ability of the middle-aged to face the physical challenge in the everyday life.

Supported by NSC 95-2413-H-179-009.

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### 2153 Board #41 May 28 2:00 PM - 3:30 PM **The Effects Of Sodium Bicarbonate Ingestion On Boxing Performance**

Lars R. Mc Naughton, FACSM, Kristian, Hirscher, Jason Siegler. University of Hull, Hull, United Kingdom.  
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(No relationships reported)

**PURPOSE:** Boxing is a sport that consists of multiple high intensity bouts separated by minimal recovery time and may benefit from a pre-exercise alkalotic state. To observe the ergogenic potential of sodium bicarbonate (NaHCO<sub>3</sub>) ingestion on boxing performance.

**METHODS:** Ten amateur boxers volunteered to participate in two competitive sparing bouts (repeated-measures design separated by one week). The boxers were pre- matched for weight and boxing ability and consumed either 0.3g.kg<sup>-1</sup>BW of NaHCO<sub>3</sub> (BICARB) or 0.045g.kg<sup>-1</sup>BW of NaCl placebo (PLAC) mixed in diluted low-calorie flavoured cordial. The sparing bouts consisted of four 3-minute rounds, each separated by 1-minute seated recovery. Blood acid-base (pH, bicarbonate (HCO<sub>3</sub><sup>-</sup>), base excess (BE)) and performance (RPE, HR (HR<sub>ave</sub> & HR<sub>max</sub>), total punches landed successfully) profiles were analyzed pre (where applicable) and post-sparing.

**RESULTS:** There was a significant condition x time interaction effect for HCO<sub>3</sub><sup>-</sup> (F = 23.7; p ≤ 0.001; Figure 1) and BE (F = 27.0; p < 0.001), but not for pH (F = 0.54; p = 0.48). Post hoc analysis revealed higher pre-sparing HCO<sub>3</sub><sup>-</sup> and BE for the BICARB condition, but no differences between the BICARB and PLAC conditions post-sparing. There was no



significant condition x time interaction effects for HR<sub>ave</sub> (F = 2.0; p = 0.15), HR<sub>max</sub> (F = 1.2; p = 0.32), RPE (F = 1.1; p = 0.38) or punches landed (F = 0.58; p = 0.64).

**CONCLUSION:** Although NaHCO<sub>3</sub> elevated pre-sparring blood buffering capacity, it had no effect on four round sparring performance.

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**2154 Board #42 May 28 2:00 PM - 3:30 PM**

**A Comparison Of Two Pre-season Measures Of Body Weight, Percent Body Fat, Peak Torque, And Percent Decline In College Wrestlers**

Doug Smith<sup>1</sup>, Aric Warren<sup>1</sup>, Matt O'Brien<sup>1</sup>, Steve Rossi<sup>2</sup>, Thomas Buford<sup>3</sup>, Matt Herrill<sup>1</sup>, Joanna Fedick<sup>1</sup>, Crishel Kline<sup>1</sup>, Ali Boolani<sup>1</sup>. <sup>1</sup>Oklahoma State University, Stillwater, OK. <sup>2</sup>Georgia Southern University, Statesboro, GA. <sup>3</sup>Baylor University, Waco, TX. (Sponsor: Bert H. Jacobson, FACSM)  
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(No relationships reported)

**PURPOSE:** The purpose of this study is to determine if there is a difference between two pre-season measures of body weight (BW), percent body fat (BF), peak torque (PT) and percent decline (PD) in college wrestlers.

**METHODS:** Eight Division I collegiate wrestlers volunteered for participation in this study. The wrestlers BW was recorded along with PT and PD of the quadriceps femoris at 180 °/sec using a Biodex II isokinetic machine. The subjects completed fifty maximal leg extensions at 180 °/sec. Peak torque was recorded as the greatest amount of torque produced during any one repetition and PD was determined by taking the initial PT minus the final PT divided by the initial PT. T-tests were used to determine if significant (p<0.05) changes occurred in these measures between one year of pre-season measures and the following year of pre-season measures. Both recording times were scheduled during the second week in November.

**RESULTS:** The results of the study indicated that there was a significant (p>0.05) increase in PT from the first pre-season measure compared to the following pre-season measure. There was no significant (p>0.05) change in BW, BF, or PD between the two years.

**CONCLUSIONS:** The results suggest that the off season training programs are significantly increasing strength in the lower extremity without compromising the wrestler's body weight and percent body fat. The lack of significant change in PD indicates that even though PT was increasing the final PT during the 50 rep test had also increased. This is important information for the coach and the strength training staff showing that the training programs are having a positive impact on strength.

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**D-27 Free Communication/Poster - Diagnostic Testing**

MAY 28, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**2155 Board #43 May 28 3:30 PM - 5:00 PM**

**Near Infrared Spectroscopy (nirs) Describes Physiologic Payback Associated With Excess Post-exercise Oxygen Consumption (epoc).**

Michael J. Danduran, Rohit P. Rao. *Children's Hospital of Wisconsin, Milwaukee, WI.*

(No relationships reported)

The human response to exercise is well described. Increased demands associated with exercise creates a physiologic burden resulting in the individual meeting demands or succumbing to exhaustion. Recovery from such efforts are crucial to adaptation. Excess Post-Exercise Oxygen Consumption (EPOC) refers to the body's increased metabolic need following physical work.

**PURPOSE:** To determine the role of NIRS (a non-invasive method of measuring regional tissue oxygenation) in the description of exercise recovery in healthy children and adolescents.

**METHODS:** Healthy adolescents were recruited. Exercise testing was performed to exhaustion. Physiologic parameters measured included: HR, BP, and breath-by-breath gas analysis. Four site NIRS (brain, kidney, deltoid, and vastus lateralis) were measured during exercise and into recovery to establish trends.

**RESULTS:** 29 individuals (14 M, 15 F) age 15.6 yrs (7-20 yrs) underwent testing. Exercise (Ex) results as follows: ExTime: 13.1 ± 2.52 mins, PeakHR: 193 ± 11.4 bpm, PeakVO<sub>2</sub>: 42.5 ± 4.09 ml/kg/min, RQ: 1.12 ± 0.07. EPOC was observed in all 29 patients. NIRS values are presented at 4 distinct intervals below. A significantly higher rate of re-perfusion was seen in the vastus lateralis with super-compensation well above baseline at 2 and 5 minutes post exercise. (\*=P<0.01)

Site	Rest	Peak Exercise	Change	2 Min Post Ex	Change	5 Min Post Ex	Change
Kidney	75.4%	51.5%	-31%	75.5%	0%	77.6%	-3%
Brain	70.4%	60.8%	-13%	68.5%	-2%	74.9%	6%
Deltoid	78.1%	53.5%	-31%	74.3%	-5%	77.7%	-1%
Leg	63.9%	51.5%	-19%	78.5%	23%*	80.7%	26%*

**CONCLUSIONS:** The identified trends support an immediate compensation of organ systems to re-establish homeostasis through enhanced perfusion. Moreover, non-invasive NIRS monitoring helps delineate patterns of redistribution associated with EPOC in healthy adolescents, emphasized by the super-compensation in the exercising leg. The sensitivity of such measurements in assessment of exercise pathology is intriguing.

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**2156 Board #44 May 28 3:30 PM - 5:00 PM**

**Comparison Of Stress-induced Myocardial Ischemia And Cardiac Autonomic Control**

Adi Shachar<sup>1</sup>, Mickey Scheinowitz<sup>1</sup>, Tali Sharir<sup>2</sup>, Itzik Pinhas<sup>3</sup>, Solange Akselrod<sup>1</sup>, Linda R. Davrath<sup>3</sup>. <sup>1</sup>Tel Aviv University, Tel Aviv, Israel. <sup>2</sup>Maccabi Healthcare Services, Procardia, Tel Aviv, Israel. <sup>3</sup>Biological Signal Processing Inc., Tel Aviv, Israel.

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(No relationships reported)

In a prospective study, we previously described autonomic function in a small group of patients with abnormal heart rate recovery (HRR) defined as a reduction in HR of ≤ 18 bpm during the 1st min of recovery immediately after a maximal exercise treadmill test (ETT).

**PURPOSE:** The goal of this retrospective analysis was to investigate autonomic contributions to HRR in a large patient cohort referred for evaluation of coronary artery



disease, and examine the association with stress induced ischemia.

**METHODS:** Exercise myocardial perfusion SPECT imaging (MPI) was performed in 894 consecutive pts and used as gold standard for ischemia. High resolution ECG was acquired throughout the ETT using the HyperQ™ System (BSP, Israel). Time-dependent spectral analysis was computed on HR from ETT to provide dynamic measures of low (LF) and high-frequency (HF) peaks associated with autonomic activity.

**RESULTS:** Moderate to severe MPI ischemia was found in 36 pts. Patients were classified based on HRR:  $HRR \leq 12$  (P12, n=53);  $HRR \leq 18$  (P18, n=80); normal HRR (NHRR, n=753). NHRR patients were selected for comparison (n=98) by random sampling. Presence of coronary artery disease (MPI ischemia, history of MI, CAD, PCI or CABG) was not different between groups. HF fluctuations, representative of vagal activity were significantly depressed in P12 vs. PN during the first min of recovery, indicating delayed vagal reactivation after exercise. Additionally, LF fluctuations recovered immediately upon cessation of exercise in PN, but were similarly depressed in P12 and P18, indicating prolonged sympathetic stimulation in P12 and P18.

**CONCLUSIONS:** Abnormal HRR is associated with impaired autonomic function, and is not related to stress induced myocardial ischemia.

	NHRR	P18	P12	P-Value*
Rest HR (b/min)	78±11.4	87.5±14.8	85.8±16.1	0.000
Hypertension	35.7%	57.5%	50.9%	0.012
Diabetes	17.3%	13.8%	34.0%	0.012
METS	11.5±2.6	10.6±2.6	9.9±2.4	0.001
Exercise Induced Ischemia	0.9±3.2	0.9±3.4	0.9±2.7	0.855

## 2157 Board #45 May 28 3:30 PM - 5:00 PM A Scoring System To Aid In The Interpretation Of Cardiopulmonary Test Results

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(No relationships reported)

Cardiopulmonary analysis during graded exercise testing (CPX) is commonly used to diagnose illness and determine physical working capacity. Given the number of variables generated during CPX it can be difficult to provide concise and meaningful interpretations for health personnel not familiar with its use. We proposed to develop a scoring system yielding a composite score that describes physiological function and working capacity using the results from a two day test-retest CPX. The purpose is to provide a single score that accurately describes performance in order to compare one day's performance with the next.

**METHODS:** CPX results from a group of women with chronic fatigue syndrome (n=15) and age-, gender- and weight-matched sedentary controls (n=15) were employed to develop the scoring system. Peak values for oxygen consumption, heart rate and ventilation were compared with age- and gender-predicted values. If an individual achieved at least 85% of predicted values this corresponded to value of 5 points. One point was subtracted for each 10% decrement below the 85% predicted value, and 1 point was added for each 10% increment above 100% of predicted. Scoring for anaerobic threshold (AT) was given a full 5 point value for achieving 40% of predicted peak oxygen consumption and one point deducted for 10% increments below 40% and above 60% of predicted peak oxygen consumption. Reaching 85% of predicted values for every variable resulted in a composite score of 25 points.

**RESULTS:** To be included, each subject reached ACSM criteria for maximal effort on both test days the control subjects achieved an average score of 27.9±4.0 on test 1 and 29.1±5.6 on test 2. The CFS subjects scored 26.0±5.3 on test 1 and 24.7±5.3 on test 2. For the control subjects eleven out of 15 achieved at least 85% of their predicted max and scores of 25 or above for test one. For test two, ten out of 15 achieved values of 25 or above. In the CFS group 10 out of 15 achieved 25 points on test one and 7 out of 15 for test 2.

**CONCLUSIONS:** The scoring system as employed can be used to describe performance compared with age- and gender-predicted values and may be helpful in describing the reduction in physical performance in a test-retest situation. This scoring system better describes the differences in physical capabilities than a previously employed method.

## 2158 Board #46 May 28 3:30 PM - 5:00 PM Gender Affects On Pediatric Heart Rate And Vo2 Relationships Compared To The ACSM Predicted Values

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(No relationships reported)

**PURPOSE:** To evaluate the gender affect on the percent of maximal heart rate (%Max HR) and oxygen consumption relationship in pediatric patients compared to the established adult values by the American College of Sports Medicine.

**METHODS:** 1087 patients (Male 548, Female 539) referred for evaluation of chest pain, syncope and exercise intolerance were evaluated by a maximal exercise test using the James cycle ergometer protocol. The patients were cleared of structural heart disease by echocardiograph and/or physical examination and history. All exercise tests were maximal efforts. Patient demographics for the males and females were: Age 14.1±3.1 vs 14.8±3.3 years, Height 1.64±0.17 vs 1.60±0.11 meters and Weight 61.2±21.3 vs 56.7±14.5 kg, respectively.

**RESULTS:** The observed exercise values for %MaxHR for both male and female were significantly higher than the ACSM predicted values at 40%, 50%, 60%, 80% and 85% Max VO<sub>2</sub> levels. Additionally, the %MaxHR was significantly higher in females compared to males. Heart rate for females was significantly higher than males at all stages except 80%MaxVO<sub>2</sub>.

	40%Max VO2	50%Max VO2	60%Max VO2	80%Max VO2	85%Max VO2
ACSM predicted %Max HR	55	62	70	85	90
Male Observed %Max HR	60 ± 7	66 ± 7	73 ± 7	88 ± 6	91 ± 6
Female Observed %Max HR	**63 ± 7	**69 ± 7	**76 ± 7	**90 ± 6	**93 ± 4
Male Heart Rate	116 ± 15	127 ± 15	142 ± 16	169 ± 14	174 ± 17
Female Heart Rate	*120 ± 14	*132 ± 16	*146 ± 17	171 ± 16	*179 ± 13

\*P<0.05, \*\*P<0.01

**CONCLUSION:** The observed values for %MaxHR are significantly higher in pediatrics compared to the predicted values by the ACSM. Additionally, %MaxHR and HR was significantly higher in females. When developing an exercise prescription for pediatric patients, values must be based on pediatric standards divided into gender strata.

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**2159 Board #47 May 28 3:30 PM - 5:00 PM**  
**Utilization Of Exercise Sestamibi In The Evaluation Of Cardiac Ischemia In Pediatric Patients**

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**PURPOSE:** We evaluated the utility of exercise sestamibi (SM) in the diagnosis of exercise cardiac ischemia in pediatric patients with heart disease or referred for evaluation of chest pain or syncope.

**METHODS:** We evaluated 40 pediatric patients (19 female, mean age 13.6 years) presenting with possible exercise induced cardiac ischemia with a standard cycle ergometer (31 patients) or treadmill protocol (9 patients). The group consisted of: 13 Kawasaki, 5 TGV, 3 HLHS, 3 CM, 2 Heart Transplant, 3 Coronary Artery Abnormality, 2 PS, 9 with cardiac symptoms. SM was injected 1 minute before termination of the exercise test with a follow-up perfusion scan post exercise. The exercise test and the nuclear medicine report were interpreted by separate physicians blinded to the results of the coexisting test. A positive exercise test was based on ST depression in any lead greater than or equal to 1.5mm.

**RESULTS:** All exercise tests were maximal with a mean respiratory quotient of 1.14 and a maximal heart rate of 187 BPM. There were 10 positive exercise tests for ischemia with 2 showing normal SM perfusion. Both patients had abnormal apical myocardial thinning delineated by the perfusion report. There were 11 positive SM tests for perfusion defects, 3 of these showed normal exercise tests (no ST segment depression). In patients with a cardiac diagnosis, 9 of 31 showed perfusion defects. In patients referred for symptoms, 2 of 9 showed perfusion defects.

	(+) Sesta Mibi	(-) Sesta Mibi
(+) Graded Exercise Test	8	2
(-) Graded Exercise Test	3	27

**CONCLUSION:** These results demonstrate good agreement between a positive exercise test and the presence of SM perfusion defects. However, there was not a 100% agreement between the 2 methods. This could be a lack of sensitivity of one or both methods or as a need to utilize both methods in the evaluation of cardiac ischemia.

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**2160 Board #48 May 28 3:30 PM - 5:00 PM**  
**Comparison Of Oxygen Pulse In Healthy Smokers And Nonsmokers During Cycle Ergometry Exercise**

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(No relationships reported)

Oxygen pulse ( $O_2$  pulse), the ratio of oxygen consumption ( $VO_2$ ) and heart rate (HR), estimates the product of stroke volume and arteriovenous oxygen difference and thus has been used as an indicator of oxygen transport in the circulatory system. Blunted HR responses to exercise have been observed in smokers (S) as have lower peak heart rates. Because HR is a component of  $O_2$  pulse, differences in  $O_2$  pulse during exercise may be seen between S and nonsmokers (NS).

**PURPOSE:** To compare the maximal and submaximal  $O_2$  pulse in healthy S and NS during stationary cycle exercise.

**METHODS:** Eight untrained male S (M±SD: 25.8±5.3 years) and eleven untrained male NS (25.6±3.4 years) participated in the study. Peak measurements for  $VO_2$ , HR and  $O_2$  pulse were assessed using a standardized cycle protocol. Submaximal measurements for  $VO_2$ , HR, and  $O_2$  pulse were recorded during a 60 minute session of cycle exercise at 50% of  $VO_{2PEAK}$ .

**RESULTS:** MANOVA procedure yielded a significant overall multivariate effect for the peak measurements ( $F_{3,15}=5.75$ ,  $p<.01$ ). Follow-up univariate tests revealed a significantly lower peak HR ( $159\pm12$  vs.  $175\pm11$  beats  $min^{-1}$ ,  $p<.01$ ) and a significantly higher peak  $O_2$  pulse ( $17.4\pm2.8$  vs.  $14.7\pm2.2$  ml  $beat^{-1}$ ,  $p<.05$ ) for S. No significant differences between groups were noted for the submaximal measurements for  $VO_2$ , HR, and  $O_2$  pulse. Strong positive correlations were seen between  $VO_{2PEAK}$  and peak  $O_2$  pulse for both S ( $r=.953$ ,  $p<.001$ ) and NS ( $r=.928$ ,  $p<.001$ ). No significant correlations between  $O_2$  pulse and HR were noted for either group.

**CONCLUSION:** Compared to NS, healthy S demonstrated a higher peak  $O_2$  pulse due to a significantly attenuated peak HR response, although peak  $O_2$  pulse was more strongly related to  $VO_{2PEAK}$  than to peak HR.

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**2161 Board #49 May 28 3:30 PM - 5:00 PM**  
**Echocardiography with Tissue Doppler Imaging And Cardiopulmonary Exercise Testing Correlates In Patients With Diastolic Heart Failure**

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(No relationships reported)

Previous investigations have reported a relationship between variables obtained from echocardiography with tissue Doppler imaging (TDI) and cardiopulmonary exercise testing (CPX) in patients diagnosed with systolic heart failure (HF).

**PURPOSE:** We are unaware of any prior study performing such an analysis in patients with diastolic HF, which is the purpose of the present investigation.

**METHODS:** Thirty-two patients with diastolic HF [69% male, age:  $62.8\pm9.7$  years, left ventricular ejection fraction (LVEF):  $55.5\pm4.5\%$ ] underwent echocardiography with TDI and CPX to determine the following variables: 1. the ratio between mitral early (E) to mitral annular (E') velocity, 2. LVEF, LV mass, 3. LV end systolic volume (LVESV), 4. peak oxygen consumption ( $VO_2$ ), 5. ventilatory efficiency ( $VE/VCO_2$  slope), 6. the partial pressure of end-tidal carbon dioxide ( $P_{ET}CO_2$ ) at rest and peak exercise and 7. heart rate recovery at one minute (HRR<sub>1</sub>).

**RESULTS:** Pearson correlation results are listed in Table 1. LV mass and LVESV were not correlated with any CPX variable. LVEF was correlated with HRR<sub>1</sub> and approached statistical significance with peak  $VO_2$ . E/E' demonstrated significant correlations with all CPX variables. A HRR<sub>1</sub> threshold of  $\leq 17$  beats per minute (higher

value positive) identified subjects with an E/E'  $\leq 10$  (lower value positive) with a 77% sensitivity and 88% specificity.

Table 1

	LVEF (%)	E/E'	LV mass (grams)	LVESV (mL)
Peak VO <sub>2</sub> (mLO <sub>2</sub> •kg <sup>-1</sup> •min <sup>-1</sup> )	-0.35 p=0.05	-0.49* p=0.005	-0.18 p=0.32	0.12 p=0.50
VE/VCO <sub>2</sub> slope	0.14 p=0.45	0.57* p=0.001	0.18 p=0.33	-0.07 p=0.69
PETCO <sub>2</sub> at rest (mmHg)	-0.23 p=0.21	-0.36* p=0.04	-0.25 p=0.17	-0.11 p=0.54
PETCO <sub>2</sub> at peak exercise (mmHg)	-0.26 p=0.15	-0.49* p=0.005	-0.23 p=0.21	-0.19 p=0.52
HRR1 (beats per minute)	-0.55* p=0.001	-0.63* p<0.001	-0.05 p=0.79	0.14 p=0.45

**CONCLUSION:** E/E' provides an accurate reflection of LV relaxation, uninfluenced by changes in filling pressure. An association between E/E' and peak VO<sub>2</sub> has previously been reported in patients with systolic HF. The present study demonstrates a significant correlation between E/E' and clinically important CPX variables in patients with diastolic HF.

**2162 Board #50 May 28 3:30 PM - 5:00 PM**

**Indices Of Autonomic Dysfunction During Exercise Testing: Relationship To Reduced Levels Of Cardiorespiratory Fitness**

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(No relationships reported)

Reduced levels of cardiorespiratory fitness are associated with an increased risk of coronary artery disease. Moreover, indices of autonomic dysfunction, including chronotropic impairment (CI) and/or abnormal heart rate recovery (HRR), have been linked to an increased incidence of cardiac events.

**PURPOSE:** To identify differences in levels of cardiorespiratory fitness, expressed as metabolic equivalents (METs), in patients referred for diagnostic exercise testing who demonstrate CI, abnormal HRR, or both.

**METHODS:** Diagnostic exercise tests (n=1035) in the Beaumont database utilizing a modified, stage half or conventional Bruce treadmill protocol were reviewed. Subjects on beta-blocker therapy were excluded. Subjects whose exercise tests were terminated for reasons other than fatigue were excluded from comparisons involving CI. CI was identified in those patients who were unable to achieve  $\geq 80\%$  of heart rate reserve. Abnormal HRR was signified by a reduction in heart rate of  $< 12$  beats per minute within the first minute post exercise. Fitness was estimated from the treadmill time, speed, and grade.

**RESULTS:** Subjects who met the criteria for study inclusion (n=632) were divided into two groups: those with CI (n=145) and those without CI (n=487). Subjects with CI were more likely to have a lower fitness level (8.3 + 2.2 METs) as compared to those without CI (10.0 + 2.2 METs; p < 0.001). In a second analysis, 761 subjects were divided into two groups: normal HRR (n=699) and abnormal HRR (n=62). Those with abnormal HRR tended to be older and have lower fitness levels (7.0 + 2.3 METs) than those with normal HRR (9.5 + 2.3 METs; p < 0.001). Finally, 639 subjects were divided into two groups: those with CI and abnormal HRR (n=20) and those with neither or only one marker of autonomic dysfunction (n=619). Subjects with both CI and abnormal HRR tended to be older and have lower fitness levels (6.6 + 2.8 METs) than those with neither or only one abnormal index (9.7 + 2.2 METs; p < 0.001).

**CONCLUSIONS:** Subjects with abnormal HRR, with and without CI, tend to be older and have significantly reduced levels of cardiorespiratory fitness than individuals without these markers of autonomic dysfunction. Improving aerobic fitness may serve to normalize these prognostic indicators in patients with and without known cardiovascular disease.

**2163 Board #51 May 28 3:30 PM - 5:00 PM**

**Early Repolarization And Ectopy During Stress Testing**

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( C.C. Dunbar, Pfizer, Consulting Fee.)

**PURPOSE:** To examine the interaction between resting early repolarization and the occurrence of ectopy during clinical exercise testing.

**METHODS:** Pre-stress 12-lead resting ECGs of patients presenting for the following types of stress testing were examined for evidence of early repolarization (ER): exercise ECG, nuclear exercise ECG, exercise echocardiography, dipyridamole nuclear, dobutamine nuclear and dobutamine echocardiography. Each case of ER (n=26) identified was matched with two randomly selected control patients without ER (n=52). Stress tests were performed using standard hospital protocols. The ECGs recorded before, during and after stress were examined for supraventricular (PAC) and ventricular ectopy (PVC). Ectopy was further categorized by type (uniform versus multiform PVC, isolated ectopic beats versus runs of ectopy, etc.). A chi-square test for two independent samples (2 x 2 contingency table) was used to determine if a significant interaction was present between the occurrence of resting ER and the presence of each of the following before, during and/or after stress: PAC and/or PVC, PAC only, PVC only, multiform PVC, and PVC runs.

**RESULTS:** The proportions of the sample exhibiting and not exhibiting ectopy before, during and/or after stress did not differ significantly between patients with and without evidence of ER on resting ECG. That is, there were no significant (p>0.05) interactions between the occurrence of ER and the presence of ectopy.

**CONCLUSIONS:** The presence of ER on the resting ECG does not appear to be indicative of ectopy during clinical stress testing.

**2164 Board #52 May 28 3:30 PM - 5:00 PM**

**Exercise Recovery Hemodynamics In Overweight Vs. Obese Patients Diagnosed With Coronary Disease.**

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(No relationships reported)

**PURPOSE:** To determine if blood pressures assessed during exercise recovery differ in overweight vs. obese patients diagnosed with coronary artery disease (CAD).

**METHODS:** A group of 225 patients with CAD (N=183 males, mean age=63.5, mean BMI=30.2; N=42 females, mean age=64.0, mean BMI=30.2) underwent cycle exercise testing. Height and weight were assessed using calibrated equipment and BMI was calculated as weight (kg) / height (m) squared. All 225 test subjects were classified as either "overweight" (OW)(N=126) or "obese" (OB)(N=99) according to the National Institutes of Health guidelines. Resting systolic (SBP) and diastolic (DBP) blood pressures were taken following a 3 minute rest period. Mean arterial pressure (MAP) was estimated as  $[(3(SBP-DBP))+DBP]$ . Pressures were also assessed at 1, 3, and 5 minutes after the test. An analysis of covariance (ANCOVA) with resting pressure and body weight as covariates was used to determine if differences in recovery SBP, DBP, and estimated MAP were present at the three post-exercise recovery times (RT).

**RESULTS:** After ANCOVA adjustment, all three recovery pressures were higher in the obese group at every RT with statistical significance found at the 1 minute time point for DBP and MAP.

**CONCLUSION:** Obese subjects with CAD demonstrate higher recovery SBP's, DBP's, and estimated MAP's than overweight subjects.

Table: unadjusted means + SD, * = sig. different from OW, p<0.05			
RT	1:00	3:00	5:00
	SBP	SBP	SBP
OB	179.7+30.7	159.0+23.11	140.9+18.8
OW	167.9+28.2	152.5+25.1	135.3+23.6
	DBP	DBP	DBP
OB	85.0+11.53*	82.5+10.5	81.0+10.1
OW	79.1+10.8	78.4+9.8	76.9+9.3
	MAP	MAP	MAP
OB	116.3+16.2*	107.7+12.5	100.8+11.5
OW	108.3+13.9	102.7+12.7	96.1+12.2

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2165 Board #53 May 28 3:30 PM - 5:00 PM

#### Estimating Cardiorespiratory Fitness In Morbidly Obese Patients: Validity Of The Duke Activity Status Index

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(No relationships reported)

**PURPOSE:** To assess the accuracy of the Duke Activity Status Index (DASI) questionnaire in morbidly obese patients (MOP) undergoing pre-surgical graded exercise testing (GXT).

**BACKGROUND:** Although the DASI has been previously established as a valid and reliable predictor of cardiorespiratory fitness in healthy individuals, its applicability in the morbidly obese remains unclear.

**METHOD:** As part of a pre-bariatric surgery evaluation, the DASI questionnaire was administered to MOP scheduled to undergo a GXT with concomitant measures of cardiorespiratory fitness ( $VO_{2max}$ ). Questions about the survey were not clarified by the test administrator to minimize bias. Upon completion of the DASI, each patient completed their GXT using a treadmill or combined arm-leg ergometer protocol.

**RESULTS:** The DASI and subsequent GXT with  $VO_{2max}$  were completed on 122 patients [101 women (mean age + SD = 43.7 + 12.2) and 21 men (mean age + SD = 43.6 + 14.3)]. Mean + SD body mass index of the MOP was 49.9 + 7.9 kg/m<sup>2</sup>. Utilizing the DASI, our study population achieved a predicted  $VO_{2max}$  of 27.4 + 5.9 ml/kg/min. Measured  $VO_{2max}$  in this population was 18.3 + 4.2 ml/kg/min, resulting in a significant overestimation of the predicted versus measured level of cardiorespiratory fitness ( $p<0.0001$ ). Mean + SD respiratory exchange ratio achieved during exercise testing was 1.15 + 0.13.

**CONCLUSION:** The DASI questionnaire significantly overestimates predicted aerobic capacity in MOP prior to gastric bypass surgery. Measured  $VO_{2max}$ , expressed as ml/kg/min, can be predicted from the following regression equation: measured  $VO_{2max}$  = 10.23 + 0.29(predicted  $VO_{2max}$ ).

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2166 Board #54 May 28 3:30 PM - 5:00 PM

#### Body Weight As A Determinant Of Exercise Capacity In Overweight Adolescents

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(No relationships reported)

Excess bodyweight may increase the metabolic cost of work and diminish physical activity tolerance.

**PURPOSE:** To determine the influence of excess bodyweight on exercise capacity in adolescents who were overweight.

**METHODS:** Subjects were 30 (16 females and 14 males) normal weight (NW), (height: 1.6±0.1 m, weight: 55.5±12.1 kg) and 63 (45 females and 18 males) overweight (OW) (height: 1.7±0.1 m, weight: 107.5±20.3 kg) adolescents. The NW and OW groups were 14.5±1.7 years and 14.8±1.4 years of age respectively. Oxygen uptake ( $VO_2$ ) was first measured during unloaded cycling (UL $VO_2$ ). Subjects then completed a maximum cycle ergometer test to exhaustion. Maximum  $VO_2$ , and power output ( $W_{max}$ ) were measured. The change in  $VO_2$  from unloaded cycling to maximum exercise (Net $VO_2$ ) was calculated as the difference between  $VO_{2max}$  and UL $VO_2$ . Group differences in the dependent variables were determined by Student's t tests. A Pearson product moment coefficient of determination ( $r^2$ ) was used to characterize the relationship between UL $VO_2$  and body weight (BW) and  $W_{max}$  and Net $VO_2$ .

**RESULTS:**  $VO_{2max}$  was similar for NW (2067±571 mlO<sub>2</sub>/min) and OW (2041±481 mlO<sub>2</sub>/min). UL $VO_2$  in OW (693±169 mlO<sub>2</sub>/min) was significantly ( $p<0.001$ ) higher than in NW (406±125 mlO<sub>2</sub>/min) and significantly related to BW ( $r^2=0.63$ ,  $p<0.0001$ ).  $W_{max}$  (185±44 in NW vs 153±34 watts in OW;  $p<0.001$ ) and Net $VO_2$  (1661±495 in NW vs 1348±427 mlO<sub>2</sub>/min in OW;  $p<0.004$ ) were significantly lower in OW than in NW.  $W_{max}$  and Net $VO_2$  were determinately related ( $r^2=0.85$ ,  $p<0.001$ ).  $W_{max}$  and Net $VO_2$  were 17.3% and 18.8 % lower in OW than in NW.

**CONCLUSION:** The gender make-up of the NW and OW groups was disproportional. Nonetheless, the very high coefficient of determination, combined with the close proportionality between the reduction in Net $VO_2$  and  $W_{max}$ , suggested that the increased metabolic cost of work was likely the cause of the reduced exercise capacity in these adolescents who were overweight.



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**2167 Board #55 May 28 3:30 PM - 5:00 PM****Age-predicted Heart Rate Equations: Comparisons Of Equations In College-aged Subjects**

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(No relationships reported)

Although the maximum heart rate ( $HR_{max}$ )-prediction model of 220-age (Fox et al.) is well established and widely used in clinical and fitness settings, its validity is uncertain in the college-aged population.

**PURPOSE:** To compare several age-predicted  $HR_{max}$  equations to recorded maximum heart rate (RMHR) from sprint tests in college-aged subjects.

**METHODS:** Informed consent was obtained for 96 (52 males and 44 females, age=22.0±2.8 yr, height=163.9±9.5 cm, 70.6±14.7 kg, resting HR=68.9±11.2 bpm) healthy volunteers. RMHR was obtained during three sprint tests (Wingate cycle test and two-200 m sprints on a standard track) and maximal effort was confirmed via plasma lactate ≥6 mmol/L and rating of perceived exertion ≥16 points. The highest RMHR from the sprint test was compared to 7 age-predicted  $HR_{max}$  equations: Fox, 3 equations from Gellish et al., Tanaka et al, and gender-specific equations from Fairbairn et al. and Hossack et al. Descriptive statistics and standard errors of estimate (SEE) were calculated. One-way ANOVA was used to assess differences between RMHR and age-predicted  $HR_{max}$ .

**RESULTS:** Predicted  $HR_{max}$  from Fox, Gellish<sub>2</sub>, Tanaka and Hossack were all significantly higher ( $p \leq .05$ ) than RMHR. In 88.5% (n=85) of the cases, the most commonly used equation (Fox) over-predicted  $HR_{max}$ . Compared to RMHR (189.2±8.1 bpm), the Fox equation predicted a  $HR_{max}$  of 104.6% of RMHR (198.0±2.8 bpm, SEE=12.2), Gellish<sub>1</sub> = 99.4% (188.1±1.0 bpm, SEE=10.1), Gellish<sub>2</sub> = 101.6% (192.1±1.9, SEE=5.9), Gellish<sub>3</sub> = 99.7% (188.6±1.0 bpm, SEE=8.1), Tanaka = 101.8% (192.6±2.0 bpm, SEE=5.5), Fairbairn = 99.9% (males and females=188.9±2.7, SEE=8.3), and Hossack = 105.0% (males and females=198.7±6.0, SEE=13.3).

**CONCLUSIONS:** The most accurate equation was Gellish<sub>3</sub> ( $HR_{max}=192-0.007 \times \text{age}^2$ ) with one of the closest estimates of the RMHR without exceeding it and one of the lowest SEE. Although it is not the simplest equation to use, in a healthy, college-aged population, the Gellish<sub>3</sub> equation is the safest and most accurate estimate of  $HR_{max}$  and should be used when prescribing exercise intensity.

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**2168 Board #56 May 28 3:30 PM - 5:00 PM****Reference Equation for the Incremental Shuttle Walk Test in Healthy Adults**

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Incremental shuttle walk test (ISWT), in which the speed of walking is imposed by pre-recorded signals, was developed in an attempt to standardize and improve reproducibility of field walk tests. Nowadays, ISWT is an established measure of exercise capacity in patients with cardiopulmonary disease. Despite its widespread use, there is no reference equation for prediction of the distance walked in the ISWT in healthy subjects.

**PURPOSE:** To evaluate the ISWT for healthy subjects aged 38-84 years and to establish a reference equation for its prediction.

**METHODS:** Seventy-five healthy subjects (30 men; 50 ± 10 years) performed two ISWT in a 10-m long corridor. Other measurements included height, weight, body mass index (BMI), forced expiratory volume in 1s (FEV<sub>1</sub>), forced vital capacity (FVC) and reported physical activity (RPA). Blood pressure, heart rate (HR), dyspnea and leg fatigue were assessed at baseline and at the end of the ISWT.

**RESULTS:** The average ISWT was 541 ± 172 m and was greater in male when compared to female subjects (675 ± 182 m vs. 469 ± 128 m;  $p < 0.05$ , respectively). Substantial variability in the ISWT was present in these healthy subjects, with a range of 210-1090 m. Subjects reached 75 ± 13% of their maximal predicted heart rate. Age ( $r = -0.45$ ), height ( $r = 0.56$ ), weight ( $r = 0.28$ ), FEV<sub>1L</sub> ( $r = 0.50$ ), FVC<sub>L</sub> ( $r = 0.64$ ), %HR<sub>max</sub> ( $r = 0.55$ ) and RPA ( $r = 0.34$ ) were significantly correlated with ISWT ( $p < 0.05$ ). The following regression equation showed that age, height, weight and gender were independent contributors to the ISWT in Brazilian healthy subjects explaining 42.6% of the variability:  $ISWT_m = -245.794 - (6.112 \times \text{age}_{\text{years}}) - (3.743 \times \text{weight}_{\text{kg}}) + (8.079 \times \text{height}_{\text{cm}}) + (100.776 \times \text{gender}_{\text{males}=1; \text{females}=0})$ . A modest learning effect was apparent between the first and the second test (493 ± 159 m vs. 541 ± 172 m;  $p = 0.095$ ).

**CONCLUSIONS:** The present study showed considerable variability of the ISWT in Brazilian healthy subjects. However, an important part of the variability was explained adequately by demographic and anthropomorphic attributes as age, weight, height and gender. Moreover, the ISWT represents a submaximal exercise in Brazilian healthy subjects. Other studies are necessary to confirm if one practice walk should be performed.

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**2169 Board #57 May 28 3:30 PM - 5:00 PM****Relationship Between Streaming Triaxial Accelerometry And VO<sub>2</sub> During Treadmill Locomotion On An Uphill Grade**

James A. Yaggie<sup>1</sup>, Michael A. Busa<sup>2</sup>, Timothy Muth<sup>2</sup>, Erik M. Bollt<sup>3</sup>, Stephen J. McGregor<sup>2</sup>. <sup>1</sup>University of Findlay, Findlay, OH. <sup>2</sup>Eastern Michigan University, Ypsilanti, MI. <sup>3</sup>Clarkson University, Potsdam, NY.

(No relationships reported)

**INTRODUCTION:** High resolution accelerometry (HRA) has been used increasingly for gait analysis, while lower resolution “activity monitors” have been used to estimate energy expenditure. The purpose of this study was to test the reliability of HRA in repeated trials and determine if HRA could be used as a valid proxy for VO<sub>2</sub> during uphill locomotion on a treadmill.

**METHODS:** Procedures were approved by the EMU-HSRC. Ten recreationally active students (27.7±7.4 yr, 62.7±12.7 kg, 43.9±6.4 ml/kg/min) performed two incremental treadmill trials at 10% grade, starting at 2 kph and increasing 2 kph every two minutes until volitional exhaustion. Metabolic gasses were collected using an Oxycon Mobile (Viasys, CA) and averaged over 15 sec intervals. Data was streamed at 625 Hz from wireless, triaxial accelerometers (Microstrain, VT) affixed to the lower back of subjects corresponding to the L4-L5 segment. Raw signal from three axes, vertical (V), medial/lateral (M/P) and anterior/posterior (A/P) was integrated to obtain resultant (RES) acceleration vectors (Matlab; Mathworks, MA). Axial root mean square (RMS) calculations using the last minute of acceleration data, per stage, were also computed (LabView, v 8.6, National Instruments, Austin, TX) and compared to relative VO<sub>2</sub> using Pearson's correlation (SPSS, IL;  $\alpha = 0.05$ ).

**RESULTS:** Axial RMS test-retest correlations were 0.93, 0.96, 0.73 and 0.96 for V, M/L, A/P and RES, respectively ( $p < .001$ ), and Chronbach's Alpha was 0.96 ( $p < .001$ ). Highly significant, strong correlations of individual axes and VO<sub>2</sub> were 0.80, 0.76, 0.60, 0.90 and .97 for V, M/L, A/P, RES and speed, respectively ( $p < .001$ ). Curve fit regressions showed a linear fit was best for RMS of RES vs VO<sub>2</sub>, but a quadratic fit of RES vs speed exhibited an  $r = 0.94$  ( $p < .001$ ).

**CONCLUSIONS:** These data indicate HRA is a reliable tool for the determination of RES, VO<sub>2</sub> and speed, in addition to the typical biomechanical analyses during uphill locomotion. Further study is warranted to compare these relationships in subjects of varied training status, as well as other locomotive conditions.

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**D-28 Free Communication/Poster - Fitness Testing**

**2170 Board #58 May 28 2:00 PM - 3:30 PM**  
**Comparison Of Self-selected Paces For Walking And Stair-climbing**

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(No relationships reported)

**PURPOSE:** To describe the differences between self-selected paces during level walking (SSWP) and stair climbing (SSCP).

**METHODS:** Maximal oxygen consumption (MVO<sub>2</sub>) of 45 women and 54 men (32.6±14.3 yrs and 29.6±13.4 yrs, 41.7±10.4 ml/kg/min and 53.2±12.0 ml/kg/min) was determined using a modified Bruce treadmill protocol. VO<sub>2</sub> at ventilatory threshold (VT) (30.9±7.6 ml/kg/min and 38.5±8.8 ml/kg/min) and lactate threshold (LT), VO<sub>2</sub> at 4mmol blood lactate (30.4±9.8 ml/kg/min and 37.0±10.8 ml/kg/min), were calculated from the maximal treadmill test. On a motor-driven treadmill, subjects were instructed to identify a walking pace (SSWP) that they would use typically when walking across campus (3.05±.22 mph and 3.14±.35 mph, p>.05), described as a functional pace. For the stair-climbing test, they were instructed to climb the stairs at a pace (SSCP) that they normally would when they encounter a flight of stairs. VO<sub>2</sub> (using telemetry), RPE, LA, and HR were recorded for SSWP and SSCP. The Student unpaired t-test was used to determine whether there were any significant differences between genders and SSWP and SSCP.

**RESULTS:** While both women and men showed similar VO<sub>2</sub> (p>.05) at SSWP (17.54±3.8 ml/kg/min and 17.6±3.7 ml/kg/min) and SSCP (26.7±6.5 ml/kg/min and 27.3±5.0 ml/kg/min), there were significant differences (p.05) and stepping frequency at SSCP (113.3±22.1 steps/min and 120.7±18.2 steps/min) was also compared. While the men walked and climbed at the same step frequency (p<.05), the women did not (p=.09).

**CONCLUSIONS:** Subjects chose to climb at higher VO<sub>2</sub> during SSCP than SSWP. While SSWP and SSCP were the same for both, this represented a higher intensity for the women.

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**2171 Board #59 May 28 2:00 PM - 3:30 PM**  
**Effect Of Moderate Hypoxia On The Power-endurance Relationship**

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(No relationships reported)

**PURPOSE:** The asymptote of the hyperbolic power-endurance relationship (Critical Power, CP) has been suggested to represent a sustainable power output using renewable aerobic energy. Work rates above CP would result in blood [lactate] rising until peak VO<sub>2</sub> is attained and exhaustion would occur when the curvature of the power-endurance relationship, defined as a fixed Anaerobic Work Capacity (AWC), is totally depleted. Since CP is dependent on aerobic energy supply, we tested the hypothesis that it should be reduced systematically under hypoxia while AWC would remain unaltered.

**METHODS:** Seventeen subjects (8 males; age: 37 ± 3; mass: 71 ± 2 kg) performed a ramp test to determine peak VO<sub>2</sub>, and three to four constant-load tests to exhaustion in order to model the linear P-t<sup>-1</sup> relationship (using a 2-parameter model where CP is the intercept, and AWC the slope). All tests were performed in a random order under moderate hypoxia (FiO<sub>2</sub>=0.15; pre-exercise SaO<sub>2</sub> of 93.5 ± 0.8%) and normoxia (pre-exercise SaO<sub>2</sub> of 98.3 ± 0.3%) on a SRM cycle ergometer with VO<sub>2</sub> measurement using a breath-by-breath analyzer (Ergocard; Medi-Soft). Paired t-tests were performed to identify differences. Relationships were explored using the Spearman correlation coefficient. The significance was set at P<0.05.

**RESULTS:** Peak VO<sub>2</sub> (3.55 ± 0.17 L.min<sup>-1</sup> vs 3.11 ± 0.15 L.min<sup>-1</sup>; P<0.01) and CP (225 ± 10W vs 193 ± 8 W; 2.86 ± 0.13 L.min<sup>-1</sup> vs 2.45 ± 0.12 L.min<sup>-1</sup>; P<0.01) were both significantly reduced by hypoxia. The decrease in CP (-14 ± 2%; range from 1 to -26%) and peak VO<sub>2</sub> (-12 ± 1% decrease; range from -1 to -21%) were significantly correlated (r=0.82; P<0.05). AWC was not significantly different under hypoxia (11.8 ± 1.2 kJ vs 12.2 ± 0.9 kJ; P>0.05) with the changes in AWC (+12 ± 8%; range from +60 to -36%) being highly correlated with the changes in CP (r=-0.80; P<0.05).

**CONCLUSION:** The present study demonstrates the aerobic nature of the intercept of the P-t<sup>-1</sup> relationship. A reduction in the systemic O<sub>2</sub> transport systematically affects CP, with 67% of its change being explained by peak VO<sub>2</sub> changes. The extreme changes in AWC in individuals whose CP were most affected by hypoxia, challenges the current interpretation of this parameter.

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**2172 Board #60 May 28 2:00 PM - 3:30 PM**  
**'Reverse Lactate Threshold' - A Novel Approach To High-resolution, Single-session Determination Of The Anaerobic-threshold**

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Existing single-session tests for estimating of the Anaerobic-Threshold (AnT) or Maximal Lactate Steady-State (MLSS) show unsatisfactory validity, reliability, or resolution. The main shortcomings of the accepted 'Gold Standard', the multi-session MLSS test, are prohibitive impracticality and unproven reliability.

**PURPOSE:** To introduce the proposed single-session 'Reverse Lactate Threshold' test (RLT) for AnT/MLSS determination, validate it against the accepted 'Gold Standard' (MLSS test), and test its reliability.

**METHODS:** The RLT consists of 2 contiguous series of continuous 4-min stages. A 3-5-stage series is progressively incremented from a mild work load to 5-20% above the presumed MLSS intensity. It is followed by a 3-6-load reverse series decremented in small steps. Capillary blood is sampled at the end of each stage for lactate concentration ([La]). [La] is then plotted against load and the power output at peak [La] during the reverse series is taken as the RLT-determined AnT. Four athletes of different training levels and disciplines (rowing, cycling, running) served for RLT validation and completed all RLT and MLSS-verification tests. Accepted MLSS-determination criterion was used for verification ([La] rise of ≤1.0mM in the last 20 min of the 30-min MLSS test). One athlete was retested, following a 2.5-month endurance-training period, to gauge RLT's sensitivity to fitness changes. Additional 10 trained and untrained cyclists were tested twice, 2-5 days apart, to evaluate the RLT's test-retest reliability.

**RESULTS:** RLT-MLSS agreement within 1W (<0.5%) or <0.1 mph (~0.5%) was shown in all 4 'validation' subjects. Post-training, both RLT-determined AnT and MLSS increased by 15W and were in complete agreement. The test-retest coefficient in the reliability testing was 0.998.

**CONCLUSIONS:** The RLT precisely predicted MLSS intensity in all subjects. Its single-session attribute makes it highly practical for routine testing of trained and untrained individuals. Based on the present data, the RLT appears to at least match the MLSS test's accuracy and exceed its resolution in estimating true AnT exercise intensity and in reflecting training-induced AnT changes. The observed level of reliability is higher than any reported for any existing test.

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**2173 Board #61 May 28 2:00 PM - 3:30 PM**  
**Familiarization, Reliability, And Evaluation Of A Multiple Sprint Running Test Using Self-selected Recovery Periods**

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Kingdom. <sup>2</sup>East Stroudsburg University, East Stroudsburg, PA. (Sponsor: Dr Gregory B Dwyer, FACSM)  
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**PURPOSE:** The aims of the present study were to investigate the process of self-selected recovery in a multiple sprint test with a view to using self-selected recovery time as a means of reliably quantifying an individual's ability to perform this type of exercise.

**METHODS:** Twenty physically active exercise science students (Means  $\pm$  standard deviation for age, height, body mass, body fat, and  $\text{VO}_{2\text{max}}$  of the subjects were:  $21 \pm 2$  years,  $179.2 \pm 8.6$  cm,  $83.7 \pm 10.8$  kg,  $16.6 \pm 3.9\%$ , and  $52.7 \pm 7.2$  ml $\cdot$ kg $^{-1}\cdot$ min $^{-1}$  respectively) completed four trials of a  $12 \times 30$  m multiple sprint running test under the instruction that they should allow sufficient recovery time between sprints to enable maximal sprint performance to be maintained throughout each trial. Heart rate and ratings of perceived exertion (RPE) were recorded throughout each trial, with sprint and recovery times recorded using twin-beam photocells.

**RESULTS:** Mean recovery times across the four trials were  $73.9 \pm 24.7$  s,  $82.3 \pm 23.8$  s,  $77.6 \pm 19.1$  s, and  $77.5 \pm 13.9$  s respectively; with variability in the first two trials considered evidence of learning effects. Test-retest reliability across trials 3-4 revealed a good level of reliability as evidenced by a coefficient of variation of 11.1% (95% likely range: 8.0 to 18.1%) and an intraclass correlation coefficient of 0.76 (95% likely range: 0.40 to 0.91). Despite no change in sprint performance throughout the trials, RPE increased progressively and significantly ( $p < 0.001$ ) from a value of  $10 \pm 2$  after sprint 3 to  $14 \pm 2$  after sprint 12. Mean heart rate throughout trial 4 was  $152 \pm 18$  b $\cdot$ min $^{-1}$ . The correlation between absolute  $\text{VO}_{2\text{max}}$  and mean recovery time was 0.46 (95% likely range: -0.03 to 0.77).

**CONCLUSIONS:** Although self-selected recovery time is a reliable measure in a multiple sprint test, it only appears to be moderately associated with an individual's  $\text{VO}_{2\text{max}}$ .

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**2174 Board #62 May 28 2:00 PM - 3:30 PM**  
**The Effect Of Music Loudness On Anaerobic Performance And Muscular Endurance**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to investigate the effect of music loudness on average anaerobic power, bench press muscular endurance, and leg press muscular endurance in regularly active 20 to 22 year old females.

**METHODS:** At each testing session, participants were randomly assigned to 1 of 4 music loudness levels: zero decibels (Db), 20 Db lower than preferred volume, 20 Db higher than preferred volume, and preferred volume. Leg press repetitions to fatigue, bench press repetitions to fatigue, and average power (watts/kilogram) on a 30-second Wingate test were measured for each participant at every music loudness level.

**RESULTS:** Wingate data revealed that soft music resulted in significantly higher average power than no music ( $p=0.035$ ), preferred music resulted in significantly higher average power than no music ( $p=0.009$ ), and loud music resulted in significantly higher average power than no music ( $p=0.005$ ). Bench press data revealed that preferred music resulted in significantly higher repetitions to fatigue than no music ( $p=0.004$ ), loud music resulted in significantly higher repetitions to fatigue than no music ( $p=0.031$ ), and loud music resulted in significantly higher repetitions to fatigue than then soft music ( $p=0.009$ ). Leg press data revealed that loud music resulted in significantly higher repetitions than no music ( $p=0.011$ ), and loud music resulted in significantly higher repetitions than soft music ( $p=0.041$ ).

**CONCLUSIONS:** Music had a positive effect on performance, as measured in all exercises, with preferred and loud music conditions having the greatest impact.

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**2175 Board #63 May 28 2:00 PM - 3:30 PM**  
**Allometric Modeling Of Anaerobic Capacity In College Men And Women**

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The Wingate ergometer test has become the standard for the measurement of anaerobic capacity (AnC). The outcome of the test is typically reported in absolute (W) and relative terms (W/kg). Both of these methods may disproportionately favor the heavier individual. Allometric modeling has been used in place of simple ratio standards in order to normalize distribution of raw variables and eliminate disproportionalities.

**PURPOSE:** To evaluate the use of allometric scaling for assessing the gender difference in AnC from the Wingate ergometer test.

**METHODS:** College-aged participants (200 F, 90 M) performed a 20-sec supramaximal sprint on a standard friction-loaded bicycle ergometer (Monark, model 894) against a load equivalent to 0.075 g/kg of body mass. A computerized program monitored revolutions per minute and determined power output based on load. Following a 5-min warmup, each subject performed several 10-s familiarization sprints in order to set the workload and allow the subject to start from a pre-loaded condition.

**RESULTS:** Men ( $792 \pm 143$  W and  $9.8 \pm 1.3$  W/kg) had significantly greater ( $p<0.001$ ) absolute peak and relative peak AnC than women ( $481 \pm 108$  W and  $7.4 \pm 1.3$  W/kg). Men ( $655 \pm 122$  W and  $8.2 \pm 1.2$  W/kg) also had significantly greater ( $p<0.001$ ) absolute mean and relative mean AnC than women ( $406 \pm 88$  W and  $6.3 \pm 1.1$  W/kg). Linear regression of log-transformed values indicated no significant gender interaction. The common mass exponents were 0.85 for peak power (95% C.I. = 0.79 to 0.96) and 0.81 for mean power (95% C.I. = 0.79 to 0.96). Production of proportionality constants for each gender in each power component indicated that men produce approximately 1.6 times more AnC than women. The Fatigue Index was not significantly different between men ( $63.2 \pm 14.9\%$ ) and women ( $62.8 \pm 13.5\%$ ). The new allometric scaling coefficient for AnC in this sample was significantly greater than the theoretical value of 0.67.

**CONCLUSIONS:** Allometric scaling of AnC may be more appropriate than ratio comparisons in active young men and women when assessing gender difference. The proportional difference in AnC between the genders is comparable to differences noted previously in muscular strength.

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**2176 Board #64 May 28 2:00 PM - 3:30 PM**  
**The Effect Of Climbing Experience On Metabolic Responses To Graded Exercise Tests Performed On A "Treadwall", Treadmill, And Cycle Ergometer**

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Evidence suggests that subjects will achieve an ~16% lower  $\text{VO}_2$  during a GXT performed on a cycle ergometer (CE) and a vertical treadmill {treadwall (TW)} as compared to a treadmill (TM). However, there appears to be no data comparing the same parameters between experienced (Ex) and nonexperienced (NEx) climbers.

**PURPOSE:** To compare metabolic data between Ex and NEx subjects that performed GXT's on a TM, CE, and a TW.

**METHODS:** NEx (n=22 (11 males & 11 females);  $24.0 \pm 3.5$  yrs;  $170.8 \pm 12.4$  cm;  $69.7 \pm 14.0$  kg;  $19.1 \pm 7.5\%$  bf) and Ex (n=8 (7 males & 1 female);  $28.0 \pm 8.7$  yrs;  $175.8 \pm 5.4$  cm;  $67.9 \pm 10.3$  kg;  $8.6 \pm 4.6\%$  bf) subjects were tested on the different ergometers on separate days to determine their highest achievable  $\text{VO}_2$  (order counterbalanced).  $\text{VO}_2$ , respiratory exchange ratio (RER), and heart rate (HR) were measured, along with several metabolic parameters.

**RESULTS:** A significant difference ( $p < 0.05$ ) was found between groups (Ex vs. NEx) for  $\text{VO}_2$  on the TM, CE, and TW, but not for RER or HR on any ergometer. With Ex and NEx grouped separately, a significant main effect was found between all ergometers for  $\text{VO}_2$ , RER, and HR. A significant difference was found for  $\text{VO}_2$  between TM (Ex =  $52.1 \pm 6.0$ ; NEx =  $42.9 \pm 4.6$ ) and CE (Ex =  $48.0 \pm 4.4$ ; NEx =  $35.9 \pm 4.9$ ) and between TM and TW (Ex =  $45.3 \pm 6.1$ ; NEx =  $36.2 \pm 4.1$ ) in both the Ex and NEx groups. There was also a significant difference found for RER between TM (Ex =  $1.11 \pm 0.08$ ; NEx =  $1.10 \pm 0.04$ ) and CE (Ex =  $1.19 \pm 0.08$ ; NEx =  $1.19 \pm 0.06$ ), between TM and TW (Ex =  $1.01 \pm 0.05$ ; NEx =  $1.05 \pm 0.06$ ), and between CE and TW in both the Ex and NEx groups. Lastly, a significant difference was found for HR between TM ( $195.1 \pm 7.2$ ) and CE ( $183.3 \pm 10.1$ ) and between TM and TW ( $180.6 \pm 7.7$ ) in the NEx group. However, in the Ex group the only significant difference found for HR was between TM ( $186.6 \pm 15.9$ ) and TW ( $175.8 \pm 17.7$ ).

**CONCLUSION:** There was found to be a 7.9% difference between TM and CE for  $\text{VO}_2$  in Ex. However, the difference in  $\text{VO}_2$  between TM and CE was 16.3% in NEx. The percentage difference for  $\text{VO}_2$  was more similar for the Ex and NEx groups between TM and TW (13.1% and 15.6% respectively), which suggests regardless of climbing experience subjects performing a GXT on a TW will hit a ceiling in  $\text{VO}_2$  at approximately the same point relative to their aerobic fitness.

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**2177 Board #65 May 28 2:00 PM - 3:30 PM**

**Comparison Of Blood Vs. Saliva Lactate Measurements Resulting From Lactate Minimum Vs. Constant Load Tests**

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(No relationships reported)

The determination of saliva lactate concentrations in saliva samples represents a non-invasive and an innovative method for determination of endurance capacity and endurance diagnostics.

**PURPOSE:** To assess the concentration of saliva lactate (SL) in contrast to blood lactate concentration (BL).

**METHODS:** 18 healthy subjects (13 male, 5 female; age:  $27.3 \pm 6.2$  yrs; physical activity:  $6.9 \pm 2.7$  h $\cdot$ wk<sup>-1</sup>) performed four cycle ergometer tests (one lactate minimum test [LMT] and 3 constant load tests at 95%, 100% and 105% of the workload at the maximum lactate steady state [MLSS] determined from the LMT). Blood and saliva samples were collected simultaneously and analyzed for lactate.

**RESULTS:** All tests exhibit a clear delay in SL measurements when compared to BL. SL values were lower than BL values (range: 2-5 times). SL curve leveled off later than BL during the constant load tests. Workload of MLSS from the constant load test [BMLSS<sub>CL</sub>] ( $209.7 \pm 44.8$  W) was significantly lower in comparison to workload measured for maximum lactate steady state during LMT generated from blood [BMLSS] ( $219.7 \pm 45.5$  W;  $n = 18$ ;  $p < 0.05$ ) and saliva [SMLSS] ( $235.9 \pm 58.4$  W;  $n = 16$ ;  $p < 0.05$ ).

**CONCLUSION:** More inertial appearance of SL may be explained by an additional diffusion of lactate in the salivary glands. An approximation of BMLSS<sub>CL</sub> by SMLSS is not possible when using the established protocol with an increment duration of 3 min. due to the delayed appearance of lactate in saliva.

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**2178 Board #66 May 28 2:00 PM - 3:30 PM**

**Cerebral And Skeletal Muscle Oxygen Response To Two Brief High Intensity Exercise Trials**

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(No relationships reported)

The 30 second Wingate Anaerobic Test (WAT) is an accepted assessment of anaerobic power. The use of 30 seconds however, is sometimes associated with adverse symptomatic responses immediately following the supramaximal effort. Previous studies have looked at multiple 15 second WATs that may better represent brief high intensity intervals seen in many anaerobic sporting events and also may reduce adverse responses sometimes seen with the 30 second WAT.

**PURPOSE:** The purpose of this study was to examine the oxygen response in cerebral tissue (CT) and skeletal muscle (SM) during two 15 second WATs (WAT1 and WAT2), separated by a 4 minute recovery period in both anaerobically trained and non-anaerobically trained individuals.

**METHODS:** Seventeen participants (9 soccer players, 8 sedentary; mean age  $20.7 \pm 1.4$  yrs) were recruited for this study. Participants completed one familiarization session and one data analysis session. Two 15 second supramaximal cycling efforts (resistance =  $0.075$  kg/kg body weight) were separated by a 4 minute active recovery. SM and CT O<sub>2</sub> responses for oxy-hemoglobin (O<sub>2</sub>Hb) and deoxyhemoglobin (HHb) were assessed using a four-channel continuous wave near infrared spectrophotometer (NIRS). O<sub>2</sub>Hb and HHb was measured simultaneously at 3 sites on the right side of the body; rectus femoris (RF), vastus lateralis (VL), and the forehead approximately 1 inch above the eyebrow.

**RESULTS:** O<sub>2</sub>Hb demonstrated a significantly greater reduction during the second 15 second period compared to the first 15 second WAT in both RF ( $-9.20 \pm 10.35$  vs  $-11.10 \pm 11.15$   $\mu\text{m}$ ) and in VL ( $-9.81 \pm 8.17$  vs  $-11.01 \pm 8.18$   $\mu\text{m}$ ) in all participants ( $p < 0.05$ ). Cerebral O<sub>2</sub>Hb remained stable or demonstrated a slight increase during both WAT1 ( $2.47 \pm 0.95$   $\mu\text{m}$ ) and WAT2 ( $1.81 \pm 1.24$   $\mu\text{m}$ ). There was no significant difference in power measurements for either peak or mean power when comparing WAT1 ( $677.48 \pm 136.85$  W and  $650.68 \pm 114.20$  W) vs WAT2 ( $678.31 \pm 134.29$  W and  $651.61 \pm 112.11$  W). These results were consistent when comparing anaerobic vs non-anaerobic individuals.

**CONCLUSIONS:** The results of this study suggest that although there is a significant decrease in SM O<sub>2</sub>Hb during the second test, cerebral O<sub>2</sub>Hb remains stable and power is maintained with two 15-second WAT utilizing four minute active recovery between bouts.

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**2179 Board #67 May 28 2:00 PM - 3:30 PM**

**Predicting Maximal Oxygen Uptake Via A Sub-maximal Perceptually Regulated Treadmill Exercise Test.**

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(No relationships reported)

Recent research has provided encouraging results to support the prediction of maximal oxygen uptake ( $\text{VO}_{2\text{max}}$ ) from a perceptually regulated exercise test (PRET). Studies to date have solely investigated its application to cycle ergometry.

**PURPOSE:** To determine if  $\text{VO}_{2\text{max}}$  can be predicted with acceptable accuracy and repeatability from a sub-maximal treadmill PRET.

**METHODS:** Eighteen volunteers ( $21.7 \pm 2.8$  years) completed three treadmill PRETs (each separated by 48hrs) and one maximal graded exercise test. Participants self regulated their exercise at RPE levels 9, 11, 13 and 15 in a continuous and incremental fashion. Oxygen uptake ( $\text{VO}_2$ ) was recorded continuously during each three minute bout.  $\text{VO}_2$  values for the RPE range 9-15 were extrapolated to RPE 20 using regression analysis to predict individual  $\text{VO}_{2\text{max}}$  scores. This same procedure was also adopted to calculate estimated  $\text{VO}_{2\text{max}}$  from treadmill speed and gradient using ACSM metabolic equations. The concordance of the predicted and actual  $\text{VO}_{2\text{max}}$  scores and the trial-to-trial reliability of the predicted scores were analysed using intraclass correlation coefficients (ICC) and the limits of agreement (LoA) technique.

**RESULTS:** The mean  $\text{VO}_2$  following the last stage of the PRET (RPE 15) was  $73 \pm 8\%$  of  $\text{VO}_{2\text{max}}$ . The LoA between actual ( $48.0 \pm 6.2$  ml $\cdot$ kg<sup>-1</sup> $\cdot$ min<sup>-1</sup>) and predicted scores were  $1.9 \pm 13.3$ ,  $1.0 \pm 8.8$  and  $-0.6 \pm 7.1$  ml $\cdot$ kg<sup>-1</sup> $\cdot$ min<sup>-1</sup> for trials 1, 2 and 3, respectively. The corresponding values from the ACSM calculations were  $3.2 \pm 19.8$ ,  $0.2 \pm 11.9$  and  $-0.7 \pm 9.9$  ml $\cdot$ kg<sup>-1</sup> $\cdot$ min<sup>-1</sup>. Reliability analysis for the PRET  $\text{VO}_{2\text{max}}$  predictions yielded ICCs of 0.76 and 0.84 and LoAs of  $0.9 \pm 12.3$  ml $\cdot$ kg<sup>-1</sup> $\cdot$ min<sup>-1</sup> and  $1.7 \pm 8.5$  ml $\cdot$ kg<sup>-1</sup> $\cdot$ min<sup>-1</sup> for trial1 versus trial 2, and trial 2 versus trial 3, respectively.

**CONCLUSIONS:** These findings demonstrate that, given practice, a sub-maximal treadmill PRET can yield predictions of  $\text{VO}_{2\text{max}}$  that are acceptably reliable and more



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**2180 Board #68 May 28 2:00 PM - 3:30 PM**  
**The Metabolic Cost Of Critical Velocity At Different Treadmill Grades**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to test whether the Critical Velocity (CV) represents a set metabolic rate, regardless of the treadmill grade used.

**METHODS:** Nine volunteers (4 male; mean  $\pm$  SD, age  $31.8 \pm 6$  years; mass  $65.7 \pm 7.3$  kg; height  $170.7 \pm 8.6$  cm) performed a series of tests on two differing treadmill grades: 0% and 10%. The testing series comprised 1) a fast ramp to determine maximum oxygen uptake (treadmill velocity increasing  $0.1 \text{ km}\cdot\text{h}^{-1}$  every 6s); 2) three trials to determine CV, with intensities selected to bring about exhaustion between 3 and 15 minutes; and 3) a trial to exhaustion at the grade specific CV. Oxygen uptake ( $\text{VO}_2$ ), heart rate and blood lactate ([BLA]) data were collected during the exercise tests. Results are expressed mean  $\pm$  SEM, with significance taken at  $P < 0.05$ .

**RESULTS:** There were no differences in the grade specific  $\text{VO}_2\text{max}$  ( $55.7 \pm 4.3$  vs  $56.3 \pm 4.4 \text{ mL}\cdot\text{min}\cdot\text{kg}^{-1}$  in 0% and 10% respectively). However, peak treadmill velocity was significantly higher in 0% ( $17.6 \pm 0.8$  vs  $13.2 \pm 0.6 \text{ km}\cdot\text{h}^{-1}$  in 10%,  $P < 0.001$ ). Although the velocities used to determine CV on both grades differed ( $P < 0.001$ ), the time to exhaustions (TTE), importantly, did not (short:  $215 \pm 13.6$  vs  $201.8 \pm 15.3$  s; middle:  $386 \pm 23.4$  vs  $337 \pm 29$  s; long:  $703.8 \pm 40.2$  vs  $677.5 \pm 43$  s in 0% and 10% respectively). The 0% CV was significantly higher ( $14.1 \pm 0.6 \text{ km}\cdot\text{h}^{-1}$ ) than in 10% ( $9.1 \pm 0.4 \text{ km}\cdot\text{h}^{-1}$ ). When the volunteers ran at each grade specific CV, the metabolic rate ( $\text{VO}_2$  measured at 3 min) did not differ ( $3.24 \pm 0.3$  vs  $3.24 \pm 0.3 \text{ L}\cdot\text{min}^{-1}$ , 0% and 10% respectively, equivalent to 88 and 90%  $\text{VO}_2\text{max}$ ). There was a tendency for  $\text{VO}_2$  at end exercise (EE) to reach a higher percentage of  $\text{VO}_2\text{max}$  in 10% (attaining 95% compared to 89% in 0%). The same pattern was seen with delta [BLA] (EE - 3 min) tending to be higher in 10% ( $\sim 2$  vs  $\sim 1 \text{ mM}$  in 0%). Time to exhaustion at CV, although not statistically different, tended to be longer in 0% ( $1997 \pm 259$  vs  $1752 \pm 205$  s in 10%).

**CONCLUSIONS:** We conclude that CV does indeed represent a set metabolic rate as evidenced by the 'steady state'  $\text{VO}_2$  at minute 3 of exercise at CV. However, the tolerance to exercise at CV in 10% appears to be lower (6 out of 9 subjects having shorter TTE), Supported by a tendency for higher  $\text{VO}_2$  and [BLA] at EE. These differences in fatigue development could be explained by possible differences in muscle fiber recruitment.

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**2181 Board #69 May 28 2:00 PM - 3:30 PM**  
**Examination Of Relationship Between Physical Activity And Weight Decrease Rate For Abdominally Obese Japanese Men**

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(No relationships reported)

Increasing the amount of physical activity is important to prevent metabolic syndrome (MS). To prevent MS, usage of an activity meter (AM) is increasing due to its ability to measure low to moderate physical activity and accuracy in energy estimation.

**PURPOSE:** The aim of this study is to assess the usefulness and the high precision of AM to prevent metabolic syndrome.

**METHODS:** Thirty four male subjects aged 35-55 participated in the study. They were recruited from an electrical appliance company and had abdominal circumferences (AC) larger than 85 cm. None were taking internal medicine (age  $44.0 \pm 6.0$  yr., BMI  $26.9 \pm 2.3 \text{ kg}/\text{m}^2$ , AC  $94.3 \pm 5.4$  cm). Regular physical activity was measured more than a week before intervention by AM with a blinded display. Initial exercise and diet intervention were performed based on the results. AM can display the amount of time of more than 3 METs physical activity and the energy expenditure of physical activity (EE). The data of 12-weeks of exercise and diet intervention were examined. Every morning and evening the subjects weighed themselves, and measured their ACs on a weekly basis. Using AM, they also measured all of their physical activity except sleeping and aqua exercise. The results of these self measurements were reported and sent by e-mail every week. Two telephone and face-to-face coachings were performed during the middle of the intervention. Nutritional surveys by photos were performed three days before and after intervention.

**RESULTS:** The following are the results of three-month interventions. The change of nutritional content was  $-277 \pm 359$  kcal, and the amount of physical activity also significantly increased (EE/weight:  $8.6 \pm 1.5$  to  $10.3 \pm 2.0 \text{ kcal}/\text{kg}/\text{d}$ ;  $p < 0.001$ , gt. 3METs:  $50.7 \pm 13.8$  min to  $67.8 \pm 17.7$  min;  $p < 0.001$ , lt. 3METs  $460.4 \pm 82.4$  min to  $471.3 \pm 81.8$  min;  $p < 0.05$ ). Some MS risk parameters decreased (AC:  $94.5 \pm 5.4$  to  $90.5 \pm 6.0$  cm;  $p < 0.001$ , LDL-C:  $147 \pm 27.6$  to  $133 \pm 25.1 \text{ mg}/\text{dL}$ ;  $p < 0.001$ ). A significant negative correlation was found between the rate of weight change and the physical activity energy expended per unit of weight ( $r = -0.50$ ,  $p < 0.005$ ).

**CONCLUSIONS:** This study suggests that accurate physical activity monitoring is effective for exercise intervention to prevent metabolic syndrome.

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**2182 Board #70 May 28 2:00 PM - 3:30 PM**  
**Effect Of Exercise Intensity On The Flow Rate, Viscosity, And Osmolarity Of Human Saliva**

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(No relationships reported)

The physical nature of saliva during exercise remains as yet un known.

**PURPOSE AND METHODS:** We determined the characteristics of human whole saliva during exercise in 10 males and 5 females, whose ventilatory threshold (VT) was  $120 \pm 17 \text{ W}$  (mean  $\pm$  SD). The subjects performed an incremental cycle ergometer exercise (20 and 30 W every 3 min for males and females, respectively). At each stage, the subjects expectorated once a minute for 2 min. Subjects placed a nylon ball in their oral cavity to promote salivary flow. The flow rate was assessed as the mass of saliva per minute. Using a cone and plate viscometer and vapor pressure osmometer, we measured the viscosity and osmolarity of stimulated saliva. The viscosity was measured at a shear rate of  $22.5$  and  $90.0 \text{ s}^{-1}$ .

**RESULTS:** Compared with the resting baseline, the flow rate gradually decreased, and it showed a significant decrease at intensities of more than VT -  $18 \pm 4 \text{ W}$  ( $p < 0.05$ ). It decreased to half of the baseline value. The osmolarity showed significant increase at intensities of more than VT +  $20 \pm 4 \text{ W}$ . The viscosity revealed a significant increase only at an intensity of VT +  $58 \pm 4 \text{ W}$ .

**CONCLUSION:** These result showed an effect of exercise intensity on the characteristics of saliva. Sympathetic activation increases mucin secretion, which relates to salivary viscosity, whereas parasympathetic activation increases saliva flow. Thus, the results regarding the flow rate and viscosity suggest that a detectable increase in the sympathetic activation of salivary glands occurs at a much higher intensity than the VT, whereas parasympathetic inhibition occurs at a relatively lower intensity.

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**2183 Board #71 May 28 2:00 PM - 3:30 PM**  
**Is Anaerobic Power Related To  $\text{Vo}_2$  Max Attainment?**

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(No relationships reported)

**PURPOSE:** To determine if anaerobic power is related to  $\text{VO}_{2\text{max}}$  attainment in recreationally-active men and women.

**METHODS:** Nineteen subjects (10 men and 9 women, mean age, height, mass, and  $\text{VO}_{2\text{max}} = 23.0 \pm 4.1$  yr,  $174.1 \pm 7.3$  cm,  $68.1 \pm 10.7$  kg, and  $42.2 \pm 6.0$  mL/kg/min, respectively) initially completed the Wingate Test. At least 24 h later, subjects completed incremental cycle ergometry followed by 10 min of active recovery, then performed a verification protocol at a supramaximal workload one stage above the last completed stage during the incremental test. During exercise, gas exchange data were obtained every 15 s.  $\text{VO}_{2\text{max}}$  was defined as a change in  $\text{VO}_2$  ( $\text{DVO}_2$ )  $< 2.1$  mL/kg/min. Day-to-day error in  $\text{VO}_{2\text{max}}$  ranged from 3.0 - 3.2 % for the supramaximal and incremental protocol, respectively. A paired t-test was used to examine differences in  $\text{VO}_{2\text{max}}$  and gas exchange data between tests. Linear regression was used to describe the relationship between  $\text{DVO}_2$  at  $\text{VO}_{2\text{max}}$  and peak power, mean power, and fatigue index.

**RESULTS:** Peak power, mean power, and fatigue index were equal to  $9.4 \pm 1.4$  W/kg,  $7.1 \pm 1.0$  W/kg, and  $51.4 \pm 5.6$  %, respectively. Peak power and mean power significantly ( $p < 0.05$ ) predicted  $\text{DVO}_2$ ,  $\text{DVO}_2 = 0.04(\text{MP}) - 0.03(\text{PP}) + 0.79$ ,  $R = 0.56$ ,  $p = 0.05$ . There was no correlation between fatigue index and  $\text{DVO}_2$ ,  $r(19) = -0.29$ ,  $p > 0.05$ . There was no difference ( $p > 0.05$ ) in mean  $\text{VO}_{2\text{max}}$  between the incremental ( $42.2 \pm 6.0$  mL/kg/min) and supramaximal trial ( $42.2 \pm 5.4$  mL/kg/min).  $\text{VCO}_2$  and RER were higher ( $p < 0.05$ ) in response to the incremental ( $3.42 \pm 0.66$  L/min and  $1.20 \pm 0.06$ ) compared to the supramaximal protocol ( $3.13 \pm 0.69$  L/min and  $1.09 \pm 0.07$ ), although maximal HR and  $\text{V}_E$  were similar ( $p > 0.05$ ) between protocols.

**CONCLUSION:** Linear regression revealed that mean and peak power are significant predictors of  $\text{DVO}_2$  yet they explain only 31 % of the variability in  $\text{DVO}_2$ . Despite no difference in mean  $\text{VO}_{2\text{max}}$  between protocols, there were three subjects who had a higher  $\text{VO}_{2\text{max}}$  in the supramaximal trial, and five subjects who had a lower  $\text{VO}_{2\text{max}}$  in the supramaximal trial versus the incremental bout. Additional investigation is needed to further elucidate the  $\text{VO}_{2\text{max}}$  phenomenon, specifically why some subjects do not reveal a 'true'  $\text{VO}_{2\text{max}}$  after completion of a verification protocol.

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**2184 Board #72 May 28 2:00 PM - 3:30 PM**

**Low Cardiorespiratory Fitness Is Independently Associated With Metabolic Syndrome In Young Korean Adults**

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Substantial evidence supports the use of CRF and physical activity as powerful predictors of health outcomes, including metabolic syndrome, among western populations. No such studies have been conducted in Asians including Koreans.

**PURPOSE:** To investigate the relationship between cardio/respiratory fitness (CRF) and metabolic syndrome (MS) in young Korean men.

**METHODS:** In a cross-sectional study, we examined 909 young Korean men (mean  $\pm$  SD age,  $24.0 \pm 2$  years) who were healthy and not taking any medications affecting blood pressure, glucose, or lipids concentrations. Body fatness, resting blood pressures, and fasting blood levels of lipids, glucose, and insulin were measured with our standardized laboratory protocols. CRF was quantified as the maximum volume of minute oxygen consumption measured during a graded treadmill test.

**RESULTS:** Group analyses showed significant and inverse dose-response trends between the metabolic risk factors and CRF levels such that men with high and moderate CRF levels had more favorable profiles in body fatness, resting blood pressures, mean values in fasting lipids, glucose, and insulin, and homeostasis model of assessment-insulin resistance than men with low CRF level. After adjusting for several potential confounders such as age, smoking, and body fatness variables, the low and moderate CRF groups had odds of 4.64 (95% CI, 2.00 to 10.79) and 2.57 (95% CI, 1.04 to 6.34) for having MS than the high CRF group.

**CONCLUSION:** These findings suggest that low CRF is significantly associated with elevated risk of MS independent of body fatness in young Korean men.

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**2185 Board #73 May 28 2:00 PM - 3:30 PM**

**Validation Of The Cosmed Fitmate For Predicting Maximal Oxygen Consumption**

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(No relationships reported)

**PURPOSE:** The primary purpose of this study was to assess the validity of the Cosmed Fitmate (FM) in predicting maximal oxygen consumption ( $\text{VO}_{2\text{max}}$ ), compared to the Douglas bag (DB) method. In addition, this study examined whether measuring submaximal  $\text{VO}_2$ , rather than predicting it, can improve upon the prediction of  $\text{VO}_{2\text{max}}$ .

**METHODS:** Thirty-two males and sixteen females (Mean  $\pm$  SD: age  $30 \pm 9$  yr, body mass  $72.9 \pm 13.0$  kg, height  $1.75 \pm 0.09$  m, BMI  $23.4 \pm 3$  kg·m<sup>-2</sup>) volunteered to participate in the study. Each participant completed a submaximal and a maximal treadmill test using the Bruce protocol on two separate occasions. During the submaximal test,  $\text{VO}_{2\text{max}}$  was predicted using the FM, while during the maximal test  $\text{VO}_{2\text{max}}$  was measured using the DB method. The Cosmed Fitmate predicts  $\text{VO}_{2\text{max}}$  by extrapolating the linear regression relating heart rate and measured  $\text{VO}_2$  to age-predicted maximum heart rate (HR = 220-age). This study also examined the validity of predicting  $\text{VO}_{2\text{max}}$  by using the ACSM metabolic equations to estimate submaximal  $\text{VO}_2$ .  $\text{VO}_{2\text{max}}$  values from the FM, the DB method, and ACSM prediction equations were analyzed using repeated measures ANOVA and linear regression analyses. The level of significance was set at  $P < 0.05$  for all statistical analyses.

**RESULTS:** There was no significant difference between  $\text{VO}_{2\text{max}}$  predicted by the FM ( $45.6$  mL·kg<sup>-1</sup>·min<sup>-1</sup>, SD 8.8) and measured by the DB method ( $46.5$  mL·kg<sup>-1</sup>·min<sup>-1</sup>, SD 8.8) ( $p = 0.152$ ). The results of this study showed that a strong positive correlation ( $r = 0.897$ ) existed between  $\text{VO}_{2\text{max}}$  predicted by the FM and  $\text{VO}_{2\text{max}}$  measured by the DB method, with a standard error of the estimate (SEE) =  $3.97$  mL·kg<sup>-1</sup>·min<sup>-1</sup>. There was a significant difference in  $\text{VO}_{2\text{max}}$  predicted by the ACSM metabolic equations ( $53.6$  mL·kg<sup>-1</sup>·min<sup>-1</sup>, SD 8.0) and  $\text{VO}_{2\text{max}}$  measured by the DB method ( $p = 0.01$ ). The correlation between these variables was  $r = 0.699$  (SEE =  $5.84$  mL·kg<sup>-1</sup>·min<sup>-1</sup>).

**CONCLUSION:** These findings suggest that the Fitmate is a small, portable, and easy-to-use metabolic system that provides reasonably good estimates of  $\text{VO}_{2\text{max}}$ , and that measuring submaximal  $\text{VO}_2$ , rather than predicting it from the ACSM metabolic equations, improves the prediction of  $\text{VO}_{2\text{max}}$ .

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**2186 Board #74 May 28 2:00 PM - 3:30 PM**

**Identification Of A RPE Based Warning Zone To Anticipate Graded Treadmill Test Termination.**

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(No relationships reported)

Ratings of perceived (RPE) exertion provide a measure of an individual's feelings of effort and fatigue and the relative exercise intensity. Therefore, RPE have the potential to be used to anticipate exercise test termination.

**PURPOSE:** To identify a perceptually-based warning zone for termination of the Bruce treadmill test.

**METHODS:** Clinically normal adult females (n= 116) and males (n=55) participated in this single observation perceptual estimation paradigm. Subjects completed a Bruce treadmill test. Ratings of perceived exertion (i.e. Borg 6-20 scale) for the overall body were estimated during the last 15 s of each min of exercise. Tests were terminated owing to subject fatigue. The time to test termination was determined from the point during the treadmill test that subjects estimated a RPE of 12, 13, 14, 15, 16 & 17. The criterion to establish impending test termination was the duration of a single intensity stage of a progressive protocol, i.e. 180 s. Multiple dependent t-tests were used to examine within gender differences in the time to test termination associated with each RPE. Multiple independent t-tests were used to examine the between gender differences in the time to test termination corresponding to each RPE.

**RESULTS:**

Table 1. Time(s) to test termination						
			RPE			
Male	12	13	14	15	16	17
	300.0	232.0*	190.0*	120.1*	110.3*	60.4*
	+133.0	+102.1	+102.0	+ 80.0	+60.2	+50.3
	(n=36)	(n=43)	(n=36)	(n=35)	(n=20)	(n=29)
Female	12	13	14	15	16	17
	242.7	188.1*	141.9*	99.2*	104.9	53.2*
	+98.9	+100.1	+88.7	+65.0	+111.6	+47.0
	(n=80)	(n=91)	(n=65)	(n=65)	(n=39)	(n=49)

Values are Means + SD \*different from preceding RPE (p<0.003)

**CONCLUSIONS:** It is recommended that when an RPE of 14 is reported by females and a 15 by males during a multistage treadmill protocol, test termination will occur in less than 180 s and procedures to end the test should be initiated. Accurate and timely prediction of test termination using RPE will enhance the safety of exercise testing and facilitate endpoint measures upon which to prescribe exercise intensity.

**2187 Board #75 May 28 2:00 PM - 3:30 PM**

**Electromyographical Analysis Of The Rectus Abdominis Muscle In Athletes Performing 10 Different Abdominal Exercises**

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(No relationships reported)

There has been debate recently regarding the type of exercise that optimally benefits the development of the rectus abdominis (RA) muscle. Currently, the traditional abdominal crunch is the exercise of choice, although comparative research is limited.

**PURPOSE:** To compare the myoelectric action potential using root mean square (RMS) of the RA musculature during execution of 10 different abdominal exercises (AE) using portable surface electromyography.

**METHODS:** Following informed consent and medical screening of all subjects, surface electrodes were placed symmetrically and bilaterally over the upper, middle and lower parts of the RA musculature on a sample of 15 athletes {(Mean ± SD) age 27.53± 6.8 yrs, height 1.77 ± 0.1 m, and mass 74.93± 8.8 kg} with flat abdominal walls. The skin site was cleansed with alcohol-wipes to reduce the impedance. Subjects performed 10 repetitions of each of the 10 AE. Exercises performed were the traditional abdominal crunch (TAC), bicycle manoeuvre, crossover crunch, reverse crunch (RC), isometric abdominal exercise (IAE), swiss ball, decline bench (DB), abdominal roller, hanging knee-to-waist raise, and hanging knee-to-chest raise (HKCR). All exercises were performed to the pace of a digital metronome at the rate of 2 seconds per repetition, with a rest period of 10 minutes between each exercise. The order of exercises was randomised using Standardised Latin-Square design to reduce the effects of muscular fatigue and the hip and knee angles were standardised throughout testing. Repeated measures One-way ANOVA with post-hoc Least Significant Difference (LSD) correction was used to analyse the data.

**RESULTS:** Myoelectric action potential, measured using RMS, was significantly greater when performing the HKCR exercise (4.04mV, p=0.008), and the DB exercise (3.63mV, p=0.013) in comparison to the TAC (3.13mV). RMS was significantly reduced when performing the IAE (0.73mV, p<0.000) and the RC (1.83mV, p=0.001) compared to the TAC (3.13mV).

**CONCLUSION:** Hanging knee-to-chest raise and DB elicit the highest RMS activity, while IAE and RC elicit the lowest activity in the RA muscle. HKCR and DB are, therefore, suggested to be the best exercises to train the abdominal muscles. Future research should be conducted to analyse the vertebral compression forces during these AE.

**2188 Board #76 May 28 2:00 PM - 3:30 PM**

**Elliptical Trainer Brands And The Development Of A Metabolic Prediction Equation**

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(No relationships reported)

**PURPOSE:** The primary purpose of this study was to determine the effect of elliptical trainer brand on gas exchange data as well as to develop separate brand-specific equations.

**METHODS:** Twenty-three healthy volunteers (22.3 ± 4.6 yrs, 172 ± 8.2 cm, 67.5± 9.3 kg) completed two testing sessions on two different brands of elliptical trainers, the Precor EFX 576i® and the TRUE TS1®, exercising equivalent watt output readings on each elliptical trainer was determined by resistance and cadence. Each subject exercised on each machine for six, 5-min. stages for a total exercise time of 30 minutes per session. Oxygen consumption (VO<sub>2</sub>), heart rate, rating of perceived exertion (RPE), and caloric cost of the exercise were measured during each session. Two (machine) x three (workload) repeated measures ANOVA was used to analyze differences between machines. Stepwise multiple nonlinear regression analysis was used to develop metabolic equations for submaximal elliptical trainer exercise on both the Precor and the TRUE.

**RESULTS:** Significant differences were found between elliptical trainer brands for all exercise variables analyzed (p<0.001), with the TRUE eliciting higher values than the Precor for equivalent watt output readings. Oxygen consumption values at the same watt output reading were 6.85 ± 4.4 ml/kg/min higher on the TRUE for watt levels between 107 and 131 watts. Two separate metabolic equations were developed for submaximal elliptical trainer exercise on the TRUE (R<sup>2</sup> = 0.95, SEE = 2.6), and the Precor (R<sup>2</sup> = 0.92, SEE = 2.4).

**CONCLUSIONS:** Differences exist in physiological responses to submaximal elliptical trainer exercise at equivalent watt output readings. These differences may require the acceptance of a metabolic prediction equation that is specific to a particular brand of elliptical trainer.

**2189 Board #77 May 28 2:00 PM - 3:30 PM**  
**Bruce Protocol Versus Costill-fox Protocol For Vo2 Max In College Male Cross Country Athletes**

Miles Erwin, Coleen Fava, Ludmila Cosio-Lima. *University of West Florida, Pensacola, FL*  
(No relationships reported)

VO2 max is the most reliable method to predict cardiovascular performance. Several protocols have been used; which have mostly been developed in the late 1960's and 1970's. The most commonly used protocol is the Bruce protocol.

**PURPOSE:** To determine if the Bruce protocol, which is a slow speed and high-incline based VO2 max protocol will produce the same results as the Costill-Fox protocol, which has a higher speed yet lower incline.

**METHODS:** Five college male cross country runners age 19.4 yrs +/- 1.14, with a height of 1.77m +/- .06, and a weight of 68.55kg +/- 7.99, were tested for VO2 max using the Bruce protocol and the Costill-Fox protocol. Each subject had 7 to 18 days between testing. The protocols were performed in random order. The subjects were monitored on a metabolic cart to determine VO2 max during the 2 running treadmill tests. VO2 max results were compared using a paired samples T test with a significance level of (0.05).

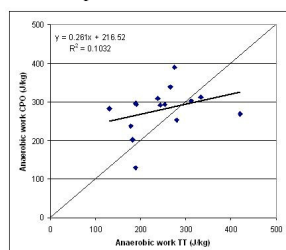
**RESULTS:** VO2 max for the Bruce protocol resulted in an average of 66.74 ml/kg +/- 6.63 and the Costill-Fox in an average of 69.52 ml/kg +/- 4.90. Average RER recorded for the Bruce protocol was 1.04 +/- .07 while the Costill-Fox average was 1.08 +/- .08. Average heart rate for the Bruce protocol tested as 179.80 +/- 20.12 with the Costill-Fox heart rate average as 190.60 +/- 7.83. A significant ( $p < 0.05$ ) difference in VO2 max was observed between the 2 protocols.

**CONCLUSION:** The protocol used to determine VO2 max will have an effect on the outcome. The athletes were able to achieve a higher exertion on the Costill-Fox protocol without being restricted by running steep inclines. Higher results can be achieved by well trained runners when a protocol is implemented that uses greater speed with a lower incline by allowing the individual to extend themselves more fully.

**2190 Board #78 May 28 2:00 PM - 3:30 PM**  
**Effect Of Different Cycling Protocols On The Anaerobic Capacity**

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**BACKGROUND:** The anaerobic capacity (AnC) can be determined with the gross efficiency (GE) method. The AnC can be determined during different exercise protocols, but it is expected that the AnC would be the same for different exercise protocols with durations ranging from 2-5 min.



**PURPOSE:** This study evaluated the effect of closed loop (time trial) versus open loop (a ride to failure at a constant PO) exercise protocols on the computed value of the AnC.

**METHODS:** Well trained male cyclists ( $n=15$ ) performed two exercise protocols; a 2500m cycling time trial (TT)(closed loop) and a ride to failure at constant power output (CPO)(open loop), at the mean PO of the TT. With the GE method, the mechanical power attributable to the anaerobic energy system ( $P_{an}$ ) is calculated by summing the difference between the mechanical aerobic power production ( $P_{aer}$ ) and the total mechanical power output ( $PO_{total}$ ) over time. GE was determined from measures of PO and gas exchange preceding each trial.

**RESULTS:** The duration of TT ( $199.9 \pm 6.8$  s) was significantly longer than of CPO ( $167.4 \pm 46.4$  s) ( $p=0.01$ ). The AnC computed during TT ( $246 \text{ J/kg} \pm 74$ ) was not significantly different from that during CPO ( $281 \text{ J/kg} \pm 60$ ) ( $p=0.11$ ). Despite the finding that there is no significant mean difference in AnC between closed loop & open loop exercise protocols, a non significant ( $p=0.24$ ) correlation was found between methods ( $r=0.32$ ). Only 10% of the variance in the computed AnC during the CPO could be explained by the variance in AnC during the TT.

**CONCLUSIONS:** These results indicate that there were no mean differences in AnC between open loop & closed loop exercise protocols, but there were meaningful individual differences.

**2191 Board #79 May 28 2:00 PM - 3:30 PM**  
**Comparison Of Cardiac Diastolic Time In Exercise Among Different Fitness Groups**

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Heart sounds have been used in conjunction with ECG, to determine cardiac cycle parameters including electro-mechanical systole. Cardiac perfusion time significantly correlates with the degree of coronary stenosis and is determined as  $[(RR)-(S1-S2)]\Delta f_{HR}$ , where S1 and S2 represent the first and second heart sounds. The values for diastolic perfusion time at the ischemic threshold ranged from 27 to 33.5 sec. Furthermore, we have reported that cardiac systolic time (ST) and diastolic time (DT) fit well a cubic regression equation in relation to RR interval that converged to the origin of the coordinates. These reports indicated the usefulness of heart sounds during exercise.

**PURPOSE:** The purpose of this study is to compare the percent of DT for RR interval at the same HR, specifically at the same RR interval, during exercise among persons of different age (young vs. old), fitness (low vs. high) and disease history (cardiac vs. none).

**METHODS:** Subjects were 9 elderly low fit persons (LFG), 8 elderly high fit persons (HFG) and 8 young male students (YMG). We obtained the informed consents from all subjects before exercise test. The exercise test was performed on a cycle ergometer with an incremental loading method. ECG and heart sounds were recorded throughout the test, ST was determined by measuring interval between S1 and S2, and DT was calculated by subtracting ST from RR interval. DT was plotted in relation to RR interval, and the cubic regression curve was fit in each subject. DTs at 100 and 110 bpm of HR were calculated from each regression equation, and %DT was calculated as  $DT/RR\Delta f_{100}$ . %DTs at HR 100 and 110 bpm were compared among three groups.

**RESULTS:** At HR 100 bpm, mean ( $\pm$ SD) %DTs were 49.4  $\pm$  2.4 %, 55.6  $\pm$  4.7 %, 57.4  $\pm$  1.5 %. At HR 110 bpm, the mean %DT were 47.2  $\pm$  2.2 %, 54.7  $\pm$  4.9 %, 56.0  $\pm$  1.5 % in three groups of LFG, HFG and YMG, respectively. The %DTs in LFG were significantly lower than that in HFG and YMG. However, there was no significant difference of %DTs between HFG and YMG.

**CONCLUSIONS:** These results indicate that low fitness elderly appear to reach an ischemic threshold at HR 100 bpm. Furthermore these results demonstrate the importance of evaluating the diastolic perfusion time during exercise.

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**2192 Board #80 May 28 2:00 PM - 3:30 PM**  
**Bilateral Comparison And Reliability Of Ground Reaction Forces During Single Leg Hop Test**

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**PURPOSE:** To compare single leg horizontal hop ground reaction forces (GRF) between the dominant (DOM) and non-dominant (NDOM) limbs and to determine the reliability GRF based variables.

**METHODS:** After a standardized warm-up, 20 (10 men, 10 women) physically active (Tegner score = 6.5  $\pm$  1.7, range 4-9) young adults (21.7  $\pm$  2.1 yrs) performed three DOM and three NDOM single leg horizontal hops in random order during two sessions 72 hours apart. In addition to recording hop distance, GRF were used to calculate 10 variables using the vertical (vGRF) and anterior-posterior (apGRF) GRF: peak, peak to ground off (GO), impulse, average force, and impulse time. Reliability was assessed across session one trials (intrasession) and between sessions one and two (intersession) using intraclass correlation coefficients (ICC) and standard error of measurement. Separate two factor analysis of variance were conducted to assess interactions between limb (DOM, NDOM) and direction (vGRF, apGRF) using the session one three trial average. The relationship between hop distance and GRF variables were established using correlational analyses.

**RESULTS:** No significant hop distance difference was found ( $t_{19} = -.840$ ,  $P = .412$ ) between the NDOM (1.07  $\pm$  .12 % ht, 95% CI: 1.03 - 1.09) and DOM (1.06  $\pm$  .11 % ht, 95% CI: 1.02 - 1.08) limbs. Similarly there were no significant limb differences (interactions or main effects) for any of the GRF variables ( $P > .05$ ). A significant direction main effect was observed for peak (vGRF > aGRF, PaGRF,  $P < .001$ ), average force (vGRF > aGRF, PvGRF,  $P = .75$ ) with the exception of intrasession vGRF peak to GO (both limbs). Four GRF variables significantly related to hop distance: DOM vGRF impulse ( $r = .480$ ,  $P = .032$ ), DOM aGRF peak ( $r = .524$ ,  $P = .018$ ), DOM aGRF impulse ( $r = .677$ ,  $P = .001$ ) and NDOM aGRF impulse ( $r = .765$ ,  $P < .001$ ).

**CONCLUSION:** Equal hop distances and underlying GRF may be expected between DOM and NDOM in healthy individuals. Except vGRF peak to GO, all GRF based variables were reliable. Further research is needed to determine if GRF analyses increases the sensitivity of the single leg hop test in identifying performance deficits, and/or injury predisposition.

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**2193 Board #81 May 28 2:00 PM - 3:30 PM**  
**Determining The Anaerobic Capacity With Two Computational Methods**

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**BACKGROUND:** The primary method for estimating the anaerobic capacity (AnC) has been the maximally accumulated oxygen deficit (MAOD). This method requires an individual power output (PO)-oxygen uptake (VO<sub>2</sub>) relationship, based on multiple submaximal steady state exercise bouts, to be extrapolated to predict the VO<sub>2</sub> demand during a supramaximal task. The MAOD is calculated by subtracting the summated measured VO<sub>2</sub> from the accumulated VO<sub>2</sub> demand. An alternative AnC procedure is to determine the anaerobic power production (P<sub>an</sub>) by subtracting the aerobic power production (P<sub>aer</sub>) from the PO<sub>total</sub> and summing this difference over time. P<sub>aer</sub> is calculated from VO<sub>2</sub>, RER, and gross efficiency (GE). This method is referred to as the GE method.

**PURPOSE:** This study compares the AnC based on the MAOD and GE method.

**METHODS:** Well trained male cyclists (n=15) performed a maximal incremental exercise test, 10 x 10 min submaximal bouts to establish the PO-VO<sub>2</sub> relationship and one supramaximal constant PO trial (441  $\pm$  41 W). The MAOD was calculated according to Medbø et al. (1988). The supramaximal trial was preceded by a single work bout to determine GE. Results of both methods were expressed in terms of O<sub>2</sub> equivalents.

**RESULTS:** The difference between the AnC determined with the MAOD (50.7 ml O<sub>2</sub>/kg  $\pm$  19.5) and GE (62.3 ml O<sub>2</sub>/kg  $\pm$  14.7) method was not significantly different ( $p = 0.06$ ). A significant interaction effect was found between the mean VO<sub>2</sub> during min 4 and min 8 of the 10 min submaximal bouts, and the submaximal exercise intensity steps ( $p < 0.001$ ). This indicates that during the highest submaximal exercise bouts a slow component in VO<sub>2</sub> was present. Consequently, the O<sub>2</sub> demand at the higher exercise intensities was overestimated with the MAOD method, if we assume that during the relatively short supramaximal PO trial (167 s  $\pm$  46) no slow component in VO<sub>2</sub> was present. The MAOD calculated with a PO-VO<sub>2</sub> relationship based on the mean VO<sub>2</sub> of min 4 instead of min 8-10 was 33.2 ml O<sub>2</sub>/kg  $\pm$  22.5 and significantly different from the GE method ( $p < 0.001$ ). Therefore, the values for the AnC calculated with the MAOD method as proposed by Medbø et al. (1988) may be an overestimation and meaningful different from the values of the GE method.

**CONCLUSION:** The values for the AnC calculated with the MAOD method and GE method are not directly comparable.

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**2194 Board #82 May 28 2:00 PM - 3:30 PM**  
**Using Maximal Isometric Force To Determine The Optimal Load For Measuring Dynamic Muscle Power**

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Maximal power output typically occurs when subjects perform ballistic exercises using loads of ~30-50% of one-repetition maximum (1-RM). However, performing 1-RM testing prior to power measurement requires considerable time, especially when testing involves multiple exercises. Maximal isometric force (MIF), which requires substantially less time to measure than 1-RM, might be an acceptable alternative for determining the optimal load for power testing.

**PURPOSE:** To determine the optimal load based on MIF for maximizing dynamic power output during leg press and bench press exercises.

**METHODS:** Twenty healthy volunteers (12 men and 8 women; mean  $\pm$  SD age: 31  $\pm$  6 y; body mass: 72  $\pm$  15 kg) performed isometric leg press and bench press movements, during which MIF was measured using force plates. Subsequently, subjects performed ballistic leg press and bench press exercises using loads corresponding to 20%, 30%, 40%, 50%, and 60% of MIF presented in randomized order. Maximal instantaneous power was calculated during the ballistic exercise tests using force plates and position transducers. Repeated-measures ANOVA and Fisher LSD *post hoc* tests were used to determine the load(s) that elicited maximal power output.

**RESULTS:** For the leg press power test, six subjects were unable to be tested at 20% and 30% MIF because these loads were less than the lightest possible load (i.e., the weight of the unloaded leg press sled assembly [31.4 kg]). For the bench press power test, five subjects were unable to be tested at 20% MIF because these loads were less than

the weight of the unloaded aluminum bar (i.e., 11.4 kg). Therefore, these loads were excluded from analysis. A trend ( $p = 0.07$ ) for a main effect of load existed for the leg press exercise, indicating that the 40% MIF load tended to elicit greater power output than the 60% MIF load (effect size = 0.38). A significant ( $p \leq 0.05$ ) main effect of load existed for the bench press exercise; *post hoc* analysis indicated that the effect of load on power output was: 30% > 40% > 50% = 60%.

**CONCLUSIONS:** Loads of 40% and 30% of MIF elicit maximal power output during dynamic leg presses and bench presses, respectively. These findings are similar to those obtained when loading is based on 1-RM.

**2195 Board #83 May 28 2:00 PM - 3:30 PM**  
**Estimating Lactate Threshold Power From The End Power Of A 3-min All-out Cycling Test**

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(No relationships reported)

The average power output over the last 30 s of a 3-min all-out cycling test (end power, EP) has been shown to be equivalent to critical power, a power sustainable for approximately 30 min. By comparing EP to the power at established measures of blood lactate concentration ([BLA]), the 3-min all-out cycling test (3MT) could be used in place of a lactate threshold (LT) test in certain applications.

**PURPOSE:** The primary aim of this study was to compare power at LT to EP. A secondary aim was to provide the methodology to perform the 3MT using equipment readily available to cyclists.

**METHODS:** Eight competitive cyclists (7 men, 1 woman, age =  $35 \pm 7$  yrs,  $\dot{V}O_{2peak} = 64 \pm 7$  mL•kg<sup>-1</sup>•min<sup>-1</sup>) completed 3 laboratory visits within a 14 d period, each visit separated by at least 48 h. All tests were performed using the subjects' own bicycles and a laboratory provided rear wheel with a power measuring hub (WHEEL). Visit 1: The subjects performed an incremental load test (100 W initial load increasing stepwise 25 W every 4 min) to volitional termination using an electronically controlled load. Blood samples were taken during minute 3 of each 4 min stage, and immediately analyzed for [BLA].  $\dot{V}O_{2peak}$  was established as the highest 20 s average  $\dot{V}O_2$  observed. [BLA] versus power was fit to a third order polynomial curve and 3 measures of power at LT were mathematically determined: power at an absolute [BLA] of 4 mmol•L<sup>-1</sup> (P-OBLA); power at a [BLA] of 1 mmol•L<sup>-1</sup> over exercise baseline (P-1E); and power at the second of 2 subsequent  $\geq 1$  mmol•L<sup>-1</sup> increases in [BLA] (P-1+1). Visits 2 and 3: Subjects performed the 3MT using a progressive resistance trainer, and were instructed to give maximal effort throughout the test. A familiarization trial for the 3MT was performed on Visit 2. During Visit 3, the EP was recorded as the mean power over the last 30 s of the 3MT.

**RESULTS:** Repeated measures ANOVA showed EP ( $278 \pm 47$  W) was significantly greater ( $P < 0.05$ ) than P-OBLA ( $239 \pm 55$  W), P-1E ( $209 \pm 48$  W), and P-1+1 ( $216 \pm 60$  W). Pearson correlation showed EP was correlated with P-OBLA ( $r = 0.82$ ,  $P = 0.007$ ), P-1E ( $r = 0.79$ ,  $P = 0.010$ ), and P-1+1 ( $r = 0.86$ ,  $P = 0.003$ ). Using linear regression, P-OBLA could be estimated at 86% EP, P-1E at 75% EP, and P-1+1 at 78% EP.

**CONCLUSION:** The EP from the 3MT can be used to estimate power at LT in competitive cyclists, using readily available equipment.

**2196 Board #84 May 28 2:00 PM - 3:30 PM**  
**Relationship Between Two Upper Extremity Functional Performance Tests And Shoulder And Trunk Muscle Strength**

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In contrast to the lower extremity, data concerning upper extremity (UE) functional performance tests (FPT) are more limited.

**PURPOSE:** To determine the relationship of two UEFPT with shoulder and trunk flexion peak torque (PT) and anthropometric characteristics.

**METHODS:** In a random order, 26 healthy, physically active men ( $1.80 \pm 0.07$  m,  $80.9 \pm 10.1$  kg  $24.9 \pm 2.7$  yrs) completed two UE FPT and concentric isokinetic assessments for shoulder internal rotation (IR) and trunk flexion during a single session. All testing was performed using the dominant arm. The UE FPT consisted of the Underkoffler Softball Throw for Distance (USTD) and a one-arm seated shot put throw (SPT). Following two submaximal and one maximal effort warm-up trials, the average of three maximum effort trials of each UE FPT were used for data analysis. Shoulder IR PT (60°/s, 180°/s, 300°/s) and trunk flexion PT (60°/s, 120°/s) were calculated across five trials at each speed. Height, mass and body mass index (BMI) were also measured. Correlational analyses were conducted between UE FPT performance, shoulder PT and trunk flexion PT, and anthropometric characteristics.

**RESULTS:** No significant relationships were revealed with the anthropometric characteristics or trunk flexion PT; however shoulder IR PT at all speeds were moderately related to both UE FPT.

	Anthropometrics			Shoulder IR			Trunk Flexion	
	Mass	Height	BMI	60°/s	180°/s	300°/s	60°/s	120°/s
USTD	$r = -.049$ $P = .841$	$r = .288$ $P = .154$	$r = -.293$ $P = .147$	$r = .676$ $P < .001$	$r = .574$ $P = .002$	$r = .566$ $P = .003$	$r = .208$ $P = .309$	$r = .053$ $P = .795$
SPT	$r = .302$ $P = .134$	$r = .349$ $P = .081$	$r = .055$ $P = .790$	$r = .564$ $P = .003$	$r = .484$ $P = .012$	$r = .521$ $P = .006$	$r = .218$ $P = .284$	$r = .383$ $P = .053$

**CONCLUSION:** Normalization to body mass, height and BMI do not appear to be necessary for either UE FPT. The USTD and SPT tests appear to moderately reflect shoulder IR force production capabilities. The lack of significant relationships with trunk flexion PT may be a function of the UE FPT requiring coupled trunk flexion and rotation simultaneously. These data support using the USTD and SPT tests as indicators of shoulder function.

**2197 Board #85 May 28 2:00 PM - 3:30 PM**  
**Physiological Characteristics Of College Age Students Enrolled In Entry Level Fitness Classes**

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(No relationships reported)

Physical fitness characteristics of college students today are purportedly diminished compared to normative data established in the 1960's.

**PURPOSE:** The purpose of this study was to compare a range of physiological characteristics of college students enrolled in entry level physical fitness classes to norms established almost 50 years ago.

**METHODS:** 84 male (ht  $177 \pm 6.6$  cm, body mass  $80.4 \pm 17.4$  kg) and 135 females (ht  $162.8 \pm 6.0$  cm, body mass  $63.5 \pm 13.8$  kg) students, age  $19.9 \pm 1.7$  yr enrolled in personal fitness classes at



a medium size private university were assessed by well-trained laboratory staff prior to initiating cardiovascular, metabolic and resistance stimulus intervention. Blood pressure (BP) was obtained at rest. Three minute curl-up (CU) and hand grip (HG) dynamometer were used to assess muscular endurance and strength, respectively. Flexibility was assessed by the Wells Sit and Reach test (F) and body composition by skinfold technique (%fat). Cardiovascular function was assessed in the mile run (MR) and extrapolated to estimated max  $\text{VO}_2$ .

**RESULTS:** BP  $127/77$  and  $117/72$  mmHg, CU  $54.9 \pm 20.2$  and  $44.3 \pm 21.6$ , sum of HG  $64.1 \pm 15.7$  and  $27.7 \pm 10.2$  kg, F  $39.9 \pm 10.7$  and  $44.9 \pm 10.4$  cm, body fat  $14.6 \pm 7.6$  and  $27.7 \pm 6.9$  % fat, MR  $8.86 \pm 2.6$  and  $11.81 \pm 2.8$  min, and max pred  $\text{VO}_2$   $42.8 \pm 8.2$  and  $34.1 \pm 7.4$  mL/kg·min<sup>1</sup> for males and females, respectively. With the exception of flexibility for both sexes and percent body fat of the females, all characteristics were classified as average or better. Relative to muscular endurance (CU) and max  $\text{VO}_2$ , both males and females were classified as good.

**CONCLUSION:** This 2008 sample of college age students reveals that with the exception of female body composition, there is little difference in physiological characteristics compared to data accrued from college age students almost 5 decades ago.

**2198 Board #86 May 28 2:00 PM - 3:30 PM**  
**Effects Of Stepping Pattern And Speed On Energy Expenditure**

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(No relationships reported)

Stepping is a common physical movement (e.g., in dance or DDR), but its corresponding energy expenditure (EE) has not been well studied.

**PURPOSE:** To examine effects of stepping pattern and speed on energy expenditure when subjects stepped on a close diamond shape. **METHOD:** 15 male volunteers (20.40±1.24 yrs older; HT = 177.20±5.59 cm and WT = 74.33±7.97kg) were asked to step on three patterns (sideways [SW], back and forth [BF], & random [RD]) at three speeds (30 beats/M, 40 beats/M, & 50 beats/M) within in a 80 x 80 cm diamond shape. Each mode went on for 10 minutes, with a 20-min break between, and testing order was chosen randomly. Each subject was tested 3 modes a day and finished testing in 3 days. EE during the resting and testing was measured by COSMED K4b2 portable pulmonary.

**RESULTS:** The results of two-way repeated measures ANOVA indicate that there were statistically significant differences in EE among stepping speeds (30B/M vs.40B/M vs. 50B/M p<.05). There was a statistically significant difference between BF and RD step patterns. There was no interaction effect between stepping speed and pattern on EE. Similar finding was confirmed in MET values by speed and pattern.

DVs	Energy expenditure (Kcal)			METs		
IVs	SW	BF	RD	SW	BF	RD
30B/M	44.90±	46.14±	36.56±	3.71±	3.94±	2.60±
	12.51	11.16	9.33	0.95	1.02	0.77
40B/M	53.80±	55.69±	39.81±	4.38±	4.82±	3.46±
	11.26	7.77	6.53	1.02	0.62	0.55
50B/M	60.16±	63.53±	49.26±	5.41±	5.64±	4.18±
	5.08	6.26	7.45	0.35	0.70	0.62

**CONCLUSIONS:** Speed is the key determinant in stepping. While there was no difference in EE between sideways and back-and-forth patterns, they both had a higher EE than the random pattern.

**2199 Board #87 May 28 2:00 PM - 3:30 PM**  
**Characterization Of Joba Core Trainer Cardiopulmonary Responses**

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The Joba® Core Trainer (JOBA) is an ergometric device which simulates horseback riding. The computer-driven saddle reproduces all components of horse movements, except vertical displacement. Based on the counterbalance principle, it efficiently engages trunk and thigh muscles. Previous research showed that JOBA enhances glycemic control in diabetic patients and reduces pain and disability in subjects with chronic low back pain. However, no data are available about the cardiopulmonary responses elicited by JOBA.

**PURPOSE:** To describe the cardiopulmonary responses induced by using JOBA at different speeds.

**METHODS:** Twenty healthy subjects (11 men, 9 women) were investigated (age 54.8±11.8 yrs). ECG and respiratory gas exchange were measured during a training session with JOBA (3 min warm-up, 5 steps of 7 min of duration each with speed increasing from lowest to highest, 3 min cool down). The following day an incremental, cardiopulmonary stress test was carried out on a cycle ergometer to determine peak aerobic power and ventilatory threshold (VT) by means of the V-slope method.

**RESULTS:** Heart rate (HR) and oxygen consumption ( $\text{VO}_2$ ) did not differ among speeds (from 82.7±13.2 beats/min at speed 1 to 87.0±9.7 at speed 9, n.s., and from 4.2±1.2 mL/kg/min to 4.9±1.5, n.s., respectively). Respiratory Exchange Ratio remained unchanged across different speeds of exercise (from 0.9±0.1 to 1.0±0.2, n.s.). HR and  $\text{VO}_2$  were also expressed as a percentage of their respective VT values: HR increased from 78.7±13.9 % of VT at the lowest exercise intensity to 83.3±15.5 at the highest (n.s.), while  $\text{VO}_2$  raised from 33.6±8.6 to 38.8±11.3 (n.s.). Eventually, at the highest speed, HR reached 65.5±11.4% of peak HR and  $\text{VO}_2$  20.8±5.6% of peak  $\text{VO}_2$  (n.s. vs. lowest speed).

**CONCLUSION:** Training with JOBA at increasing speeds resulted in a slight modification of cardiopulmonary parameters. Even at the highest speed, HR and  $\text{VO}_2$  remained well below the values measured at the VT. Thus, JOBA may be a safe alternative to usual ergometers in the rehabilitation process of subjects with severely reduced exercise tolerance, such as frail elderly, patients with heart failure, cardiac transplant, and severe obstructive pulmonary disease. Further studies are needed to describe the cardiopulmonary responses to JOBA of patients in these clinical subgroups.

**2200 Board #88 May 28 2:00 PM - 3:30 PM**  
**Reliability Of The Reverse Lactate Threshold Test**

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(No relationships reported)

The multi-session Maximal Lactate Steady-State (MLSS) test is the accepted 'Gold Standard' for anaerobic threshold estimation. Existing single-session tests for anaerobic threshold estimation suffer from unsatisfactory validity, reliability and resolution.

**PURPOSE:** To evaluate the test-retest and intra-evaluator reliability of the Reverse Lactate Threshold Test (RLT) - a newly proposed, single-session test, based on a novel

testing concept.

**METHODS:** Eight trained and 2 untrained cyclists (26-51 yrs) were tested twice, 2 to 5 days apart, on an electro-magnetically-braked cycle ergometer. The cycling version of the RLT consists of a series of 4-5 continuous 4-min stages, progressively incremented (by 20-40W) to a load 5-20% above the presumed MLSS, immediately followed by 4-6 loads progressively decremented (by 10W). Fingertip capillary blood was sampled at the end of each stage for blood lactate concentration ([La]). [La] was then plotted against load and the power output at peak [La], during the decremental (reverse) loading was taken as the RLT-determined anaerobic threshold. When all 20 tests were completed, they were plotted, coded and standardised so as to facilitate anonymity of the plot. All plots were then given to the reviewer for 'blind' AnT determinations.

**RESULTS:** There was no significant difference between the 1<sup>st</sup> and 2<sup>nd</sup> test in the mean RLT-determined anaerobic threshold ( $238.5 \pm 69.3$  &  $237.7 \pm 67.0$  W, respectively) and no order effect was found. The test-retest reliability coefficient ( $n=10$ ) was 0.998 ( $R^2=0.996$ ) and the inter-reviewer reliability was ( $r=0.998$ ).

**CONCLUSIONS:** The new RLT was shown to be highly reliable in its estimation of the AnT in cycling. The observed level of reliability is higher than any reported for existing tests. [Funding: Brock University]

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**2201 Board #89 May 28 2:00 PM - 3:30 PM**

**A Comparison Of Physiological And Pain Responses Between Exercise Modalities**

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(No relationships reported)

**PURPOSE:** Elliptical cross-trainers (ECT) have become an increasingly popular exercise modality within the fitness industry. Cybex International, Inc. has recently manufactured a new exercise modality, the Cybex® Arc Trainer (ARC), that utilizes a low impact mechanical design. To determine differences in physiological responses and perceived discomfort during maximal and submaximal exercise with two common exercise modalities, the ECT and the ARC which undergoes an excursion of motion utilizing an arc pathway.

**METHODS:** Eighteen subjects (10 male and 8 female; age= $24.7 \pm 2.6$  yrs, ht= $172.2 \pm 10.3$  cm, mass= $69.8 \pm 14.9$  kg, %fat= $22.5 \pm 8.1$ %; mean $\pm$ SD) performed maximal exercise protocols on a treadmill (TML), the ECT, and ARC. Subjects also performed three 10-minute submaximal exercise bouts on the ECT and ARC at 55%, 65%, and 75% of TML VO<sub>2</sub>max where HR, VO<sub>2</sub>, VE, RER, hip, knee and low-back discomfort were monitored using a 1 - 10 scale, 1 indicating no pain and 10 suggesting extreme pain. All ECT and ARC tests were performed in a counterbalanced order.

**RESULTS:** VO<sub>2</sub>max was greater during TML exercise compared to ECT ( $P=0.007$ ), but similar to the ARC. Both ECT and ARC elicited lower HR<sub>max</sub> values compared to maximal TML exercise ( $P=0.0001$ ). No difference was observed between ECT and ARC for VO<sub>2</sub> during the submaximal exercise bouts ( $P>0.05$ ). However, HR was greater during submaximal ECT exercise ( $P>0.05$ ). Perception of discomfort was not different between ECT and ARC for knees ( $P>0.05$ ) and lower back ( $P>0.05$ ), but different for the hips ( $P=0.02$ ).

**CONCLUSIONS:** Similar VO<sub>2</sub>max values were observed with ARC and TML modalities. Greater perceptions of discomfort were observed with ECT compared to ARC at similar submaximal exercise intensities suggesting individuals with, or at risk for, lower extremity joint pathology may benefit from exercise with modalities other than the ECT.

Equipment was provided by Cybex International, Inc.

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**2202 Board #90 May 28 2:00 PM - 3:30 PM**

**Comparison Of Rpe Values From A Maximal Graded Exercise Test Between Firefighters And Non-firefighters**

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(No relationships reported)

Certain occupations, due to their nature, repeatedly place greater physical and psychological demands on individuals. Individuals exposed to this type of high, work-related physical and psychological stress include firefighters, policemen/women, and military personnel.

**PURPOSE:** The purpose of this investigation was to determine if such individuals (firefighters -FFs) when compared to lay persons (non-firefighters -non-FFs) would report similar rating of perceived exertion (RPE) values when performing a maximum graded exercise treadmill test.

**METHODS:** A total of 94 FF (mean age 36 yrs) and 30 non-FFs (mean age 27 yrs) participated in this study. All subjects completed a standard Bruce Treadmill Protocol. ACSM guidelines for maximum aerobic testing were used to determine if maximum effort was achieved. Those guidelines included 1) a respiratory exchange ratio (RER) value greater than 1.15, 2) reaching 85% of maximum heart rate, 3) an RPE of more than 17 (6-20 scale).

**RESULTS:** Sixty-eight FFs and 24 non-FFs meet both physiological criteria (85% of max HR and 1.15 RER value) indicating a maximal test was achieved. Of these, 46 of the FFs and 9 of the non-FFs did not report a RPE value indicating they were working at a maximal effort (17 or above/very hard). FFs under-reported maximal effort as indicated by RPE by 67% compared to 37% of non-FFs, respectively. An independent t-test showed there was a significant difference in mean RPE values for FFs that meet all three criteria versus those that meet only physiological criteria ( $p=0.00$ ). Those that meet all three criteria had a mean RPE of  $17.6 (\pm 0.85)$  compared to a mean RPE of  $14.3 (\pm 1.99)$  in those that meet only the two physiological criteria. There was also a significant difference ( $p=0.035$ ) between the FFs under-reported mean RPE value ( $14.3 \pm 1.99$ ) and the mean for the non-FFs that under-reported RPE ( $15.8 \pm 0.44$ ).

**CONCLUSION:** According to these findings, due to the strenuous nature of their job, FFs, and other individuals with physically and psychologically demanding jobs, may not perceive physical stress caused by exercise the same way lay individuals do. In addition to affecting verbal responses to perceived stress of exercise testing, it may also carry over into their work environment and lead to an underestimation of perceived physical stress on the job.

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**2203 Board #91 May 28 2:00 PM - 3:30 PM**

**Examination Of A Single-stage Submaximal Treadmill Test To Estimate Aerobic Capacity**

Jeff Lynn, Kimberly Smith, Anne Hays, Nicole Zeller, Jeremy Gebhart, Kristen Vogt, Meredith Velez, Andrea Campbell. *Slippery Rock University, Slippery Rock, PA.* (Sponsor: Patricia Pierce, FACSM)

(No relationships reported)

**PURPOSE:** The purpose was to evaluate the reliability and validity of a one-stage submaximal treadmill test (Vehrs, PR *et al.*, 2007) to estimate VO<sub>2</sub>max.

**METHODS:** VO<sub>2</sub>max was measured by expired gas analysis using a maximal treadmill protocol in 34 SRU students (23 women and 11 men, aged  $19 \pm 1$  years) with average to above average fitness (VO<sub>2</sub>max range, 37 to 69 ml/kg/min). The submaximal estimation test (SET) was performed on 2 separate days. Subjects sustained a comfortable jogging pace (4.3-7.5 mph, 0% grade; HR =  $158 \pm 12$  bpm) for 5 minutes on a treadmill while heart rate was measured via heart rate monitor. The steady state heart rate at the end of the test was used in the following equation to estimate VO<sub>2</sub>max:  $58.687 + (7.52 \times \text{sex}, 1=\text{male and } 0=\text{female}) + (4.334 \times \text{speed in mph}) - (0.211 \times \text{weight in kg}) - (0.148 \times \text{HR}) - (0.107 \times \text{age})$ .

**RESULTS:** The SET produced similar results when repeated on 2 separate days ( $46.4 \pm 4.7$  ml/kg/min and  $46.3 \pm 5.1$  ml/kg/min), and there was a strong correlation between the results of the SETs ( $r = .965, p \leq 0.01$ ). The SET underestimated VO<sub>2</sub>max in 30 of 34 subjects, including every subject with a VO<sub>2</sub>max above 50 ml/kg/min. A paired t-test revealed that estimated VO<sub>2</sub>max was significantly lower than measured ( $52.6 \pm 8.0$  ml/kg/min,  $p < 0.01$ ). The correlation between estimated and actual VO<sub>2</sub>max was statistically significant, but not strong ( $r = 0.656, p < 0.01$ ). The standard error of the estimate (SEE) was 3.6 ml/kg/min.

**CONCLUSIONS:** In a small sample of college students, the Vehrs SET for  $\dot{V}O_{2\max}$  had excellent test-retest reliability, but tended to underestimate  $\dot{V}O_{2\max}$ , particularly in subjects whose  $\dot{V}O_{2\max}$  was over 50 ml/kg/min. This submaximal estimation test appears to lack concurrent validity, especially in high fit subjects.

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**2204 Board #92 May 28 2:00 PM - 3:30 PM**  
**Ventilatory Threshold And Lactate Threshold Coincide Using The Dmax Method**

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The ventilatory threshold has been used as a non-invasive technique to monitor exercise intensity during training. The ventilatory threshold and the lactate threshold have been shown to coincide using visual inspection. The Dmax method has been proposed to provide an accurate estimate of the lactate threshold.

**PURPOSE:** The purpose of this study was to determine the relationship between the ventilatory threshold and the lactate threshold when both being determined by using the Dmax method.

**METHODS:** Twenty-two trained male subjects, 8 cyclists and 14 runners (age:  $31.9 \pm 7.5$  yrs; height:  $178.9 \pm 5.6$  cm; weight:  $71.5 \pm 7.3$  kg; body fat:  $9.7 \pm 4.27\%$ ;  $\dot{V}O_{2\max}$ :  $63.0 \pm 7.04$  ml  $\text{kg}^{-1} \text{min}^{-1}$ ) completed a single continuous incremental maximal exercise test to determine their individual lactate profile. Oxygen consumption, minute ventilation, and blood lactate were measured. Blood samples were collected at the end of each exercise stage and at maximal exercise through a venous catheter placed in an antecubital vein and analyzed using an automated lactate analyzer. The Dmax method was used to identify the lactate and ventilatory thresholds. Pearson's Correlation Coefficient was used to determine the relationship between the two thresholds. A paired *t* test was used to determine differences between the two estimates.

**RESULTS:** The ventilatory threshold and lactate threshold were significantly correlated ( $r=0.91$ ;  $P<0.05$ ). The paired *t* test indicated no difference ( $P=0.42$ ) in the intensity determined by each threshold.

**CONCLUSIONS:** These results indicate that the ventilatory threshold determined by the Dmax method can be used as a non-invasive technique to estimate the lactate threshold.

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**2205 Board #93 May 28 2:00 PM - 3:30 PM**  
**Spring-mass Leg Stiffness Is Not Affected By Brief Static Or Dynamic Stretching**

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Stretching has had a longstanding use in the development of flexibility, prevention of injury, and preparation for exercise. Recent research has demonstrated a loss of muscle power following an acute bout of prolonged static stretching. However studies using briefer periods of stretch or dynamic stretching have provided equivocal results.

**PURPOSE:** To investigate the effect of brief static and non task-specific dynamic stretching on spring-mass leg stiffness in a vertical bouncing task.

**METHODS:** 37 physically active male volunteers completed the study. Subjects were randomly assigned to one of two groups (natural bouncing [NAT],  $n=20$ ; maximal bouncing [MAX],  $n=17$ ). NAT bounced at their self-selected stiffness and MAX were instructed to bounce as stiffly as possible. Bouncing was controlled at a frequency of 2.2 Hz ( $\pm 5\%$ ). After each of four treatment conditions, subjects completed three  $\times 30$  s bouts (separated by 2 minute rest periods) of vertical bouncing, in a counterbalanced crossover design. Treatment conditions were: no stretch (NO); single 30 s stretch (SS); repeated ( $4 \times$ ) 30 s stretch (RS) and dynamic stretch (DY). Stretches were carried out on the gluteals, hamstrings, quadriceps and calves and did not involve any direct replication or rehearsal of the movements used in the bouncing task. Spring-mass leg stiffness was calculated as the ratio of peak vertical force to vertical displacement during ground contact. Data was collected via a piezoelectric force plate (1000 Hz) and vertical displacement calculated from the second integral of the acceleration curve.

**RESULTS:** Three-factor ANOVA (group  $\times$  treatment  $\times$  bout) with repeated measures indicated that the MAX group were predictably stiffer than the NAT group ( $31162 \pm 10080$  vs  $17324 \pm 4871$  N $\cdot\text{m}^{-1}$ ;  $F=35.8$ ;  $p<0.001$ ), the NAT group scores being similar to those elsewhere in the literature. There were no significant effects of treatment ( $F=0.46$ ;  $p=0.71$ ), bout ( $F=0.05$ ;  $p=0.95$ ), or interactions ( $p>0.05$ ) on leg stiffness scores.

**CONCLUSIONS:** Relative to control (NO), the results of this study showed that brief static stretching or non task-specific dynamic stretching does not affect spring-mass leg stiffness during vertical bouncing.

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**2206 Board #94 May 28 2:00 PM - 3:30 PM**  
**The Influence Of Bout Interruptions On Predicted Physical Activity During Treadmill Walking And Running**

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Activity monitors (AM) are commonly used to assess daily physical activity (PA) behaviors in clinical and research settings. However, the presence of bout interruptions (BI), which are brief pauses ( $\leq 2$  min) in PA, can complicate the interpretation of AM determined PA outcome variables.

**PURPOSE:** This study systematically assessed the effect of 1- and 2-min BIs on PA outcome variables derived from AMs.

**METHODS:** Subjects (6 women, 9 men; Mean $\pm$ SD:  $23 \pm 3$  yrs.,  $68.0 \pm 9.7$  kg,  $176.2 \pm 8.6$  cm) completed a series of walking (53.6 and 107.2 m/min at 0% grade) and running (160.8 m/min, 0% grade) trials on a treadmill while wearing AMs on the right hip (RH) and left wrist (LW) to predict activity energy expenditure (AEE) and Activity Time. Treadmill speeds were selected to elicit light (L), moderate (M), and vigorous (V) PA intensities. Subjects completed three 5-min walking/running bouts separated by successive 1- and 2-min BIs. Predicted AEE and time were evaluated using three BI rules: 1) No allowance for a BI (BI0), 2) Allowance for 1-min BI (BI1), and 3) Allowance for a 2-min BI (BI2). AEE was calculated from raw AM data using previously validated hip and wrist double regression modeling algorithms. Activity Time, defined as the time spent at or above a moderate intensity, was calculated using an AEE cut point of 0.0831 kcal/kg/min = 3 METs. A 2-factor RMANOVA was used to compare each BI definition within each intensity category for both AEE and time variables ( $\alpha=0.05$ ).

**RESULTS:** AEE significantly increased when allowing for BI1 (RH: 0.5, 1.0, 3.0 kcal; LW: 0.5, 0.5, 3.0 kcal) and BI2 (RH: 0.3, 1.0, 3.0 kcal; LW: 0.7, 0.5, 3.0 kcal) at L, M, and V intensities, respectively. Activity Time increased an average of +3 mins when going from BI0 to BI1 and +5 mins when going from BI1 to BI2 for both AMs. When expressed as a percentage, the increase between BI0 & BI1 and between BI1 & BI2 was 0.3-2.7% for AEE and 5.5-11.0% for Activity Time.

**CONCLUSIONS:** This study indicates that allowing for a BI within a PA bout significantly increases predicted AEE and Activity Time from AMs during treadmill locomotion. These results are especially important when interpreting AM data in terms of 8-10 min minimum bout durations as suggested by ACSM. Thus, rules for BIs in AM analyses should be established since BIs will significantly influence PA outcome variables.

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**2207 Board #95 May 28 2:00 PM - 3:30 PM**  
**Comparison Of Resting, Walking, And Jogging Energy Expenditure Prediction Equations In Normal And Overweight Females**

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Knowledge of resting energy expenditure (REE) and energy expenditure (EE) during physical activity is essential for designing dietary and exercise interventions for weight management.

**PURPOSE:** To compare 7 estimated REE prediction equations (Table 1.) and the ACSM walking/jogging EE prediction equations to measured REE and EE.

**METHODS:** 13 normal weight (22.2±2.0 BMI) and 10 overweight (27.2±2.4 BMI) healthy university females between the ages of 18 and 24 were assessed for REE and EE using indirect calorimetry (Parvo Medics' TrueOne® 2400) while walking (79 mmin<sup>-1</sup>) and again while jogging (134 mmin<sup>-1</sup>) for 1.6 km, on separate days.

**RESULTS:** The Bernstein, Owen, and BOD POD estimates of REE were significantly different (p<.05) from the measured in both groups (Table 1.). The measured EE while walking was not significantly different from the ACSM predicted EE in normal weight females (67.4±6.5 and 69.0±7.0 kcal, respectively), but was significantly different in overweight females (81.8±7.5 and 85.9±6.6 kcal, respectively). The measured EE during running was significantly different from the ACSM predicted EE in normal weight (94.3±11.2 and 107.9±11.0 kcal, respectively) and overweight (113.4±14.4 and 134.4±10.3, respectively) females.

	Normal Weight (n=13)	Overweight (n=10)
Measured	1461±161	1643±107
Harris Benedict	1447±66.2	1591±62.2
Bernstein	1158±45.3*	1270±43.6**
Livingston	1364±66.8	1517±55.9
Mifflin	1358±81.7	1518±76.9
Owen	1224±43.7*	1329±41.2**
Quick Estimate	1315±134	1637±126
BODPOD	1180±95.7*	1391±135**

Note: values are kcal/day in means±SD.  
\*Significantly different from measured in normal weight (p<.05).  
\*\* Significantly different from measured in overweight (p<.05).

**CONCLUSIONS:** The results suggest that normal weight females can use the Harris Benedict or Livingston equation and overweight females can use the Harris Benedict or Quick Estimate equation to accurately predict their REE. With only a 4 kcal difference between measured and estimated EE while walking in the overweight group, the ACSM walking equation predicted EE well in both groups; however, the jogging equation has a tendency to overestimate EE in both groups and should therefore be used with caution.

**2208 Board #96 May 28 2:00 PM - 3:30 PM**  
**Actigraphy Assessment Of The Effects Of Circuit Training Exercise On Sleep In Healthy, Morning-type Women**

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(No relationships reported)

**PURPOSE:** The purpose of this study was (1) to compare wrist actigraphy-derived nocturnal sleep characteristics of healthy, morning-type women between non-exercise days and structured exercise program (circuit training class) days, and (2) to examine whether a change in the regular time-of-day of their established exercise routine from the morning hours to the early evening hours affects sleep.

**METHODS:** Fifteen healthy, morning-type women (age: 47.4±5.5 yrs) were recruited for this study. All subjects were following an established (6 weeks or longer) morning (between 7am-9am) exercise training routine that consisted of a 60 min, personal trainer supervised, moderate-intensity, circuit-training program at a commercial fitness facility. For purpose of this study, sleep/wake patterns were determined from 24-hour wrist actigraphy (AW 64 Actiwatch) recordings over five successive weekdays. During three of these five weekdays, subjects did not participate in any formal exercise training sessions. On the remaining two (always non-consecutive) days, subjects completed their regular circuit training classes on one day during their normal morning hours and on the other day it was changed to the evening hours (between 5pm-7pm). Actigraphy data were scored using the Actiware (version: 5.0) sleep analysis software (Mini Mitter, Bend, OR) for the assessment of total sleep time (TST), sleep onset latency (SOL), wake after sleep onset (WASO), and sleep efficiency (SE).

**RESULTS:** Descriptive means (±SD) for the global score on the Pittsburgh Sleep Quality Index and the Beck Depression Inventory for the study cohort was 4.33 (±2.94) and 3.64 (±3.65), respectively. Repeated measures ANOVA revealed no significant differences between actigraphy-derived nocturnal sleep characteristics for TST, SOL, WASO, and SE between non-exercise and normal morning exercise days (>0.05). Moreover, changing the habitual exercise training routine from the morning hours to the early evening hours failed to have a significant effect on these sleep measures (p>0.05).

**CONCLUSIONS:** Moderately intense circuit training exercise, either performed during a regular accustomed morning training time period or when changed to an unaccustomed early evening time period, does not seem to influence the normal sleep of healthy, morning-type women.

**2209 Board #97 May 28 2:00 PM - 3:30 PM**  
**Comparison Of Muscle Activity During Jumping On The Ground Versus The Pneubounder**

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The most safe and efficient training methods to develop functional movement capacity and explosive power have been debated for decades. Explosive power training is often associated with risk of injury, specifically from high impacts associated with landing. A prototype pneumatic exercise machine that allows the user to jump or perform leg presses against a platform Supported by compressed air in a closed-chain exercise while standing in a an upright position has been developed.

**PURPOSE:** To compare peak muscle activity during ground vs. pneumatically dampened jumping.

**METHODS:** Surface EMG of 14 core and lower extremity muscles was recorded during repeated, maximal counter-movement jumping on the ground and on the machine. Data was collected at 1000 Hz, band-pass filtered (10 - 500 Hz), and RMS was calculated (50 ms envelope) on 6 men and 2 women (age = 28.8 ± 9.7 years; mass = 79.4 ± 15.7 Kg; height = 176.7 ± 9.3 cm).



**RESULTS:** Data was analyzed using repeated measures ANOVA. No statistically significant ( $p < 0.05$ ) differences were noted in peak EMG amplitude in any of the muscles between conditions. Peak EMG amplitude for machine and ground jumps respectively were (mean  $\pm$  SE): multifidus ( $632.2 \pm 58.6$  vs.  $701.5 \pm 84.35$   $\mu$ v), longissimus thoracis ( $766 \pm 84.7$  vs.  $793 \pm 176.6$   $\mu$ v), oblique abdominals ( $306.7 \pm 73.76$  vs.  $429 \pm 114.8$   $\mu$ v), lower rectus abdominus ( $835.0 \pm 208.7$  vs.  $739.0 \pm 158.4$   $\mu$ v), iliacus ( $767.3 \pm 104.32$  vs.  $829.5 \pm 121.38$   $\mu$ v), gluteus medius ( $403.3 \pm 78.9$  vs.  $405.8 \pm 77.7$   $\mu$ v), gluteus maximus abductor ( $397.4 \pm 71.1$  vs.  $422.88 \pm 73.77$   $\mu$ v), gluteus maximus extensor ( $769.1 \pm 234.0$  vs.  $758.25 \pm 238$   $\mu$ v), rectus femoris ( $612.0 \pm 64$  vs.  $730.5 \pm 112.7$   $\mu$ v), vastus lateralis ( $736.9 \pm 138.4$  vs.  $725.3 \pm 116.5$   $\mu$ v), vastus medialis ( $817.3 \pm 191.3$  vs.  $743.6 \pm 195.1$   $\mu$ v), VMO ( $1203.6 \pm 219.5$  vs.  $1223.25 \pm 184.3$   $\mu$ v), gastrocnemius ( $376.86 \pm 59.8$  vs.  $490.57 \pm 22.0$   $\mu$ v), and tibialis anterior ( $384.86 \pm 65.1$  vs.  $509.3 \pm 81.6$   $\mu$ v).

**CONCLUSIONS:** Similar peak muscle activity was recorded for ground versus potentially safer and lower impact exercise on the machine. Training on such a device may benefit rehabilitation, performance, and neuromuscular function in athletes and at-risk populations, such as the elderly, with less risk of injury.

Disclaimer: Views expressed here are the authors and do not reflect official policy or position of the US Air Force, DOD, or US Government.

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**2210 Board #98 May 28 2:00 PM - 3:30 PM**  
**Reliability Of A Dorsiflexion Lunge Test (dflt) And Star Excursion Balance Test (sebt)**

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(No relationships reported)

Ankle sprains are the most frequent acute injuries in physical activity. A significant amount of research has focused on identification of possible risk factors for sprains and, thus, prevention of these injuries. Understanding the risk factors at play is essential for the development of individualized prevention programmes. Current literature identifies ankle dorsiflexion (DF), posture sway and proprioception as factors that likely play a role in the occurrence of ankle sprains. The Dorsiflexion Lunge Test (DFLT) and the Star Excursion Balance Test (SEBT) are used to assess these three factors and to be used as valid testing tools must be reliable.

**PURPOSE:** To evaluate the reliability of the Dorsiflexion Lunge Test (DFLT) and the Star Excursion Balance Test (SEBT) in female athletes.

**METHODS:** The tests were given to female volleyball players. Twenty-five players ( $14.3$  years  $\pm 1.9$ ) took the DFLT twice. Eleven players ( $15$  years  $\pm 2.1$ ) performed the SEBT with three lines (anterior; A, posterolateral; PL, posteromedial; PM) on five different occasions using two different procedures: three times without centimetre markings on the lines (SBETw/m) and twice with centimetre marks (SBETm). To test the reliability of the tests we performed variance component analyses of different facets using SAS (SAS Institute Inc, 1999), *Generalizability Theory [GT]* (Ysewijn, 1996). Also Bland & Altman (1995) graphic (BAG) was performed. For DFLT, the components analyzed included: *date* (2 levels), *player* (25 levels), *leg* (2 levels), *attempt* (3 levels) and *measurement* (3 levels). In SEBT 3 facets were included: *date* (3 levels), *line* (3 levels) and *player* (11 levels).

**RESULTS:** The generalizability coefficient (CG) is 0.71 for DFLT using three attempts and 0.99 using the average of all attempts. BAG is adequate. The CG is 0.979 in SBETw/m but BAG aren't appropriate. SBETm CG is 0.997 and BAG is better than SBETw/m but it isn't enough.

**CONCLUSIONS:** The DFLT is a reliable method to assess ankle DF in female athletes using the average of three attempts. The SBETm is more reliable than SBETw/m but the reliability of SBET is questionable. Further research with a focus on different subjects (different ages, type of sports...) and including more detailed facets (different lines, more attempts, changes in the warm up...) is necessary.

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**2211 Board #99 May 28 2:00 PM - 3:30 PM**  
**Influence Of Difference In Knee Alignment On Site Of Pain After Long-distance Walk**

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(No relationships reported)

**PURPOSE:** Walking exercise has recently been accepted as a safe aerobic exercise. On the other hand, varus or valgus deformity of the knee is associated with a high risk of lower limb pain and may lead to gonarthrosis. This study examined whether the differences in the intercondylar and intermalleolar distances affect the site of pain in the lower limb after a continuous long-distance walk.

**METHODS:** A total of 40 healthy subjects (24 males and 16 females; mean age,  $21.2 \pm 1.3$  years) were instructed to perform continuous walking exercise for 3 days (total walking distance, 85 km), and to record episodes and sites of pain. Subjects were then classified according to the intercondylar and intermalleolar distances by an increment of 2.0 cm to analyze the relationship between the distances and the occurrence of pain.

**RESULTS:** A total of 80 episodes of pain were reported after the 3-day walking exercise. The mean numbers of pain episodes per subject were as follows: 2.4 episodes in subjects with an intermalleolar distance of  $\geq 2.0$  cm (valgus knee), 2.19 episodes in those with an intercondylar distance of  $\geq 2.0$  cm (varus knee), and 1.5 episodes in the other subjects (normal knee). The common sites of pain included the sole of the foot (17 episodes, 21.3%), posterior side of the tibia (11 episodes, 13.8%), anterior side of the thigh (10 episodes, 12.5%) and hip joint (10 episodes, 12.5%). Subjects with varus knee accounted for 53% (9/17) of the subjects complaining of pain in the sole of the foot and 60% (6/10) of those complaining of pain in the hip joint. Subjects with valgus knee accounted for 72.7% (8/11) of those complaining of pain in the posterior side of the tibia.

**CONCLUSIONS:** Subjects with knee deformity tend to experience pain in particular parts of the lower limbs after a long-distance walk. It is thus important to understand the individual characteristics of the knee and consider measures to prevent pain before performing walking exercise.

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**2212 Board #100 May 28 2:00 PM - 3:30 PM**  
**Metabolic And Ventilatory Responses During Exercise Using Medgraphics Cpx Ultima And Vo2000**

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(No relationships reported)

The usefulness of a portable metabolic measuring system is dependent upon its ability to produce valid and reliable results when compared to standard laboratory equipment such as non-portable metabolic measuring systems. Results from studies comparing the VO2000 with non-portable systems have been inconsistent.

**PURPOSE:** To compare the metabolic and ventilatory values during exercise using a portable metabolic measuring system (VO2000) with a facemask (FM) and mouthpiece/nose clip (MP) and a standard laboratory metabolic measuring system, CPX-Ultima (CPX/U).

**METHODS:** Eighteen volunteers (age  $25.7 \pm 7.2$  years) completed three 20 min exercise sessions (10 min walking/10 min jogging) using the CPX/U, FM, and MP. A counter-balanced design determined treatment order. Metabolic and ventilatory values were recorded at 20 s intervals and averaged over the last five min of walking and jogging. A one-way ANOVA with repeated measures compared the mean values for each variable for the three conditions during walking and jogging.

**RESULTS:** No significant difference ( $p > .05$ ) in HR or VO<sub>2</sub> was found due to treatment order. The VO2000 produced similar metabolic and ventilatory values whether using the FM or MP ( $p > .05$ ). However, significant differences ( $p < .01$ ) were found for VE, VO<sub>2</sub>, VCO<sub>2</sub>, and RER among the CPX/U, FM and MP during walking and jogging. The VO2000 overestimated the VO<sub>2</sub> values compared to the CPX/U by  $\hat{a} \sim 2$  ml.kg<sup>-1</sup>.min<sup>-1</sup> during walking and by  $\sim 7$  ml.kg<sup>-1</sup>.min<sup>-1</sup> during jogging.

**CONCLUSIONS:** The VO2000 is reliable, but should not be used in the field with confidence until explanations or corrections are provided for the differences between systems reported in this study. Future research should focus on internal as well as external sources of error that account for the differences between the VO2000 and standard



**2213 Board #101 May 28 2:00 PM - 3:30 PM**  
**Development Of Moving Artifacts Simulator For Reliability Evaluation Of Heart Rate Monitors**

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(No relationships reported)

**PURPOSE:** To develop a signal simulator with dynamic noise originated from the actual walking and running, for evaluation of reliability of HRMs.

**METHODS:** We classified variations of measured HR signal during exercise as three categories: actual physiological changes, effect of respiration and change in the electrode contact (moving artifact). To separate each, respiration and walking/running bounce rate were measured by independent devices: Volunteers wore 1 channel ECG device without any signal filters to their chest to get the composite signal, and used gas analyzer to measure respiration rates and wore accelerometer on their waist to monitor motional bounce. Data from each device are analyzed by frequency response method to investigate the characteristic frequencies of each artifacts and actual physiological signal. With those frequency distribution and corresponding power spectrum, simulated ECG signal contains noises due to walking/running effect were generated with known actual physiological part.

**RESULTS:** Results show that both characteristic frequencies of respiration and moving artifact are linearly increased with respect to walking speed, range from 0.59Hz to 0.88Hz and 2Hz to 2.95Hz, respectively with speed change from 5km/h to 9km/h. When subjects are running, respiration and moving artifact show different but linear increase with respect to running speed, 0.87Hz~1.0Hz and 2.95Hz~3.35Hz, respectively with speed change 7km/h~12km/h. Power spectrum, i.e., noise amplitude, of moving artifact also linearly increased when walking/running speed are increased. With these information, derived physiological signal, respiration signal and moving artifact signal were combined by using a signal generator to get the artificial ECG signal contains moving noise. Generated artificial ECG signal were strongly correlated with original signal ( $R^2 = 0.91$ ), which shows that moving artifact effect with various speed can be artificially simulated by a signal generator.

**CONCLUSIONS:** A simulation method for ECG signal with noise from moving effect was developed. Simulated signal with known signal composition including moving artifact could be used for objective evaluation of reliability of HRMs.

**2214 Board #102 May 28 2:00 PM - 3:30 PM**  
**Validity Of The Salutron Smarthealth Heart Rate Watch And Treadmill Handgrip Sensors**

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(No relationships reported)

One of the more recently developed heart rate monitoring devices is a strapless heart rate watch. Such a device may be more user-friendly than classic heart rate monitors as there is no need to wear a chest strap.

**PURPOSE:** To examine the validity of the Salutron Strapless Smarthealth heart rate watch (SHW) and the Salutron treadmill handgrip contact heart rate sensors (HG) by comparing them to an electrocardiogram (EKG).

**METHODS:** Healthy adults ( $n=25$ ; age:  $27.3 \pm 5$  yrs) engaged in a period of standing rest and graded exercise on a treadmill. Heart rate was monitored and recorded via: 1) an EKG, 2) a SHW, and 3) HG. The protocol consisted of 5-min periods of 1) standing rest, 2) 2.0 mph walking, 3) 3.5 mph walking, 4) 4.5 mph jogging, and 5) 6.0 mph running. During each period, an EKG was printed at 30-sec intervals and served as the criterion measure. Additionally, the SHW readings were recorded at time periods of 0:30, 1:30, 2:30, 3:30, and 4:30, while HG readings were recorded at time periods of 1:00, 2:00, 3:00, 4:00, and 5:00. The EKGs were analyzed to determine heart rate which was reported as a 5-beat average. Heart rate values recorded from the SHW and HG were compared to the EKG at the respective time periods. Correlation coefficients ( $r$ ) and standard error of estimate (SEE) were calculated to determine the validity of SHW and HG.

**RESULTS:** Correlation coefficients ranged from 0.95 to 0.97 between SHW and EKG and from 0.97 to 0.99 between HG and EKG. Furthermore, the SEEs were  $<5$  bpm for SHW and  $<4$  bpm for HG (Table 1).

**CONCLUSION:** Correlation coefficients were high between both devices and the EKG and SEEs were low indicating both are valid and provide accurate measures of heart rate during treadmill exercise.

Table 1.

		0 mph	2 mph	3.5 mph	4.5 mph	6 mph
EKG vs. SHW	$r$	0.96	0.95	0.96	0.98	0.97
	SEE	3.96	4.75	4.46	4.1	4.24
EKG vs. HG	$r$	0.98	0.99	0.99	0.99	0.97
	SEE	3.06	2.34	2.47	2.6	3.38

Supported in part by Salutron, Inc. Fremont, CA

**2215 Board #103 May 28 2:00 PM - 3:30 PM**  
**Bilateral Differences In Emg Responses During Submaximal Arm Ergometry**

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(No relationships reported)

**PURPOSE:** To investigate differences in electromyographic responses during submaximal arm ergometry.

**METHODS:** 19 subjects (12 males, 7 females; mean age  $\pm$  SD:  $22.63 \pm 2.01$  yrs) underwent a graded maximal arm ergometry test to determine peak oxygen uptake ( $\text{VO}_{2\text{peak}}$ ). On a separate day subjects completed two, 15-minute submaximal workloads (40% and 60% of maximal workload) administered in a randomized order. During the submaximal session electromyographic activity (EMG) of the left and right biceps brachii (BB), triceps (Tri), latissimus dorsi (LD) were recorded (sampling rate 1000 Hz). Data were divided into thirds to represent the start, middle and last three repetitions of exercise. Integrated EMG (iEMG) was calculated. Differences between conditions were analyzed with multivariate repeated measures ANOVA.

**RESULTS:** The mean  $\pm$  SD  $\text{VO}_{2\text{peak}}$  was  $1.92 \pm 0.44 \text{ L}\cdot\text{min}^{-1}$ . There were significant differences ( $p<0.05$ ) in submaximal  $\text{VO}_2$  between 40% and 60% workloads ( $1.21 \pm 0.30 \text{ L}\cdot\text{min}^{-1}$  and  $1.63 \pm 0.44 \text{ L}\cdot\text{min}^{-1}$ , respectively). Time-dependent bilateral asymmetries were evident in the iEMG data, which are presented in the table below. Pairwise comparisons demonstrated significant changes in iEMG for all muscles between start vs. mid (BB:  $p=0.040$ , Tri:  $p=0.004$ , LD:  $p=0.008$ ), and start vs. end (BB:  $p=0.021$ , Tri:  $p=0.002$ , LD:  $p=0.042$ ), but none for

mid vs. end. Univariate analysis revealed significance for speed in BB ( $p=0.006$ ), Tri ( $p=0.031$ ), and LD ( $p=0.004$ ). Univariate analysis revealed significance for side in the BB ( $p=0.001$ ), Tri ( $p<0.001$ ), and LD ( $p<0.001$ ).

**CONCLUSIONS:** These results suggest a trend toward time-dependent, bilateral differences in muscle activity during submaximal arm ergometry.

	Left BB	Tri	LD	Right BB	Tri	LD
Start 40%	144.6 ± 61.9	188.6 ± 94.4	62.5 ± 37.4	249.1 ± 161.9	436.3 ± 300.7	202.4 ± 141.2
Middle 40%	161.1 ± 57.8	202.8 ± 88.6	70.8 ± 39.6	261.4 ± 159.6	457.5 ± 222.2	213.9 ± 140.0
End 40%	172.8 ± 64.4	214.8 ± 80.0	75.1 ± 42.9	265.4 ± 158.8	454.6 ± 162.4	209.2 ± 120.6
Start 60%	159.3 ± 55.7	222.3 ± 104.8	78.7 ± 38.7	312.8 ± 236.2	464.3 ± 170.3	240.5 ± 139.5
Middle 60%	205.4 ± 66.5	278.3 ± 132.0	96.0 ± 54.0	327.0 ± 181.6	528.5 ± 139.5	274.6 ± 154.5
End 60%	231.4 ± 105.4	284.3 ± 128.8	92.5 ± 50.7	328.5 ± 183.5	572.8 ± 163.7	305.3 ± 219.1

## 2216 Board #104 May 28 2:00 PM - 3:30 PM

### Acute And Late Effects Of Passive Stretching And “Crochetage” In Hamstring Muscles Flexibility In Young Healthy Women

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(No relationships reported)

Flexibility is a component of physical fitness and doubts still persist on the efficacy of different training methods. The Crochetage (CRO) is one of the methods based upon muscular womb traction using a specific steel hook, during a 5-7 min period.

**PURPOSE:** To evaluate the acute (AE-after each session) and late effects (LE-after 10 sessions) of the passive stretching (PS) and the CRO, on hamstring muscles in healthy young women.

**METHODS:** Ten women aged 18-30 yrs, BMI of  $22.5 \pm 0.9 \text{ kg/m}^2$  were submitted to 10 consecutive flexibility sessions on week days. They received PS (one 30 sec repetition) on one thigh and CRO in the other. The application of PS or CRO was randomly assigned to each volunteer by a unique researcher. Popliteal angle (PA) was measured before and after each session by another researcher, blinded to the flexibility method. All measurements were made at the point that produced an uncomfortable sensation without pain, during the passive knee extension, in dorsal decubitus, with hip at  $90^\circ$  and the opposite leg extended. The PA was re-evaluated 14 days after the end of the program, to search for flexibility maintenance. The average differences were analyzed before and after each session (AE). Late effects were evaluated comparing the average values of the 10<sup>th</sup> session in relation to the first. The effects of PS and CRO were tested with paired t-test and the comparison between them with unpaired t-test. Differences were considered significant when  $p<0.05$ .

**RESULTS:** Baseline values for PS ( $153.5 \pm 9.7^\circ$ ) were similar to the CRO ( $156.3 \pm 8.8^\circ$ ;  $p=0.50$ ). The average values after each session of PS were higher ( $158.1 \pm 11.1^\circ$ ) than the previous ones ( $153.5 \pm 9.7^\circ$ ;  $p<0.0001$ ). The same occurred with the CRO after ( $160.0 \pm 8.9^\circ$ ), compared with the previous ( $156.3 \pm 8.8^\circ$ ;  $p<0.0001$ ). The average magnitudes of AE in PS ( $+4.7 \pm 1.6^\circ$ ) and in CRO ( $+3.7 \pm 0.8^\circ$ ) were similar ( $p=0.12$ ). The increase of flexibility (LE) with PS ( $+7.9 \pm 7.7^\circ$ ;  $p<0.01$ ) was similar ( $p=0.93$ ) to that with CRO ( $+8.8 \pm 5.7^\circ$ ;  $p=0.001$ ). After 14 days, flexibility values were similar to those observed in the last training session, in both thighs ( $p>0.05$ ).

**CONCLUSION:** Training with both PS and CRO provided similar acute and late increase in the hamstring muscles flexibility. The improvement persisted after 14 days without training and was similar to both methods.

## 2217 Board #105 May 28 2:00 PM - 3:30 PM

### Non-exercise Prediction Of Anaerobic Power

Jennifer J. Wages, Ronald K. Hetzler, FACSM, Michelle A. Cleary, Melissa Lentz, Christopher D. Stickley, Iris F. Kimura. University of Hawaii at Manoa, Honolulu, HI.

(No relationships reported)

Previous studies have documented that reasonable estimates of maximal oxygen uptake can be obtained through the combination of selected anthropometric data and a paper and pencil test.

**PURPOSE:** This study examined the possibility of predicting anaerobic power as measured by the Wingate Anaerobic Cycle Test using anthropometric data and a questionnaire.

**METHODS:** Ninety-seven (54 males and 43 females) subjects volunteered to participant in this study. Peak power (PP) and mean power (MP) were determined using a standard Wingate protocol at a resistance of 0.075 and 0.10  $\text{kg} \cdot \text{kgbw}^{-1}$  for females and males, respectively. A series of eight questions were generated corresponding to variables associated with anaerobic power, using a Likert-type scale to quantify the response. Additionally, previously published scales from papers investigating non-exercise aerobic power estimates were also included in the analysis (Jackson et al, 1995 and George et al, 1997). Descriptive statistics were generated and multiple regression were performed on SAS v9.0 with an alpha level of  $p<0.05$ .

**RESULTS:** Mean ( $\pm$  SD) age, ht, wt, BMI, resting heart rate (RHR), PP, and MP, for males and females were:  $21.9 \pm 2.5$  yrs,  $175.0 \pm 7.8$  cm,  $79.2 \pm 12.4$  kg,  $25.8 \pm 3.3$ ,  $67.3 \pm 12.1$  BPM,  $1055.7 \pm 192.2$  W and  $800.7 \pm 125.7$  W; and  $22.4 \pm 3.3$  yrs,  $163.7 \pm 7.6$  cm,  $61.0 \pm 11.2$  kg,  $22.7 \pm 3.8$ ,  $69.7 \pm 10.3$  BPM,  $607.9 \pm 121.6$  W and  $481.7 \pm 71.0$  W; respectively. The mean estimated jump height (EJHt) Likert-scale values were  $5.7 \pm 1.5$  and  $4.7 \pm 1.3$  (on a 1-9 scale) for the males and females respectively. The mean activity code (AC) (Jackson et al. 1995) was  $4.9 \pm 1.6$  and  $5.1 \pm 1.5$  for males and females respectively. Multiple regression revealed the most parsimonious models to predict PP and MP were: PP =  $195.97 + 257.05(\text{gender}) + 8.48(\text{wtkg}) + 2.81(\text{EJHt})^2 - 2.48(\text{RHR})$ ,  $R^2 = 0.80$ , SEE = 122.9 W; MP =  $214.83 + 180.93(\text{gender}) + 0.06(\text{wtkg})^2 - 0.16(\text{BMI})^2 + 66.31(\text{AC}) - 5.97(\text{AC})^2 + 14.8(\text{EJHt}) - 1.54(\text{RHR})$ ,  $R^2 = 0.91$ , SEE = 60.0 W.

**CONCLUSION:** It was concluded that reasonable estimates for Peak and Mean power could be estimated from a combination of anthropometric data and a questionnaire without performing the Wingate anaerobic cycle test.

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**D-29 Free Communication/Poster - Group Fitness and Dance**

MAY 28, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**2218 Board #106 May 28 3:30 PM - 5:00 PM****Heart Rate and Estimate Energy Expenditure During Three Different Salsa Dancing Conditions**

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*(No relationships reported)*

**PURPOSE:** Many people practice Caribbean dances to improve their physical and psychological conditions. Moreover, despite a large practice of this dance, there is paucity information on its intensity request. The aim of this study was to estimate energy expenditure by heart rate of three different salsa dancing conditions: typical salsa lesson (TSL), *rueda de casino* lesson (RCL), and salsa dancing at night club (SDN) in eleven non-professional dancer adult pairs (age: 36±7 yrs).

**METHODS:** Subjects performed a pre-testing session and three testing sessions. During the pre-testing session height, weight and  $\dot{V}O_{2max}$  were assessed. Subjects'  $\dot{V}O_{2max}$  was determined by means of a continuous graded exercise step-test. In the following testing sessions, all subjects performed three different kinds of salsa dance (TSL, RCL and SDN). Heart rate (HR) was assessed during each dance condition and related to direct measures of oxygen uptake and to heart rate obtained during the preliminary incremental step-test. Linear regression analysis was employed to estimate gross and net energy expenditures of the dance conditions. A 2×3 analysis of variance (ANOVA) (gender, salsa condition) with repeated measures on one factor (salsa condition) was performed to assess differences in the physiological variables.

**RESULTS:** Significant differences were observed in ( $p<0.05$ ): % of maximum HR between TSL and SDN ( $58\pm5$  vs  $64\pm8\%$ , respectively) in males, and between RCL and SDN ( $62\pm6$  vs  $75\pm7\%$ , respectively) in females; predicted net % $\dot{V}O_{2max}$  value between TSL and the two other conditions ( $41.5\pm8$  vs  $50.6\pm6$ ; and vs  $50.1\pm11\%$  for TSL, RCL and SDN, respectively) in males, and between TSL and RCL ( $46.7\pm9$  vs  $55.8\pm10\%$ , respectively) in females; predicted net energy expenditure value between TSL and the two other conditions ( $237\pm114$  vs  $353\pm81$ ; and vs  $338\pm88$  kcal/h for TSL, RCL and SDN, respectively) in males, and between TSL and RCL ( $181\pm44$  vs  $234\pm67$  kcal/h, respectively) in females. No significant difference between males and females was observed for all variables.

**CONCLUSION:** Our results are in agreement with recommendations of the American College of Sport Medicine (ACSM) for health and fitness improvement. Therefore TSL, RCL and SDN could be useful to improve health and fitness conditions of amateur adult dancers.

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**2219 Board #107 May 28 3:30 PM - 5:00 PM****Training Volume, Supplemental Conditioning Practices And Injuries Of Competitive Irish Dancers**

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*(No relationships reported)*

Although Irish dance competitions have existed for over two centuries, little is known about either the training-conditioning practices of or the injuries sustained by competitors.

**PURPOSE:** This study determined the relationships among competition levels, specific dance training volume, supplemental training, and types of injuries of Irish dance competitors.

**METHODS:** Data on the aforementioned variables were obtained through an online survey sent to Irish dance academies around the globe. An ANOVA assessed significance of differences among dance competition category responses.

**RESULTS:** Respondents ( $n=351$ ) included male ( $n=23$ ) and female ( $n=328$ ) dance competitors with 75% of respondents in the two highest categories: Open Champion ( $n=168$ ) and Preliminary Champion ( $n=93$ ). Open and Preliminary Champions spent 10.3 and 7.7 hours on specific dance training per week ( $P<0.05$ ) while Prize Winner and Novice categories trained for 5.8 and 3.9 hours respectively (All comparisons  $P<0.05$  except Novice versus Prize Winner  $P=0.09$ ). Supplemental training was incorporated by 65% of Open champions compared to 55% for Preliminary, 45% for Prize Winner, and 44% for Novice participants ( $P<0.05$  except Novice versus Prize Winner). All categories had greater prevalence of injury for the ankle compared to the knee and hip ( $P<0.05$ ) with the Open Champion category having a higher overall prevalence of all injuries than the other three groups ( $P<0.05$ ).

**CONCLUSIONS:** Competition category was directly associated with higher specific dance and supplemental training volumes, and also with a greater prevalence of injury. Trauma to the ankle dominated the injury spectrum regardless of dancer category and this is likely related to the rigid nature of Irish dance movements and the forces imposed upon the distal lower extremity upon landing.

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**2220 Board #108 May 28 3:30 PM - 5:00 PM****Effects Of 16-wk Jajun Dance Program And Circuit Exercise Training In Improving Physical Fitness, Risk Factors Of Cardiovascular Diseases In Menopausal Women**

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*(No relationships reported)*

Previous studies have demonstrated that circuit exercise training (CET) could improve the risk factors of cardiovascular diseases in menopausal women. Jajun dance program (JDP) (Korean traditional dance) is enjoyable and designed to improve long-term adherence to training. However, little is still known whether JDP could improve health-related physical fitness and the risk factors of cardiovascular diseases.

**PURPOSE:** To investigate the physiological effects of Jajun dance program compared to CET in menopausal women.

**METHODS:** All subjects were divided into two groups: JDP group performed Jajun dance and CET group performed dumbbell, theraband, gymball exercise. Both groups participated in 16-week, 3days/wk supervised program consisting of 10 min warm up, 40 min exercise (exercise intensity corresponding to 50-60% HRmax, RPE 13-15), and 10 min cool down. Blood glucose levels (BG), systolic blood pressure (SBP), diastolic blood pressure (DBP), grip strength, balance, trunk extension, side step were measured.

**RESULTS:** with CET and JDP, FBG, SBP, and DBP were significantly decreased in both groups. Balance, strength, agility, flexibility were significantly improved in both groups after 16 weeks program.

**CONCLUSION:** This study suggests that Jajun dance is an effective exercise program as a mean to improve health-related physical fitness and the risk factors of cardiovascular diseases.

Variable	JDP (n = 13)		CET (n =12)	
	Pre	Post	Pre	Post

SBP (mmHg)	138.8 ± 6.8	130.1 ± 4.6*	127.8 ± 10.7	125.3 ± 13.2
DBP (mmHg)	90.5 ± 3.7	84.5 ± 4.6*	82.9 ± 9.3	79.9 ± 4.1
HRrest (b/min)	72.2 ± 9.6	74.3 ± 11.2	66.5 ± 22.4	63.0 ± 20.4
BG (mg/dl)	127.9 ± 20.8	113.5 ± 19.1	89.7 ± 27.6	88.9 ± 27.3
Grip strength (kg)	19.5 ± 3.9	23.9 ± 4.3*	25.0 ± 3.1	24.7 ± 3.4
Balance (s)	12.2 ± 10.4	18.5 ± 15.0*	10.1 ± 11.8	12.3 ± 7.6
Trunk extension (cm)	14.7 ± 3.6	19.6 ± 3.4*	16.7 ± 7.3	19.5 ± 8.6*
Side step (num/20 sec)	5.5 ± 0.7	8.5 ± 1.8*	25.4 ± 9.7	24.2 ± 8.0

Data were expressed as mean value ± standard deviation. \*significantly different from prevalue (P<0.05).

## 2221 Board #109 May 28 3:30 PM - 5:00 PM Physical Activity Assessment Using Different Accelerometer Epoch Lengths During A Low-intensity Ballroom Dance Class

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(No relationships reported)

Until recently accelerometry data has been commonly collected using 1-minute sampling intervals (epochs). However, 1-minute epochs may misclassify bouts of (in)activity when compared to more intermittent assessment (e.g. 2-second epochs).

**PURPOSE:** To evaluate variability in physical activity intensity levels using different epoch lengths during a low intensity community dance programme. **METHOD:** Subjects were 66, mostly senior, adults with a self-assessed status of being physically inactive, who participated in a 2-hour beginners ballroom dance class. During class, physical activity was measured using an Actigraph GT1M accelerometer, set at 2-second epochs. Later, activity counts were transformed into 4, 6, 10, 20, 30 and 60-second epochs. Time spent in sedentary, light and moderate-to-vigorous (MTV) activity was calculated, using adjusted intensity thresholds for each epoch based on counts per minute values of <200, 200-1952 and >1952, respectively.

**RESULTS:** Using 2-second epochs, participants spent 142 ± 9 mins, 32 ± 7 mins and 6 ± 3 mins of class time in sedentary, light and MTV physical activity, respectively. However, sedentary activity based on 4, 6, 10, 20, 30 and 60-second epochs underestimated totals by 5, 7, 10, 14, 17 and 20 mins, respectively. In contrast, time spent in light activity was overestimated by 5, 7, 10, 14, 18 and 22 mins when applying the same epoch periods. Considering MTV, time spent was underestimated by <1 min using 4, 6 and 10-second epochs, and by 1-2 mins using 20, 30 and 60-second epochs. All differences were statistically significant (p<0.01).

**CONCLUSION:** In this case, where a large proportion of time was spent in sedentary and low intensity activity, it is unlikely that the differences obtained for time spent in MTV activity using varying epoch lengths are of biological significance. However, during low intensity activity evaluation, more sensitive (short duration) epochs may provide more accurate estimations. Further research is required to investigate the effect of different epoch lengths when assessing activity changes over time.

## 2222 Board #110 May 28 3:30 PM - 5:00 PM Prevalence Of Musculoskeletal Disorders In Step Instructors

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(No relationships reported)

It is widely believed that Step Exercise Programs are a powerful form of workout that elicits a number of favorable responses contributing to a healthy life. Basically, the participants follow the instructor in a routine which involves stepping up and down on platforms of varying heights, at varying cadences, in order to achieve a sound workout. Although it appears relatively safe for participants, with respect to the magnitude of loading, Step instructors are exposed to a huge amount of work that could affect their professional lives.

**PURPOSE:** to assess the prevalence and the body areas affected by musculoskeletal disorders (MSDs) in Portuguese step instructors.

**METHODS:** An adapted version of the Nordic Questioners was applied to 200 Step instructors (mean age of 26 ± 8 years), randomly select from the two most important Portuguese Fitness Convention. Statistic analyses were conducted using SPSS.

**RESULTS:** 75% of the Step instructors are concerned about the impact of MSDs in their professional lives. Independently the gender, age and professional experience, the prevalence of MSDs was high (41%). The knee (44%), ankle (42%) and foot (31%) are the most affected body areas. In the last year, 28% Step instructors interrupted their professional activities, 44 % required medical care, and 40 % were inhibited to realize their own daily activities. 44% of the professionals also reported the need of changing some routines to avoid MSDs which was confirmed by the positive correlation between MSDs, medical care, injury severity and working incapacity.

**CONCLUSIONS:** The results showed a high prevalence of MSDs in Step instructors, with negative repercussions on their professional activity. Further research is needed to identify the real impact of the MSDs in fitness instructors, and to establish the optimal amount and combinations of exercise to reduce them.

## D-30 Free Communication/Poster - Immunology

MAY 28, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

## 2223 Board #111 May 28 3:30 PM - 5:00 PM Melanocortin 3 Receptor: A Novel Mediator Of Exercise-induced Inflammation

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Chronic exercise training significantly decreases inflammatory cytokines in individuals at rest and after an acute bout of exercise; however the mechanism by which resistance

training (RT) mediates reductions in inflammation has yet to be elucidated.

**PURPOSE:** Determine the effects of chronic RT on melanocortin 3 receptor (MC3R) mRNA expression in whole blood samples at rest and after an acute bout of resistance exercise (RE). Determine if MC3R mRNA expression correlates with increased sensitivity to inflammatory stimuli, assessed by tumor necrosis factor alpha (TNF $\alpha$ ).

**METHODS:** Obese (BMI  $32.7 \pm 3.7$ ), post-menopausal women aged  $65.6 \pm 2.8$  yrs were randomized to either a control (CN) or exercise (EX) group. EX performed progressive RT 3 days/week for 12 weeks at 80% of the subjects' estimated 1RM and included 3 sets of 10 exercises. Blood samples used for mRNA analysis were collected from CN and EX, before (PR) and after the intervention period (PO), and immediately following RE. Lipopolysaccharide (LPS)-stimulated TNF $\alpha$  from whole blood cultures was measured by ELISA and expressed per monocyte.

**RESULTS:** No change in body weight (BW) or fat percentage (FP) was found in either group. MC3R mRNA was upregulated 11-fold ( $p > 0.05$ ) in response to RT in obese women. RT MC3R mRNA increased in EX to a higher degree (13-fold increase,  $p > 0.05$ ) in comparison to CN (10-fold increase,  $p > 0.05$ ). LPS-stimulated TNF $\alpha$  concentrations did not change in response to RT in EX ( $29 \pm 3$  vs.  $43 \pm 7$  fg/monocyte,  $p > 0.05$ ) nor CN ( $32 \pm 6$  vs.  $39 \pm 3$  fg/monocyte,  $p > 0.05$ ). RE elicited no change in LPS-stimulated TNF $\alpha$  ( $43 \pm 7$  vs.  $40 \pm 7$  fg/monocyte,  $p > 0.05$ ) whereas CN exhibited a slight increase ( $39 \pm 3$  vs.  $48 \pm 6$  fg/monocyte,  $p > 0.05$ ).

**CONCLUSIONS:** Chronic RT increases MC3R in whole blood and may improve sensitivity of immune cells to inflammatory stimuli independent of changes in BW or FP.

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**2224 Board #112 May 28 3:30 PM - 5:00 PM**  
**Exercise Training Does Not Influence Cd8+ Phenotype Or Mitogen-activated Tnf- $\alpha$  Production In Previously Inactive Elderly.**

Kyle L. Timmerman<sup>1</sup>, Michael G. Flynn, FACSM<sup>2</sup>, Paul M. Coen<sup>3</sup>, Melissa M. Markofski<sup>2</sup>, Brandt D. Pence<sup>4</sup>. <sup>1</sup>University of Texas Medical Branch, Galveston, TX. <sup>2</sup>Purdue University, West Lafayette, IN. <sup>3</sup>University of Pittsburgh, Pittsburgh, PA. <sup>4</sup>University of Illinois, Champaign, IL.  
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(No relationships reported)

Aging is characterized by a gradual decline in circulating naïve (CD28+CD8+) T-cells and an increase in effector/cytotoxic (CD28-CD8+) T-cells. A consequence of this shift is increased inflammation. CD28-CD8+ T-cells promote an inflammatory environment, as evidenced by their increased production of inflammatory cytokines (i.e. TNF- $\alpha$ ) compared to naïve CD+ T-cells. While exercise has been shown to exert anti-inflammatory properties, little is known about the influence of exercise training on CD8+ T-cells.

**PURPOSE:** To examine the influence of 12 weeks of combined endurance and resistance exercise training on CD8+T-cell phenotype and function in elderly adults.

**METHODS:** On the basis of their physical activity pattern, male and female subjects, 65-80 yrs. old, were assigned to either a physically active (PA, N=15) or inactive (PI, N=15) group. The PI group performed 12 weeks (3d/wk) of endurance (20 min. @ 70-80% heart rate reserve) and resistance exercise training (8 exercises, 2 sets @ 70-80% of 1 repetition maximum). Subjects in the PA group maintained their habitual activity level. Flow cytometry was used to determine CD8+ subsets and mitogen-stimulated TNF- $\alpha$  production.

**RESULTS:** There was no effect of training on any of the variables measured. However, there were significant group effects with PA subjects showing a significantly lower percentage of CD8+ T-cells expressing TNF- $\alpha$  and lower TNF- $\alpha$  mean fluorescence intensity on memory and cytotoxic CD8+ T-cells than PI subjects.

**CONCLUSION:** Twelve weeks of exercise training had no influence on CD8+ T-cell phenotype or TNF- $\alpha$  production in PI subjects. However, PA subjects had lower TNF- $\alpha$  expression on CD28-CD8+ T-cells, providing limited evidence that a history of physical activity may attenuate inflammation in CD8+ T-cells from healthy, elderly adults.

Supported by an AARP Research Scholars Award.

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**2225 Board #113 May 28 3:30 PM - 5:00 PM**  
**An Examination of Immunoendocrine and Oxidative Responses Utilizing a Dual Stress Model**

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Oxidative stress has been implicated as a critical contributor to the pathogenesis of cardiovascular disease. Additionally, catecholamine increases and inflammation are related to increases in oxidative stress. Although, physical and psychological stress elicit elevations in catecholamine release and inflammation, there are no studies examining the combined impact of physical and mental challenge on catecholamine, inflammation, and oxidative stress.

**PURPOSE:** The purpose of this study was to examine the catecholamine (epinephrine [EPI] and norepinephrine [NE]), interleukin-2 (IL-2) and 8-isoprostane responses to a dual stress model (combined physical and mental challenge). To elucidate possible mechanisms, relationships among EPI, NE, IL-2, and 8-isoprostane were also examined.

**METHODS:** Seven participants ( $\text{VO}_{2\text{max}} = 45.13 \pm 7.70$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) completed two experimental conditions. The exercise-alone condition (EAC) consisted of cycling at 60%  $\text{VO}_{2\text{max}}$  for 37 minutes, while the dual-stress condition (DSC) included 20 minutes of a mental challenge while cycling.

**RESULTS:** DSC showed greater EPI and 8-isoprostane levels (significant condition by time interaction). In addition, NE and IL-2 revealed significant increases over time in both conditions. EPI area-under-the-curve (AUC) was positively correlated with NE AUC and IL-2 AUC ( $r = 0.805$  and  $r = 0.674$ ,  $p < 0.01$ , respectively). Additionally, NE AUC was positively correlated with IL-2 AUC and peak 8-isoprostane ( $r = 0.575$  and  $r = 0.554$ ,  $p < 0.05$ , respectively). Finally, peak IL-2 was positively correlated with peak 8-isoprostane ( $r = 0.577$ ,  $p < 0.05$ ).

**CONCLUSION:** These results suggest that elevations in catecholamines, IL-2 and oxidative stress in response to physical and mental challenge, may contribute to the pathogenesis of cardiovascular disease. Furthermore, the elevations in NE and IL-2 may explain the elevated oxidative stress during dual stress. Cautious interpretation and further investigation are warranted to understand these results in the context of cardiovascular disease and stress.

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**2226 Board #114 May 28 3:30 PM - 5:00 PM**  
**The Influence Of Prolonged Cycling On Monocyte Toll-like Receptor 2 And 4 Expression In Healthy Men**

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(No relationships reported)

Several studies have reported that some immune cell functions including monocyte Toll-like receptor (TLR) expression and antigen presentation are temporarily impaired following acute bouts of strenuous exercise, which could represent an 'open window' to upper respiratory tract infection (URTI). However, reduced levels of TLR expression over the long term may be beneficial to health due to associated reductions in chronic inflammation, and consequently reducing the risk of developing chronic diseases. To date, there has been little research on the effects of acute and chronic exercise on human monocyte TLR expression.

**PURPOSE:** The purpose of this study was to examine the effects of 1.5 h cycling at 75%  $\text{VO}_{2\text{peak}}$  on human monocyte TLR2 and TLR4 expression.

**METHODS:** Nine healthy endurance trained males (age  $25 \pm 5$  years; body mass  $76.8 \pm 8.1$  kg;  $\text{VO}_{2\text{peak}} = 58.5 \pm 5.6$  ml·kg<sup>-1</sup>·min<sup>-1</sup>, mean  $\pm$  s) had PRE (rest), POST, 1H POST, 4H POST and 24H POST exercise blood samples collected and analysed using four colour flow cytometry. Friedman's ANOVA was used to analyse data that were not normally



distributed and ANOVA with repeated measures was used for other data.

**RESULTS:** Although there was an increase in the total monocyte cell count at POST, 1H POST and 4H POST ( $P < 0.01$ ), exercise reduced monocyte TLR4 expression (geometric mean fluorescence intensity, corrected for non-specific binding using an appropriate isotype control) by 30% at POST and 31% at 1H POST exercise compared with PRE values ( $X^2(4) = 9.511$ ,  $P < 0.05$ ). Values had returned to normal at 4H POST exercise. There were no statistically significant changes in TLR2 expression after exercise ( $X^2(4) = 4.178$ ,  $P = 0.402$ ).

**CONCLUSIONS:** This study showed that prolonged cycling at 75%  $\text{VO}_{2\text{peak}}$  reduces TLR4 expression, which may in part be responsible for post-exercise immunodepression but also for the anti-inflammatory effect of exercise.

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**2227 Board #115 May 28 3:30 PM - 5:00 PM**

**Is The Inflammatory Responses During And After 7-day Marathon A Good Model For Sepsis Mechanism?**

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(No relationships reported)

Purposes: To evaluate changes of the immune system in athletes during and after 7- day marathon and to correlate these changes with mechanism of clinical sepsis.

**METHODS:** The subjects were nine healthy athletes (5 males and 4 females, age 52.4±2.5 yr; means±SEM) in 7-day race of the 2008 Athens ultra-marathon festival. Blood samples were collected before, during and after the competition. The concentrations of plasma cortisol, neutrophil degranulation (total elastase release), and total white blood cell (WBC) and differential WBC counts including lymphocytes, neutrophils and monocytes were measured.

**RESULTS:** (1) Comparing to pre-race, total WBC counts, lymphocyte counts and monocyte counts of subjects significantly decreased (-6.7%~-33.6%, -61.7%~-72.7%, -3.1%~-63% respectively,  $P < 0.05$ ) during the race. Contrarily, neutrophil counts, total elastase release and the concentration of plasma cortisol significantly increased (-3.1%~-43.5%, 21.7%~-119.8%, 288.3%~-387.3% respectively,  $P < 0.05$ ) (2) Total WBC counts, neutrophil counts and total elastase release during the race were less than post-race ( $P < 0.05$ ) while lymphocyte counts slightly recovered after the race. (3) Total WBC counts, neutrophil counts, lymphocyte counts and monocyte counts during post-race were less than pre-race ( $P < 0.05$ ) while the concentration of plasma cortisol was still higher than pre-race concentration ( $P < 0.05$ ).

**CONCLUSIONS:** The main findings of this study were (1) acute inflammatory response in runners occurred in the first day of 7-day race, including increased neutrophil counts and total elastase release, which may be due to heavy stress of ultra-marathon; (2) immunosuppression induced by prolong exercise and presented as the decrement of total and differential white blood cell counts, may not fully recover during 2 days post-race; (3) the inflammatory responses pattern of the immune system in the 7-day marathon runners is similar to the developing of sepsis.

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**2228 Board #116 May 28 3:30 PM - 5:00 PM**

**Effects Of Prolonged And Brisk Exercise On Apoptosis**

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Exercise is a well-known stress factor and is able to induce an inflammatory-like status and also activates immune system. Apoptosis or programmed cell death is an important mechanism for the regulation of the immune system. Apoptosis is the immune system's major mechanism to maintain immune's system homeostasis.

**PURPOSE:** We sought investigate the effects of prolonged and brisk exercise on circulating proinflammatory cytokines and the soluble apoptosis mediators Fas (sFas) and Fas ligand (sFasL) in ultramarathon runners.

**METHODS:** In 20 male athletes participating in the ultradistance foot race of the 246 Km "Spartathlon" (continuous, prolonged, brisk exercise for up to 36 hours), we measured circulating concentrations of IL-6 using a validated Elisa kit (Quantikine; R&D Systems, Minneapolis, MN) and we determined sFas and sFasL using the multiplex assay kit Linco Human Sepsis/Apoptosis. Free plasma DNA was measured by quantitative real-time PCR using the LightCycle (Roche diagnostics, Mannheim, Germany). All the measurements were performed in samples collected before the race, at the end of the race and 48h post-race.

**RESULTS:** The mean values for IL-6 before the race (phase I) were  $0.9 \pm 0.5$  pg/ml, immediately after the race (phase II) were  $7781.0 \pm 8317.3$  pg/ml, and 48h after the race (phase III) were returned at pre-exercise levels ( $0.7 \pm 0.5$  pg/ml). DNA damage was significantly increased at phase I from  $14.8 \pm 13.9$  genome equivalents/ml to  $146.2 \pm 161.5$  genome equivalents/ml at phase II and was significantly decreased to  $51.5 \pm 73.2$  genome equivalents/ml at phase III. Lastly, apoptosis was observed to remain steady as sFas and sFas ligand were  $2.16 \pm 0.61$  ng/ml and  $0.13 \pm 0.02$  ng/ml, respectively at phase I,  $1.96 \pm 0.53$  ng/ml and  $0.12 \pm 0.02$  ng/ml, respectively at phase II and  $2.32 \pm 57$  ng/ml and  $0.13 \pm 0.02$  ng/ml, respectively at phase III.

**CONCLUSION:** Prolonged and strenuous exercise seems to induce a significant inflammatory response, which in turn induces DNA damage in cells, probably via oxidative stress's increase. However, it is observed that in well trained athletes apoptosis is not being altered because of the development of counterbalancing mechanisms.

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**2229 Board #117 May 28 3:30 PM - 5:00 PM**

**Exercise Increases Regulatory T Cell Suppression And Surface Expression In A Mouse Model Of Asthma**

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(No relationships reported)

In a mouse model of induced asthma, our lab has previously demonstrated that moderate exercise significantly reduces airway hypersensitivity (AHR) and inflammation, thereby reducing asthma severity. We hypothesized that at least some of these changes may be due in part to regulatory T cells (Tregs), a small population of T cells that have been shown to suppress inflammation and AHR in a number of disease states.

**PURPOSE:** To determine if Tregs from exercise-trained mice differ in suppression and surface expression from Tregs in sedentary mouse in an asthmatic state.

**METHODS:** Female Balb/c mice were induced into an asthmatic state (two intraperitoneal injections with ovalbumin (OVA) at days 0 and 14, followed by 5d of nebulization with OVA). OVA nebulization (10min) was administered 1h prior to exercise training (45min, 3d/wk, at 60-70% of  $\text{VO}_{2\text{max}}$  for a total of 10 bouts). Mice were sacrificed 24hr after the last exercise bout. Tissues (spleen, mediastinal lymph node (MLN), and lung) were stained for CD4+CD25+ surface expression as well as Foxp3, a marker for Tregs and analyzed via flow cytometry. Tregs were isolated from splenocytes using magnetic separation and cultured in order to measure proliferation and suppression.

**RESULTS:** Tregs from exercised mice were found to suppress effector cells at a significantly higher rate when compared with Tregs from sedentary mice ( $p < 0.05$ ). Surface expression, as assessed by CD4+CD25+ as well as Foxp3, the best-known marker for Tregs, was higher in exercised asthmatic mice when compared with sedentary asthmatic mice.

**CONCLUSION:** Exercise increases Treg surface expression on primary and secondary lymphoid organs, and Tregs from exercised mice are able to suppress significantly better than Tregs from sedentary mice.

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**2230 Board #118 May 28 3:30 PM - 5:00 PM**

**Aerobic Exercise Does Not Improve Delayed-type Hypersensitivity To Tetanus Or Candida In Older Adults**

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(No relationships reported)

Delayed-type hypersensitivity (DTH) tests the ability of an individual to mount a memory T cell-dependent response against an antigen to which that individual has been previously exposed. DTH response is elicited by intradermal injection of an antigen or vaccine, and the size of the response indicates the ability of the individual's immune system to respond to the specific challenge.

**PURPOSE:** To examine the effect of a 10 mo cardiovascular exercise intervention (CARDIO) on DTH response to tetanus and candida. We hypothesized that CARDIO would increase both the number of positive responders and strength of DTH response when compared to flexibility (FLEX) controls.

**METHODS:** 137 sedentary older adults (age  $70 \pm 0.45$  yr) were randomized to CARDIO (n=69) or FLEX (n=68) groups. There were no significant group differences in fitness or body composition pre-intervention. CARDIO underwent supervised exercise 3x/wk at 65-70%  $\text{VO}_{2\text{max}}$ . FLEX underwent non-cardiovascular exercise 2x/wk. Candida DTH response for all subjects was assessed at baseline and post-intervention. Tetanus DTH response was assessed in 91 subjects (45 CARDIO, 46 FLEX) at baseline and post-intervention. Induration >5mm was considered positive response.

**RESULTS:** A 10 month CARDIO intervention improved fitness compared to FLEX. There were no between-group differences in either the percentage of responders (32 CARDIO vs. 28 FLEX,  $\chi^2=.376$ ,  $P=.540$ ) or strength of response ( $9.68 \pm 0.71$  vs.  $10.54 \pm 0.82$  mm,  $P=.430$ ) for candida DTH after intervention. There were no between-group differences in either the percentage of responders (8 CARDIO vs. 6 FLEX,  $\chi^2=.392$ ,  $P=.531$ ) or strength of response ( $7.88 \pm 0.88$  vs.  $8.83 \pm 1.49$  mm,  $P=.569$ ) for tetanus DTH after intervention. DTH responses were not different at baseline and did not correlate at either time point with any fitness measures.

**CONCLUSION:** Long-term aerobic exercise does not improve memory T cell-dependent DTH responses to common skin test antigens in older men and women when compared to non-exercising controls.

Supported by R01-AG18861 to JW.

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**2231 Board #119 May 28 3:30 PM - 5:00 PM**

**Voluntary Wheel Running Does Not Attenuate Lps Induced Sickness Behavior In Cd-1 Mice.**

Stephen A. Martin, Sara A. Dumich, Jason C. O'Connor, Brandt D. Pence, Keith W. Kelley, Robert Dantzer, Jeffrey A. Woods, FACSM. *University of Illinois, Urbana-Champaign, Urbana, IL.*

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(No relationships reported)

**INTRODUCTION:** Peripheral inflammation induces acute sickness behavior and depressive-like behavior in mice via centrally mediated proinflammatory cytokine induction. Studies have demonstrated that moderate intensity exercise decreases inflammation and improves mood status.

**PURPOSE:** To examine the effect of voluntary wheel running on inflammation induced sickness behavior. We hypothesized that mice with access to running wheels would have an attenuated sickness response to peripheral inflammation compared to mice in an enriched cage setting and mice in a standard cage.

**METHODS:** 48 mice were randomized into three different housing situations: wheel access (WHL n=16), locked wheel (LWHL n=16), and standard shoebox cages (CON n=16). The study duration was 21 days, and all mice were provided standard chow and water *ad libitum*. Wheel running activity was monitored using VitalView Acquisition Software. At day 21, mice were injected with .083 mg/kg LPS or Saline. 24hr post LPS injection, acute sickness behavior and depressive like behavior were quantified via locomotor activity, forced swim test, and tail suspension test.

**RESULTS:** There was no interaction between housing conditions (WHL, LWHL, CON) and treatment (LPS/Saline) for acute sickness behavior as measured by locomotor activity. There was a main effect for treatment ( $p=.000$ ), as the LPS treated mice displayed increased acute sickness behavior (decreased locomotor activity) 24 hour post-injection. Results were similar for the forced swim test and tail suspension test, two measures of depressive-like behavior. There was no interaction between housing condition and treatment, but a main effect for treatment ( $p=.008$  and  $p=.002$ ; FST and TST), with LPS treated mice displaying higher levels of depressive like behavior.

**CONCLUSIONS:** Three weeks of voluntary wheel running or cage enrichment does not attenuate LPS induced sickness and depressive like behavior in CD-1 mice. Further studies are underway utilizing more sensitive measures to elucidate an interaction between housing condition and LPS induced sickness recovery kinetics.

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**2232 Board #120 May 28 3:30 PM - 5:00 PM**

**Effects Of Eccentric Exercise On The Antibody Response To A Highly Immunogenic Influenza Vaccine**

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(No relationships reported)

It has been demonstrated that an acute bout of exercise prior to vaccination can improve the subsequent immune response. However, the mechanisms underpinning this adjuvant effect remain unknown, and further investigation to determine the optimal exercise protocol is warranted.

**PURPOSE:** To determine whether the timing of eccentric arm exercise prior to vaccination influences the magnitude of the adjuvant effect on the antibody response to influenza vaccine.

**METHODS:** 155 healthy participants (75 males, 80 females) were randomly assigned to a control group or one of three groups exercising immediately, 6 hours or 48 hours prior to influenza vaccination. The exercise groups performed eccentric arm exercise of the deltoid and biceps brachii muscles for approximately 20 minutes, at an intensity eliciting 85% of each participants' one repetition maximum. Serum antibody titres were measured at baseline and at 28 days post-vaccination. Plasma creatine kinase (CK) and interleukin-6 (IL-6) were measured at baseline and at the time of vaccination.

**RESULTS:** Analyses of variance indicated that the exercise groups exhibited significant increases in bicep ( $p < .001$ ) and forearm ( $p < .001$ ) circumference, self-reported arm pain ( $p < .001$ ), and plasma markers of muscle damage (CK;  $p < .05$ ) and inflammation (IL-6;  $p < .05$ ). However, there were no significant differences between groups in the antibody responses to the A/Wisconsin, A/Solomon or B/Malaysia viral strains of influenza (all  $p > .05$ ). Comparatively, all strains induced larger antibody responses than those exhibited by antigens in previous exercise and vaccination studies.

**CONCLUSION:** Eccentric arm exercise did not improve the antibody response to influenza vaccination. It is possible that the relative magnitude of the antibody response produced by each strain superseded any potential effect of exercise. This explanation is consistent with previous research which indicates that exercise may have a beneficial effect when the antigen has a lower immunogenic response. Future research should investigate the effect of exercise on the immune response to vaccines with lower immunogenicity.

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2233 Board #121 May 28 3:30 PM - 5:00 PM

**Aerobic Exercise Training May Not Offset The Pro-Inflammatory Effects Of High Fat Feeding In Mice**

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(No relationships reported)

Increased adiposity is associated with an increase in systemic inflammation, which is involved in the pathophysiology of various disease states. A current hypothesis in our laboratory suggests that the toll-like receptor 4 (TLR4) pathway may link physical activity and systemic inflammation.

**PURPOSE:** The primary purpose was to determine if 6-weeks of aerobic exercise training (5 days per week, 1 hour per day. 21-22m/min) would limit the increase in systemic inflammation resulting from high-fat (60% of calories from fat) feeding. A secondary purpose was to determine if changes in cell-surface TLR4 expression would account for observed differences in inflammatory status between mice which exercise and those that remain sedentary.

**METHODS:** 36 CD-1 male mice were randomly assigned to one of three groups (N=12/group): HF (remained sedentary and consumed a high-fat chow (60% fat)), HF-EX (consumed the high-fat chow and underwent an aerobic exercise intervention (running 4.56±0.08 h/week for 6 weeks, or LF (sedentary and consumed a low-fat chow (10% fat)). Key outcome measurements were made on weekly saphenous vein blood samples (~40 uL) using 3-color flow cytometry. Blood glucose and cholesterol concentration were analyzed by an enzymatic assay.

**RESULTS:** Absolute and percent body weight gain over 6-weeks was similar between HF and HF-EX, but significantly greater than LF (P<0.001). HF and HF-EX had 66% more leukocytes than LF at weeks 3-5 (P<0.0001). HF and HF-EX had 145% greater CD11b+/14+/TLR4+ cells than LF (P=0.001). There was no difference in the concentration of CD11b+ cells expressing IL-6 or TNF-alpha following LPS-stimulation between HF and HF-EX. No significant difference was found for blood glucose and cholesterol concentrations between groups.

**CONCLUSIONS:** Exercise training did not prevent weight gain during 6-weeks of high fat feeding. Since HF and HF+EX gained a similar amount of weight, they did not differ with regarding to blood monocytes expressing TLR4. Both HF and HF+EX were elevated above LF. More research is needed to determine how changes in the blood relate to changes in peripheral tissue compartments.

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2234 Board #122 May 28 3:30 PM - 5:00 PM

**A Greater Vo2max Is Associated With A Reduced Frequency Of Senescent Blood T-cells In Middle-aged But Not Younger Men**

Guillaume Spielmann<sup>1</sup>, Brian K. McFarlin<sup>1</sup>, Cormac Cosgrove<sup>2</sup>, Keith Guy<sup>2</sup>, Paula JW Smith<sup>2</sup>, Richard J. Simpson<sup>1</sup>. <sup>1</sup>*University of Houston, Houston, TX.* <sup>2</sup>*Napier University, Edinburgh, United Kingdom.*

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The clonal expansion of T-lymphocytes in response to an antigenic stimulus is an essential process of adaptive immunity. Chromosome telomeres become progressively eroded with each round of cell division, eventually leading to replicative senescence. T-lymphocytes with a senescent phenotype are known to accumulate with age, increasing infection risk in middle-aged and elderly individuals. A sedentary lifestyle is associated with shortened telomeres in peripheral blood leukocytes, but the influence of regular exercise on the frequency of T-cells with a senescent phenotype in young and older adults is not known.

**PURPOSE:** To examine the impact of estimated VO2max on the frequency of senescent blood T-cells in young and middle-aged men.

**METHODS:** Twenty young (Y; age: 23.4 ± 3; BMI: 24.6 ± 3) and 20 middle-aged (O; age: 54 ± 3.6; BMI: 26.4 ± 3.4) healthy males provided a fasted resting blood sample, completed an assessment of percentage body fat and a physical activity status questionnaire designed to estimate VO2max. Y and O subjects were then divided into Hi and Lo VO2max groups (VO2max; Y: 51.2 ± 4.4 vs 42.6 ± 2.2 ml·kg<sup>-1</sup>·min<sup>-1</sup>; O: 38.7 ± 3.3 vs 29.5 ± 1.3 ml·kg<sup>-1</sup>·min<sup>-1</sup>) with n=10 in each group. Isolated lymphocytes were assessed for cell surface expression of senescence (KLRG1+, CD28-, CD57+), naïve (CD45RA+) and memory (CD45RO+) T-cell markers on CD3+ T-cells, CD4+ T-cells and CD8+ T-cells using four-colour flow cytometry. Differences in T-cell phenotype among the 4-groups was analysed by one-way ANOVA.

**RESULTS:** O had a greater proportion of KLRG1+, CD57+, CD28, KLRG1+/CD57+ and CD45RA-/CD45RO+ CD8+ T-cells than Y, regardless of estimated VO2max. No differences in senescent phenotypes were found between the Hi and Lo VO2max groups in Y. In contrast, the Hi VO2max group in O had a significantly lower frequency of CD4+ and CD8+ T-cells expressing KLRG1+ (CD4: 58%; CD8: 23% less), CD57+ (CD4: 71%; CD8: 20% less), CD28- (CD4: 91%; CD8: 24% less), KLRG1+/CD57+ (CD4: 89%; CD8: 26% less) and CD45RA-/CD45RO+ (CD4: 20% less), in comparison to the Lo VO2max group in O.

**CONCLUSION:** A higher estimated VO2max is associated with a lowered frequency of senescent and memory CD4+ and CD8+ T-cells in middle-aged but not younger men. These findings highlight the beneficial effects of regular physical activity on cellular immunity during ageing.

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2235 Board #123 May 28 3:30 PM - 5:00 PM

**Exercise-induced T-cell Activation In Human Subjects Is Affected By The Mobilization Of Klrp1+ T-lymphocytes Into The Peripheral Blood**

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**PURPOSE:** Acute exercise alters the activation status of blood T-cells, evident by changes in the cell surface expression of the early T-cell activation marker CD69. The killer cell lectin-like receptor G1 (KLRG1) is expressed on antigen-experienced T-cells which are unable to clonally expand in response to an antigenic stimulus but are capable of immediate effector functions such as recognizing and killing virally infected cells. T-cells expressing KLRG1 are preferentially mobilized into the peripheral blood in response to acute exercise, which could affect the overall activation status of blood T-cells.

**METHODS:** Ten trained males (age: 24.6 ± 4.8; height: 183.1 ± 6.7cm; mass: 72.8 ± 7.9kg; VO2max; 61.3 ± 5.9 ml·kg<sup>-1</sup>·min<sup>-1</sup>) ran at 80% VO2max until exhaustion (time: 36.1 ± 5.8 minutes). Using monoclonal antibodies and 4-colour flow cytometry, blood lymphocytes isolated before (PRE), immediately after (POST) and 1 hour after (1H) exercise were analyzed for KLRG1 and CD69 co-expression on CD3+/CD4+ and CD3+/CD8+ T-lymphocytes in response to the exercise challenge and after 4h stimulation in culture at 37°C with and without the mitogen PMA.

**RESULTS:** The proportions of KLRG1+ cells among total CD4+ and CD8+ T-cells increased by 17% and 25.2% respectively at POST, with CD8+ T-cells falling below PRE values at 1H. CD69 expression on CD4+ and CD8+ T-cells was unaffected by cell culture or the exercise challenge. When stimulated with PMA, the expression of CD69 at POST increased by 16.7% on CD4+, but decreased by 6.9% on CD8+ T-cells. KLRG1+ cells expressed higher levels of CD69 than KLRG1- cells in both CD4+ and CD8+ T-cells for all stimulated samples. CD69 expression was unaltered by coe on either KLRG1+ or KLRG1-/CD4+ T-cells. In contrast, CD69 expression fell by 11.7% on KLRG1+/CD8+ T-cells POST. No changes in CD69 expression were found on CD4+ or CD8+ T-cells at 1H.

**CONCLUSION:** The increased activation of CD4+ T-cells after exercise might be due to a greater proportion of KLRG1+ cells in blood with a heightened state of activation. In contrast, exercise appears to inhibit the ability of KLRG1+ but not KLRG1- CD8+ T-cells to become activated. As KLRG1+ T-cells are incapable of proliferation, the possibility

that exercise impacts on their effector capabilities remains to be determined.

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**2236 Board #124 May 28 3:30 PM - 5:00 PM**

**The Effects Of A Natural Anti-inflammatory Product On Systemic Markers Of Inflammation Following Downhill Running**

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( E.M. PETERS, Financial Support For Expenses Was Provided By Heel Pty South Africa. The Investigational Medicinal Products (Including Placebo) Were Provide By Heel GmbH Germany Without Charge., Ownership Interest.)

Traumeel, a natural anti-inflammatory preparation, is commonly used by athletes to reduce inflammatory response to exercise-induced muscle cell damage.

**PURPOSE:** To establish whether Traumeel, taken during five days before and three days following participation, attenuates exercise-induced systemic markers of the inflammatory response.

**METHODS:** After baseline laboratory and field testing, 24 healthy athletes (14 men and 10 women) were matched according to gender, BMI, training age and status, peak performance and foot strike patterns and randomised into Traumeel (TRS) and control (PLAC) groups in a placebo-controlled, double-blind design. One TRS or PLAC tablet was ingested 3 x per day for five days prior to and three days following a 90-minute exercise trial on a downhill (-6% gradient) at 75% VO<sub>2</sub> max. Blood samples were collected prior to the 90-minute trial, immediately after the trial and 24 hours (24 PE), 48 hours and 72 hours following the trial. They were analysed for full blood count (FBC), serum creatine kinase (CK), lactate dehydrogenase (LDH), cortisol, C- reactive protein (CRP) and myeloperoxidase (MPO) and plasma interleukin (IL) -6, -8, -10 and -12p70 concentrations. Daily records of training and symptoms of delayed onset muscle soreness (DOMS) were kept during the trial period.

**RESULTS:** The 90-minute downhill running protocol resulted in significant elevations in mean circulating leukocyte, neutrophil, CK, LDH, cortisol, CPR, MPO, IL-6, IL-8 and IL-10 concentrations following both laboratory trials ( $p < 0.001$ ). When comparing the TRS and PLAC groups, mean  $\pm$  SD total and differential leukocyte count, CK, LDH, cortisol, CPR, MPO, cytokine concentrations did not differ ( $p > 0.05$ ) over the five time points. At 24 PE, MPO concentrations were significantly higher ( $p = 0.04$ ) in the TRS group ( $227.3 \pm 130.7$  ng/ml) than in the PLAC group ( $137.2 \pm 71.9$  ng/ml), while the severity of DOMS was lower in the TRS group throughout the three-day post-trial period.

**CONCLUSIONS:** The elevated MPO concentration at 24 PE provide preliminary novel evidence of enhanced activation of neutrophil oxidative burst activity following exercise-induced muscle damage which is hypothesized to accelerate the recovery process.

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**D-31 Free Communication/Poster - Minerals and Vitamins**

MAY 28, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**2237 Board #125 May 28 3:30 PM - 5:00 PM**

**The Effectiveness Of Iron Supplementation In Endurance Trained Females During The Week Of Menses**

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(No relationships reported)

Decreased work capacity due to iron deficiency anemia has been well documented. Athletes (particularly endurance trained) who train six or more hours per week are at a greater risk of developing an iron deficiency. Menstruating women carry an increased risk for iron deficiency regardless of training status due to monthly blood loss.

**PURPOSE:** The purpose of this study was to examine the effect of one week of iron supplementation during the week of menses on serum ferritin (SF) and serum soluble transferrin receptor (sTfR) values, heart rate recovery (HRR), blood lactate (BLAC) values, predicted VO<sub>2</sub>max (VO<sub>2</sub>max), and exercise time to reach 85% of predicated max heart rate (EXTIME).

**METHODS:** Fifteen pre-menopausal endurance trained females were randomly assigned to either an iron (FE) or placebo (PL) group. The FE group took a ferrous sulfate supplement (65mg of elemental iron) once a day for seven days during menses. Each group completed two testing sessions (baseline and menses) on a cycle ergometer to reach 85% of predicted max heart rate. Blood was taken at baseline and menses testing sessions and analyzed for BLAC, SF, and sTfR. The maximum workload achieved, time to end of trial, and HRR (within 10BPM of pre-exercise heart rate) was recorded for each participant during both trials.

**RESULTS:** There were no significant differences in sTfR and SF values between FE and PL groups for baseline, menses, or supplementation. HRR was significantly ( $p = 0.033$ ) faster in the FE group during menses testing sessions than the PL group ( $4.5 \pm 2$ ,  $8.6 \pm 6.5$  mins respectively). There was no significant difference among participants' predicted VO<sub>2</sub>max at baseline or during menses testing sessions. EXTIME was not statistically different between the iron and placebo group for baseline, menses, or supplementation effect, respectively ( $P > 0.05$ ). Pre and post exercise BLAC levels were not significantly different between iron and placebo groups for baseline, menses, or supplementation effect.

**CONCLUSION:** The significant supplementation effect on heart rate recovery in conjunction with trends observed in VO<sub>2</sub>, EXTIME, and BLAC levels are compelling. Findings illustrate one week of iron supplementation during the week of menses enhanced HRR in this sample of participants.

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**2238 Board #126 May 28 3:30 PM - 5:00 PM**

**Iron Supplementation Is Associated With Aerobic Performance In Iron-deficient Female Soldiers**

J. Philip Karl<sup>1</sup>, Harris B. Lieberman<sup>1</sup>, Sonya J. Cable<sup>2</sup>, Kelly W. Williams<sup>2</sup>, Andrew J. Young, FACSM<sup>1</sup>, James P. McClung<sup>1</sup>. <sup>1</sup>US Army Research Institute of Environmental Medicine, Natick, MA. <sup>2</sup>Directorate of Basic Combat Training, Ft Jackson, SC.

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(No relationships reported)

Iron deficiency is associated with reduced aerobic performance, and may impair the adaptive response to aerobic training. Furthermore, diminished iron status observed during basic combat training (BCT) is associated with reduced aerobic performance in female Soldiers. The effect of iron supplementation on aerobic performance during BCT is unknown.

**PURPOSE:** To determine the impact of iron supplementation during BCT on aerobic performance in female Soldiers.

**METHODS:** Utilizing a randomized, double-blind, placebo-controlled design, female Soldiers ( $n = 153$ ) were provided with pills containing either 100 mg ferrous sulfate (IRON) or placebo (PLACEBO) daily during a 9-week BCT course. Iron status indicators including red cell distribution width (RDW), serum ferritin (SF), and transferrin saturation (TS) were measured immediately prior to and following BCT. Iron deficiency was defined as presentation with two or more of the following: RDW  $> 15.0\%$ , TS  $< 16.0\%$ , SF  $< 12.0$  ng mL<sup>-1</sup>. Two-mile run time (RT) was assessed following BCT. Student's t-tests were used to compare RT between groups.

**RESULTS:** Fifty-seven (37%) Soldiers began BCT iron deficient. Within this cohort, IRON-treated Soldiers demonstrated faster RT following training than those receiving

PLACEBO (mean  $\pm$  SD); 1068  $\pm$  100 sec vs. 1154  $\pm$  100 sec,  $p < 0.01$ ). No between groups differences for RT were observed in Soldiers beginning BCT with normal iron status (1086  $\pm$  87 sec vs. 1057  $\pm$  72 sec,  $p > 0.05$ ) or overall (1080  $\pm$  92 sec vs. 1095  $\pm$  98 sec,  $p > 0.05$ ).

**CONCLUSIONS:** These data suggest that daily iron supplementation (16 mg·day<sup>-1</sup> elemental iron) may benefit aerobic performance in iron-deficient Soldiers. Future studies should focus on optimizing diet for preventing and treating iron deficiency in female Soldiers during military training. Research funded by MRMCM.

**2239 Board #127 May 28 3:30 PM - 5:00 PM**

### Effect Of Calcium Supplementation On Body Composition And Total Energy Expenditure During Sub Maximal Exercise.

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(No relationships reported)

Epidemiological data suggest a positive relationship between increased calcium intake and decreased fat and total body mass in healthy people.

**PURPOSE:** The objective of the current research was to investigate the effect of 4 weeks of calcium supplementation on Total Energy Expenditure (TEE) during submaximal exercise and to measure changes in body composition.

**METHODS:** Nine moderately trained people (n = 5 males, 4 females; age 40.56  $\pm$  9.51 yrs; stature 171.8  $\pm$  7.50 cm; mass 71.33  $\pm$  10.81kg) were tested using a randomised, double blind, placebo controlled crossover design. Subjects were assigned to a placebo (P) or 1000 mg/d of elemental calcium (citrate) (Ca) group for 4 weeks with a subsequent crossover following a 4 week wash out period. Subjects undertook a 1 hour bicycle ergometer test at 50%VO<sub>2max</sub> at the baseline and end of each intervention. Gas exchange was measured by an online Spirometer (Metalyzer II; Cortex, Leipzig, Germany). TEE was calculated using ACSM guidelines. Body composition was measured using the Harpenden skinfold callipers.

**RESULTS:** Following Ca supplementation, TEE during the 60 min exercise trial increased significantly as compared to the placebo trial ( $p < 0.05$ ) with a commensurate trend towards a decrease in total body mass ( $p = 0.20$ ) and fatness ( $p = 0.29$ ).

	After (P) (difference $\pm$ SD)	After (Ca) (difference $\pm$ SD)
TEE (kJ)	2444 $\pm$ 887	2666 $\pm$ 1063*
Body Mass(kg)	- 0.05 $\pm$ 0.54	- 0.89 $\pm$ 0.73
Fat Mass (%)	0.19 $\pm$ 0.55	- 0.59 $\pm$ 0.09
Lean Mass (%)	- 0.36 $\pm$ 1.18	0.28 $\pm$ 1.07

Table 1: Difference in TEE and body composition at the end of each intervention.

**CONCLUSIONS:** These findings indicate that Ca supplementation for 4 weeks increases TEE during submaximal exercise. This is associated with a concurrent reduction in fat mass and increase in lean mass. These results support previous research that demonstrates an inverse relationship between Ca intake and adiposity, which may be achieved by a shift towards increased fat oxidation.

**2240 Board #128 May 28 3:30 PM - 5:00 PM**

### Bone Mineral Content In Black And White Adolescents Is Related To Dairy Intake And Vigorous Physical Activity

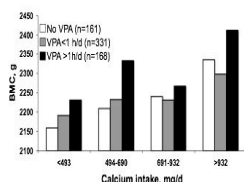
Bernard Gutin, FACSM, Anh Le, Maribeth Johnson, Inger Stallmann-Jorgensen, Paule Barbeau, Mark Hamrick, Yanbin Dong. *Medical College of Georgia, Augusta, GA.*

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(No relationships reported)

**PURPOSE:** To determine the relations of diet and physical activity (PA) to bone mineral content (BMC) in adolescents.

**METHODS:** The subjects were black and white boys and girls 14-18 years of age (n=660). Total body BMC was measured with dual-energy X-ray absorptiometry. Diet and PA were measured with 4-7 individual, non-consecutive, 24-h recalls; 52% had recalls for all 7 days. For our analyses, we examined total energy intake and percentage of energy from carbohydrates (%CHO), protein (%PRO), and fat (%FAT). The main dietary variables were daily dairy servings, vitamin D (micrograms) and calcium intake (milligrams). The main PA variables were time spent in moderate PA (3-6 METs) and vigorous PA (>6 METs).



**RESULTS:** A base regression model containing age, sex and race was used to assess the effects of the demographic variables on BMC. There was an age by sex interaction, such that the boys increased more than the girls with increasing age ( $p < 0.01$ ). BMC was greater in the blacks than in the whites ( $p < 0.01$ ). When the diet and PA variables were added to the base model one at a time significant proportions of the variance in BMC were explained



by dairy servings, calcium, vitamin D, and vigorous (but not moderate) PA (all  $p$ 's<0.01). Because the 3 diet variables were intercorrelated, results were similar regardless of which one was included in the multivariate analysis. The figure illustrates the results for calcium and vigorous PA. Both calcium intake and vigorous PA ( $p$ 's<0.01) explained independent proportions of the variance in BMC.

**CONCLUSION:** These results are consistent with the hypothesis that youths should eat sufficient amounts of dairy foods and engage in high-intensity exercise in order to develop high levels of bone mass.

*Supported by NIH (HL64157)*

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**2241 Board #129 May 28 3:30 PM - 5:00 PM**

**Effects Of Vitamin C Supplementation On Substrate Utilization And Perception Of Fatigue In Overweight Men**

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*(No relationships reported)*

Previous research suggests that vitamin C depletion modifies respiratory exchange ratio (RER) and, in particular, fat oxidation. Impaired fat oxidation has been implicated in the development of obesity and failed weight loss attempts.

**PURPOSE:** The purpose of this study was to assess the effect of vitamin C supplementation on fat oxidation and fatigue (Ratings of Perceived Exertion, RPE) during a 50-minute walk at 40% of estimated maximal oxygen consumption (VO<sub>2</sub>max) using a randomized, double-blinded, placebo-controlled, 4-week intervention trial in vitamin C-depleted overweight men.

**METHODS:** Relatively sedentary, overweight (BMI > 25 kg/m<sup>2</sup>) men (age 30.7 ± 5.9 years) unaware of their vitamin C status volunteered to participate (n = 15). Subjects were instructed to follow a vitamin C poor (~ 40 mg/day) diet for a three-week depletion period and were randomly assigned to either placebo (PL: n = 8) or vitamin C (VC: 1 g/d, n = 7). Independent t-tests and repeated measures ANOVA were used in statistical analyses, significance  $p$  < 0.05.

**RESULTS:** After the 4-week intervention, plasma vitamin C concentrations increased from baseline in VC (0.40 ± 0.20 and 1.17 ± 0.55 mg/dL, respectively) but did not change in PL (0.44 ± 0.21 and 0.56 ± 0.23) ( $p$  = 0.019 for time x group effect). There were no significant differences in measures of body weight, fat mass, BMI, physical activity, or VO<sub>2</sub>max. Exercise RER decreased in both groups (PL: -0.041 ± 0.052; VC: -0.009 ± 0.048) and nearly reached significance in PL ( $p$ -value = 0.079), however, after adjusting for the effects of change in body weight (placebo: -0.83 ± 1.27; vitamin C: 0.27 ± 1.33 kg) and physical activity (placebo: 4.38 ± 14.22; vitamin C: 2.29 ± 4.54 MET-hrs/wk), this trend was no longer observed ( $p$ -value = 0.429). No significant differences between groups were noted during the 50-minute walk in any of the exercise indices.

**CONCLUSIONS:** In summary, vitamin C did not appear to stimulate fat oxidation or lower RPE in free-living, vitamin C-depleted, overweight men during submaximal exercise. Modest acute changes in body weight and physical activity may have a greater role in eliciting beneficial alterations of substrate utilization.

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**2242 Board #130 May 28 3:30 PM - 5:00 PM**

**A Randomized, Placebo-controlled Trial Of Vitamin C Supplementation And Upper Respiratory Infections In Swimmers**

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*(No relationships reported)*

In a recent Cochrane review, a promising potential role for vitamin C supplementation in decreasing the rate of common colds in runners was identified. We are unaware of such studies in swimmers, a population at high risk of upper respiratory illnesses.

**PURPOSE:** To determine the effect of vitamin C supplementation on the rate, length and severity of upper respiratory tract infections in adolescent swimmers.

**METHODS:** 39 healthy competitive adolescent swimmers (mean age 13.5±1.5 years; 22 males, 17 females; mean training volume 15 hrs/wk) were randomized to receive either vitamin C supplementation (1 g/day) or placebo, given in a double-blinded fashion, for 3 winter months. Incidence, length and severity of upper respiratory infections were documented daily by diaries. Plasma vitamin C levels were obtained on the 8<sup>th</sup> week of study.

**RESULTS:** Swimmers in the vitamin C group had a mean of 3.1±1.9 common cold events during the study period; swimmers in the placebo group had a mean of 3.1±2.3 events, ( $p$ =0.93). The mean duration of cold episodes was 6.6 days in the intervention group and 8.2 in controls ( $p$ =0.3). The total number of sick days during the 3-month study period was high, averaging 23 days in the intervention group and 27 days in controls ( $p$ =0.57). There was no difference in the self-assessed severity of cold events. Plasma vitamin C levels did not differ between groups (1706±700ng/ml vs. 1440±560ng/ml,  $p$ =0.27), and did not correlate with rate, length or severity of cold events.

**CONCLUSIONS:** In this randomized, double-blinded, placebo controlled study of vitamin C supplementation in adolescent swimmers, at a dose of 1gr/day for 3 winter months, no decrease in the rate, length or severity of upper respiratory infections was found. Altogether, swimmers had an average of one cold event per month, lasting more than a week, so that over 25% of the time, these high-level competitive swimmers were sick. Yet based on our findings, vitamin C supplementation should not be considered as a method to decrease the highly prevalent common colds in swimmers.

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**2243 Board #131 May 28 3:30 PM - 5:00 PM**  
**Low Vitamin D Levels In Young Qatari Females**

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*(No relationships reported)*

Vitamin-D is synthesized in the skin under stimulation of UV light and is available in lesser quantities in some foods. Despite the Middle East experiencing high sunlight levels, women have been shown to have low Vitamin-D levels. This has been attributed to cultural requirements of wearing body covering clothing, and could have significant implications for bone density.

**PURPOSE:** To assess Vitamin-D status in adolescent Qatari girls with concomitant measures of bone health and physical fitness.

**METHODS:** Fifty-four girls (11.7 ± 1.5 yrs) were studied. A step-test was performed to exhaustion to measure aerobic fitness and a fasting blood sample was taken. Anthropometric measures of height and weight were recorded and Dual Energy X-ray Absorptiometry (DEXA) scanning was used to assess hip and spine bone mineral density (BMD).

**RESULTS:** Only one of the 54 girls had a serum 25-hydroxyvitamin D (25-OHD) above 20 ng/ml, 16 girls were between 10-20 ng/ml and the remainder all had levels below 10 ng/ml. Twenty seven girls recorded a 25-OHD less than 7 ng/ml. BMI ranged from 13.5 to 32.4 kg/m<sup>2</sup> with a mean of 19.5 kg/m<sup>2</sup> and the aerobic fitness ranged from 15 to 46 ml/kg/min<sup>-1</sup> with a mean of 27.2 ml/kg/min<sup>-1</sup>. When comparing the 20 % "worst" and 20 % "best" significant differences in L2-L4 (0.52 v 0.95 g/cm<sup>2</sup>), hip neck (0.47 v 0.68 g/cm<sup>2</sup>), and total hip (0.57 v 0.89 g/cm<sup>2</sup>) BMD existed between those with the lowest and highest BMI ( $P$ <0.05). The 20 % highest BMI had a significantly ( $P$ >0.005) lower VO<sub>2</sub>max (19.2 ml/kg/min<sup>-1</sup>) than those with the 20 % lowest BMI (31.3 ml/kg/min<sup>-1</sup>). Similarly, the girls with the lowest 25-OHD had a significantly lower ( $P$ <0.05) VO<sub>2</sub>max (23.5 ml/kg/min<sup>-1</sup>) than those with the highest 25-OHD (30.6 ml/kg/min<sup>-1</sup>).

**CONCLUSIONS:** Vitamin-D deficiency was highly prevalent in this cohort of adolescent Qatari girls. These data suggest that at this early age that a higher body mass is

protective to the skeleton, compensating for Vitamin-D deficiency and low levels of physical activity. Longitudinal studies are needed to track the long term effect of these factors upon metabolic deterioration and bone health.

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**2244 Board #132 May 28 3:30 PM - 5:00 PM**  
**Vitamin D Deficiency In Middle Eastern Sportsmen**

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(No relationships reported)

Vitamin-D deficiency is well recognized in Middle Eastern Women and is increasingly associated with chronic health conditions such as low bone density, diabetes and cancer. Vitamin-D is synthesized in the skin under stimulation of UV light and is available in lesser quantities in some foods. The Vitamin-D status of Middle Eastern Men is not well described in the literature.

**PURPOSE:** To assess the Vitamin-D Status of professional and semi-professional sportsmen in the Middle East.

**METHODS:** As part of their routine medical screening 93 Middle Eastern male athletes (age  $21.3 \pm 6.9$  years; BMI  $22.6 \pm 4.1$  kg/m<sup>2</sup>) completed a questionnaire and had blood taken for Vitamin-D and bone health markers.

**RESULTS:** Mean Vitamin-D (25-OH) levels observed were 12.4 ng/ml (range 7-28). Fifty-eight percent had Vitamin-D 25-OH levels less than 10 ng/ml, and 33% had levels less than 20 ng/ml. The remainder all had levels less than 30 ng/ml. None of the athletes reported a history of bone stress injuries or routinely supplemented with Vitamin-D. Eighty percent of athletes reported completing 100% of their training outdoors. Individuals with low Vitamin-D levels were significantly more likely to be dark skinned compared to fair or olive skin colouring ( $p < 0.05$ ). Vitamin-D levels did not vary significantly depending on reported sunlight exposure, skin covering or sunscreen use.

**CONCLUSIONS:** Severe Vitamin-D deficiency was highly prevalent in this cohort of Middle Eastern Sportsmen and skin colour was the only variable to correlate with Vitamin-D deficiency. Training outdoors was not protective against Vitamin-D deficiency, reflecting the tendency to train early or late in the day. Given the potential long term health impact of Vitamin-D deficiency, recognition and correction of this deficient state is vital in this group.

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**2245 Board #133 May 28 3:30 PM - 5:00 PM**  
**Repeated Bouts Of Exercise And Vitamin E Supplementation: Effect On Inflammatory Markers In Men**

Masashi Miyashita, Kiyoji Tanaka, FACSM. *University of Tsukuba, Tsukuba, Japan.*  
(No relationships reported)

Some, but not all, previous studies have shown that vitamin E supplementation is effective in attenuating C-reactive protein (CRP) and interleukin-6 (IL-6) concentrations following a single bout of strenuous exercise. However, little is known about the influence of vitamin E supplementation on inflammatory markers after repeated bouts of strenuous exercise.

**PURPOSE:** To examine whether vitamin E supplementation can attenuate CRP and IL-6 concentrations after prolonged repeated bouts of strenuous cycling in healthy young men.

**METHODS:** Eight young males (aged 21-30 y) received a vitamin E supplement (300 mg/day) or a placebo (control) for 14 days separated by an interval of at least 1 month in a randomised, counterbalanced design. On day 12 of both trials, the subjects cycled at 80% of maximal heart rate in two, 90-min bouts (150 min rest between each). In each trial, venous blood samples were collected on days 1 (baseline), 12 (pre- and post-exercise 1 and pre- and post-exercise 2), 13, 14, and 15.

**RESULTS:** After 14 days of supplementation, serum  $\alpha$ -tocopherol concentrations increased in the vitamin E trial (mean  $\pm$  SEM, Day 1,  $19.7 \pm 0.9$   $\mu$ mol/L; Day 15,  $40.9 \pm 2.1$   $\mu$ mol/L,  $P < 0.0005$ ) but not the placebo trial (Day 1,  $21.5 \pm 1.2$   $\mu$ mol/L; Day 15,  $19.7 \pm 0.7$   $\mu$ mol/L). In both trials, serum CRP concentrations did not differ between trials and over time (vitamin E,  $0.2 \pm 0.1$  mg/L; placebo,  $0.2 \pm 0.1$  mg/L, mean of 8 measurements). Peak serum IL-6 concentrations observed at the end of the second bouts of exercise did not differ between trials (vitamin E,  $4.2 \pm 0.7$  pg/mL; placebo,  $4.3 \pm 1.0$  pg/mL) and serum IL-6 concentrations did not differ at any time points during the remainder of both trials.

**CONCLUSION:** The study demonstrates that short-term vitamin E supplementation appears to have no effect on attenuating serum CRP and IL-6 concentrations in response to repeated bouts of prolonged cycling in healthy young men.

*Supported by the Japanese Olympic Committee and Coca-Cola Japan Company, Ltd.*

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**D-32 Free Communication/Poster - Motor Control**

MAY 28, 2009 1:00 PM - 6:00 PM  
ROOM: Hall 4F

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**2246 Board #134 May 28 2:00 PM - 3:30 PM**  
**Relationship Between Gross Motor Skill And Social Behavior In Children With Autism**

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(No relationships reported)

Significant deficits in social behaviors have been reported among children with autism spectrum disorders (ASD), and there is growing recognition that individuals with ASD experience motor difficulties (Berkely et al., 2001; Miyahara et al., 1997). Children with ASD experience early challenges in motor skills, which further correlate with social engagement skill deficits (Trevarthen & Daniel, 2005). However, ASD children with motor deficits were not more likely to receive service than those without the motor deficits, and research investigating the relationship between gross motor skill and social behavior of children with ASD has been limited.

**PURPOSE:** To measure the relationship between gross motor skill and social behavior in children with ASD.

**METHODS:** Sixteen (Asperger, n=8; high-functioning autism, n=8) boys with ASD aged 6-10 ( $7.23 \pm 1.05$  yrs) participated. The Test of Gross Motor Development (TGMD-2; Ulrich, 1985) was used to assess six locomotor skills (run, gallop, hop, leap, horizontal jump, and slide) and six object control skills (striking a stationary ball, stationary dribble, catch, kick, overhand throw, and underhand roll). The School Social Behavior Scales (SSBS-2; Merrell, 2002) was rated by the child's school classroom teacher to assess social competence (peer relations, self-management/compliance, academic behavior) and antisocial behavior (hostile/irritable, antisocial/aggressive, defiant/disruptive). Data are reported as standard score and T-score. Pearson product-moment correlation coefficients were calculated to evaluate the relationship between gross motor skill and social behavior. Significance was set at  $p < 0.05$ .

**RESULTS:** Findings indicate that (a) object control skills were positively correlated with peer relations ( $r_{16} = 0.65$ ,  $p < 0.01$ ), self-management ( $r_{16} = 0.58$ ,  $p < 0.05$ ), and social competence ( $r_{16} = 0.66$ ,  $p < 0.01$ ), (b) gross motor quotient was positively correlated with peer relations ( $r_{16} = 0.64$ ,  $p < 0.01$ ), self-management ( $r_{16} = 0.58$ ,  $p < 0.05$ ),

and social competence ( $r_{16} = 0.61, p < 0.05$ ), and (c) locomotor skills were not correlated with any social behavior variable.

**CONCLUSION:** The better motor skill the child with ASD performed, the more likely the child was to be socially competent.

*Supported by grant NSC 96-2413-H-017-005, Taiwan.*

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**2247 Board #135 May 28 2:00 PM - 3:30 PM**  
**Force Variability Due To Strength Differences In Discrete And Continuous Force Control Tasks**

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*(No relationships reported)*

**PURPOSE:** To examine the relation between muscular strength and force variability in discrete and continuous force control tasks.

**METHODS:** Twenty-four healthy young adults produced discrete and continuous isometric force production via elbow flexors to 7 absolute force levels (30, 45, 60, 75, 90, 105, & 120 N). Maximal voluntary contraction (MVC), the relative (coefficient of variation), and absolute (standard deviation) magnitude of force variability were determined.

**RESULTS:** As expected there were strength differences between the discrete and continuous force control tasks [ $F(1,23) = 27.82; p < .05$ ]. In the discrete force control task, MVC was positively correlated ( $r = .15$  to  $.49$ ) with CV as force level increased. However in the continuous force control tasks, the correlation between MVC and CV decreased as force level increased ( $r = .38$  to  $-.48$ ).

**CONCLUSIONS:** In discrete tasks, force variability increases as strength increases, suggesting that stronger individuals are more variable at discrete force control tasks. In continuous tasks, force variability decreases as strength increases, suggesting that stronger individuals are less variable in continuous force control tasks. This suggests that the mechanisms regulating discrete and continuous force variability are partly related to muscular strength and the effect of muscular strength on force variability are task dependent.

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**2248 Board #136 May 28 2:00 PM - 3:30 PM**  
**Post-activation Potentiation following Conditioning Contractions of Maximal And Sub-maximal Intensity**

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*(No relationships reported)*

Post-activation potentiation (PAP) is an increase in muscular force following voluntary contractile activity. It is well known that PAP occurs following maximal voluntary contraction (MVC); however, little is known regarding sub-maximal contractions or the contraction duration needed to elicit maximal PAP.

**PURPOSE:** To compare maximal PAP following voluntary conditioning contractions (CC) of maximal and sub-maximal intensity and to compare the contraction duration needed to achieve maximal PAP at each intensity.

**METHODS:** First five unpotentiated single twitches were evoked with surface electrical stimulation of the ulnar nerve at the wrist. The nine participants ( $24.2 \pm 4.2$  yrs) then performed the following intermittent, isometric thumb adduction CC protocols in random order: 25%, 50% and 100% MVC. Each CC was held 5s followed by a 2s rest interval in which a single twitch was elicited. This pattern was repeated until the twitch force was maximally potentiated. A 20s 25% MVC CC protocol and a 10s 50% MVC CC protocol matched for force-time integral to the 5s 100% MVC CC were also included in the random order. Maximal twitch force potentiation was calculated as the percent increase in twitch force following the CCs compared to the unpotentiated twitch force. Repeated measures ANOVA was used to compare: 1) unpotentiated vs. potentiated twitch force within and between protocols, 2) PAP between force-time integral matched protocols and 3) contraction duration needed to produce maximal PAP between protocols.

**RESULTS:** Twitch force increased following the 50% (mean,  $\pm$  SE:  $23.1 \pm 5.2\%$ ,  $p = .003$ ) and 100% ( $45.2 \pm 10.0\%$ ,  $p < .001$ ) CC protocols, but did not increase following the 25% ( $7.6 \pm 2.3$ ,  $p > 0.05$ ) CC protocol. Maximal PAP was greater for the 100% vs. the 50% and 25% CCs ( $p < .001$ ) and 50% was greater than the 25% CC ( $p = .017$ ). PAP was not different between force-time integral matched protocols ( $p > 0.05$ ). The contraction duration that produced maximal PAP was not different between the 50% and 100% CC protocols ( $29.4 \pm 2.8$  and  $21.1 \pm 2.2$ ,  $p > 0.05$ ).

**CONCLUSIONS:** Although PAP is greater following maximal compared to sub-maximal voluntary contraction, PAP does occur following sub-maximal contraction. Also, the duration of contraction necessary to produce maximal PAP may be dependent on the intensity of muscle contraction.

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**2249 Board #137 May 28 2:00 PM - 3:30 PM**  
**The Effects Of Motor Imagery On Performance Of A Motor Task**

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*(No relationships reported)*

Mental imagery of a motor task has been hypothesized to improve performance in physical activities. It has been suggested mental imagery engages the motor system and activates the cortex during motor imagery positively influencing performance.

**PURPOSE:** To investigate the effects of mental imagery practice on the performance of a motor task.

**METHODS:** 25 adult participants ( $M=22.8$  years,  $SD=5.4$ ; 15 females, 10 males) were examined. Participants mentally imagined a plantar flexion movement of the right foot at two intensities: 20 and 60% of maximum voluntary contraction upon completion of a series of practice trials at these intensities. Five control subjects completed the entire testing protocol but did not perform mental imagery. The subject data was analyzed by calculating the absolute, variable, and constant error scores after conversion into FtLbs.

**RESULTS:** Absolute error (AE) scores for the experimental group in practice were 0.98 FtLbs in the 20% and 1.43 FtLbs in the 60% condition. AE scores for the control group were 1.35 FtLbs in the 20% and 1.88 FtLbs in the 60% condition. Post-imagery performance AE scores were 2.29 FtLbs in the 20% and 1.39 FtLbs in the 60% condition. Control group post scores were 2.78 FtLbs in the 20% and 1.88 FtLbs in the 60% condition. Variable error (VE) scores for the experimental group in practice were 4.61 FtLbs in the 20% and 12.75 FtLbs in the 60% condition. VE scores for the control group were 6.19 FtLbs in the 20% and 15.71 FtLbs in the 60% condition. Post-imagery VE scores were 5.74 FtLbs in the 20% and 13.05 FtLbs in the 60% condition. The control group post scores were 8.1 FtLbs in the 20% and 16.5 FtLbs in the 60% condition. Constant error (CE) scores for the experimental group in practice were 0.9 FtLbs in the 20% and -1.31 FtLbs in the 60% condition. CE scores for the control group were 1.35 FtLbs in the 20% and -1.65 FtLbs in the 60% condition. Post-imagery CE scores were 2.21 FtLbs in the 20% and 0.34 FtLbs in the 60% condition. The control group post scores were 2.78 FtLbs in the 20% and -0.6 FtLbs in the 60% condition.

**CONCLUSION:** Imagery practice in the current study did not influence the accuracy of sub-maximal contractions at either the 20% or 60% MVC conditions, nor was there a reduction in the measures of error following imagery practice.

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**D-33 Free Communication/Poster - Muscle and Bone Adaptations to Exercise and Training**

MAY 28, 2009 1:00 PM - 6:00 PM

**2250 Board #138 May 28 3:30 PM - 5:00 PM**

**Musculoskeletal Profile Of Elite Adolescent Female Athletes In Weight-loaded And Weight-supported Sports**

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(No relationships reported)

In highly-active adolescent athletes, knowledge of skeletal responses to prolonged physical demands is largely derived from two-dimensional technology using dual x-ray absorptiometry. A more advanced understanding of skeletal responses in adolescent athletes is possible using Peripheral Quantitative Computerized Tomography (pQCT). Data acquired from pQCT include bone geometry and micro-architecture which are expected to be more positively influenced by high-impact sports, including gymnastics and athletics, than weight-supported sports such as water polo.

**PURPOSE:** (i) to profile the musculoskeletal health of adolescent female athletes competing at the aspiring elite level in gymnastics, track and field, water polo and less active, age- and sex- matched peers.

**METHODS:** Musculoskeletal parameters of the distal tibia and distal radius was assessed using pQCT in four groups of adolescent females (mean age 14.9 years) comprised of gymnasts (n = 25), track and field (n = 34), water polo (n = 30), and controls (n = 28). Trabecular area and density, cortical area and density, and bone strength was calculated.

**RESULTS:** After covarying for tibial length, gymnasts displayed greater trabecular density, trabecular area, and bone strength ( $p < 0.001$ ) at the 4% distal tibial site compared with water polo athletes and controls. Track and field athletes displayed greater cortical bone area at 14%, 38% and 66% distal tibial sites ( $p < 0.001$ ). Bone strength was greater in weight-loaded sports at 38% distal tibial site compared with water polo athletes and controls ( $p < 0.001$ ). At the 4% distal radius, gymnasts had greater trabecular density, trabecular area, and bone strength compared with track and field, water polo and controls ( $p < 0.001$ ). Compared with water polo and controls, weight-loaded sports showed greater cortical bone area at the 66% distal radial site ( $p < 0.001$ ).

**CONCLUSIONS:** Microarchitectural bone at the distal tibia and radius may be positively influenced by multi-axial, high impact loads associated with gymnastics. Axial compressive loads commonly experienced by track and field athletes may also contribute to greater cortical bone area at the distal tibia and mid-shaft regions. Results support the osteogenic benefits of weight-loaded activities compared to weight-supported sports and non-active controls.

**2251 Board #139 May 28 3:30 PM - 5:00 PM**

**Effect Of Resistance Training On Carnosine Concentration In Human Skeletal Muscle**

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Carnosine ( $\beta$ -alanyl-L-histidine) is a dipeptide containing histidine and is present in vertebrate skeletal muscles. It has been reported that carnosine contributes to physico-chemical buffering to maintain acid-base balance during high-intensity exercise. Moreover, it has been shown that the repeated accumulation of hydrogen ion with high-intensity exercise training is necessary to increase in carnosine concentration. However, the effects of most type of the training on skeletal muscle carnosine concentration are unclear.

**PURPOSE:** The purpose of the present study was to determine the effects of resistance training on skeletal muscle carnosine concentration.

**METHODS:** Fifteen active but not well-trained healthy males were assigned to either a "Strength-type" (S-type; n= 7) or a "Hypertrophy type" (H-type; n = 8) group and performed leg press exercise twice a week for 8 weeks. The S-type regimen consisted of 5 sets at 90% of 1 repetition maximum (RM) with 3-min rest periods between sets, whereas the H-type regimen consisted of 5 sets at 70% of 1RM with 1-min rest periods between sets. Muscle volume was measured using a magnetic resonance imaging (MRI). Muscle biopsy samples were taken from the vastus lateralis at rest before and after training. The carnosine concentration was determined using an amino acid autoanalyzer.

**RESULTS:** After the 8 weeks of resistance training, muscle volume of thigh and 1RM of leg press were significantly ( $p < 0.05$ ) increased in both groups. In addition, percentage change in muscle volume was larger in the H-type group than that in the S-type group. However, carnosine concentration was not significantly increased in either group.

**CONCLUSIONS:** These results suggest that resistance training does not improve skeletal muscle carnosine concentration regardless of the type of regimen.

**2252 Board #140 May 28 3:30 PM - 5:00 PM**

**Effect Of Reduced Training Frequency In Walk Exercise With Blood Flow Restriction Among Older Subjects**

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(No relationships reported)

Low-intensity resistance exercise combined with blood flow restriction (BFR) has been shown to increase muscle size and strength comparable to those observed after high-intensity training. As such, we have recently demonstrated that the slow walk training combined with blood flow restriction of active limbs (W-BFR) increased muscle mass and strength in young subjects. However, impact of W-BFR on muscle size and function among older individuals has not been explored.

**PURPOSE:** To determine the physiological response of W-BFR with different exercise frequency on muscle mass and strength as well as bone turnover in older individuals.

**METHODS:** Sixteen older women and men (60-78 yrs) were randomized into either W-BFR (n=11) or non-exercise control (CON; n=5) group. W-BFR group walked on the treadmill for 20min at 4.0 km/min. Initially W-BFR group exercised 5 times/wk for 6 weeks, followed by 2 times/wk for 12 weeks. Muscle size and strength as well as blood concentration of anabolic hormones and bone-specific alkaline phosphatase (BAP) were assessed before (pre), at 6<sup>th</sup> week (post-1), and 18<sup>th</sup> week (post-2; W-BFR only).

**RESULTS:** After the initial 6 weeks of training, ultrasound estimated thigh muscle mass increased by 11% (pre:5.3±0.6 kg, post:5.9±0.5 kg,  $P < 0.05$ ) while no change was observed in CON (pre:5.1±0.7, post:4.9±0.7kg,  $P > 0.1$ ). Isokinetic knee extension and flexion strength and isometric knee extension strength all increased in K-WALK (8 to 14%,  $P < 0.05$ ) while no significant increase was seen in CON group ( $P > 0.1$ ). After 12 additional weeks of reduced frequency of training, muscular strength and muscle size were well maintained in K-WALK group without any notable change in muscle mass or strength ( $P > 0.10$ ). While no change in hormonal concentrations were observed in resting condition throughout the training period, blood concentration of BAP increased significantly (pre: 23.7±9.4 U/l, post-2; 31.2±13.8 U/l,  $P < 0.05$ ) at 18<sup>th</sup> week in K-WALK group.

**CONCLUSION:** Walk training combined with blood flow restriction increased muscle size and strength when performed 5times/wk in the elderly. Furthermore, additional 2 times/wk training regimen can maintain the training response and increase bone turnover over 12 week period.

**2253 Board #141 May 28 3:30 PM - 5:00 PM**

**Effects Of Intensive Interval And Resistance Training On Muscle Size And Function During Unloading**



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(No relationships reported)

We reported that intensive interval training during 20 days of unloading prevented atrophy of the quadriceps femoris (QF) muscles. However, this training was not effective to attenuate a decrease of maximum muscle strength.

**PURPOSE:** The purpose of this study was to clarify the effects of intensive interval and resistance training on size and function of human skeletal muscle during 20 days of unilateral lower limb unloading.

**METHODS:** Twelve healthy men participated in this study and were divided into two groups: unloading with training (Tr group, n = 6) and unloading only (UL group, n = 6). Both groups underwent lower limb unloading of the left leg for 20 days. Exercise training consisted of an interval exercise protocol of 2- to 3-min intervals alternating between 40% and 80% of peak oxygen uptake and a dynamic leg press protocol of 4 sets of 10 repetitions with 70% one-repetition maximum (1RM) with the unloaded leg on every other days during the experimental period. Maximum voluntary contraction (MVC) during isometric knee extension and 1RM during dynamic leg press was measured. Anatomical magnetic resonance imaging (MRI) of the thighs was taken to calculate volume of the QF muscles. Muscle functional MRI (spin-echo, TR/TE 2000/30, 60 msec) of the QF muscles was obtained during submaximal dynamic knee extension exercise (5 sets of 10 repetitions) at a load of 33%MVC.

**RESULTS:** MVC in the Tr ( $532 \pm 178$  N to  $453 \pm 132$  N; -14%,  $P < 0.05$ ) and UL ( $495 \pm 167$  N to  $394 \pm 114$  N; -19%,  $P < 0.05$ ) groups significantly decreased after unloading. 1 RM during leg press for the Tr group significantly increased ( $138 \pm 33$  kg to  $152 \pm 39$  kg; 10%,  $P < 0.05$ ); while in the UL group significant decreased ( $141 \pm 38$  kg to  $115 \pm 32$  kg; -18%,  $P < 0.05$ ). The volume of the QF muscles in the unloading leg in the Tr group did not change after unloading ( $2472 \pm 279$  cm<sup>3</sup> to  $2470 \pm 253$  cm<sup>3</sup>, 0%, N.S.); while, that in the UL group significantly decreased ( $2252 \pm 450$  cm<sup>3</sup> to  $2111 \pm 452$  cm<sup>3</sup>, -6%,  $P < 0.05$ ). There was no significant difference in muscle functional MRI between Tr group and UL groups.

**CONCLUSIONS:** These results suggest that intensive interval and resistance training during 20 days of unloading was effective for prevention of muscle strength and atrophy.

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**2254 Board #142 May 28 3:30 PM - 5:00 PM**  
**Changes In Muscle Volume And Strength Following 16 Weeks Of Training Using The Advanced Resistive Exercise Device (ARED) And Free Weights**

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Spaceflight-induced muscle atrophy and loss of muscle strength, particularly in the postural and locomotory muscles, might impair task performance during long-duration space missions and planetary exploration. High-intensity free weight (FW) resistive exercise training attenuates muscle atrophy and strength loss during bed rest, a space flight analog. NASA developed the Advanced Resistive Exercise Device (ARED) to simulate the characteristics of FW exercise (i.e. constant resistance, inertial forces) and to be used as a countermeasure during International Space Station (ISS) missions.

**PURPOSE:** To compare the efficacy of ARED and FW training for inducing muscle hypertrophy and strength gains in ambulatory subjects prior to deploying ARED on the ISS.

**METHODS:** Twenty untrained subjects were assigned to either the ARED (8 males, 3 females) or FW (6 males, 3 females) training group and participated in a periodized training protocol consisting of squat (SQ), heel raise (HR), and deadlift (DL) exercises 3 d-wk<sup>-1</sup> for 16 wks. SQ, HR, and DL muscle strength (1RM) was measured before, after 8 wks, and after 16 wks of training. Muscle volume of the vasti group (V), hamstring group (H), hip adductor group (ADD), medial gastrocnemius (MG), lateral gastrocnemius (LG), and deep posterior muscles including soleus (DP) was measured using MRI at pre- and post-training. Consecutive cross-sectional images (10mm slices) were analyzed and summed. Anatomical references insured that the same muscle sections were analyzed pre- and post-training. Two-way repeated measures ANOVAs ( $p < 0.05$ ) were used to test for differences in muscle strength and volume between training devices.

**RESULTS:** SQ, HR, and DL 1RM increased in both FW (mean $\pm$ SE; SQ:  $49 \pm 6\%$ , HR:  $12 \pm 2\%$ , DL:  $23 \pm 4\%$ ) and ARED (SQ:  $31 \pm 4\%$ , HR:  $18 \pm 2\%$ , DL:  $23 \pm 3\%$ ) groups. Both groups increased muscle volume in the V (FW:  $13 \pm 2\%$ , ARED:  $10 \pm 2\%$ ), H (FW:  $3 \pm 1\%$ , ARED:  $3 \pm 1\%$ ), ADD (FW:  $15 \pm 2\%$ , ARED:  $10 \pm 1\%$ ), LG (FW:  $7 \pm 2\%$ , ARED:  $4 \pm 1\%$ ), MG (FW:  $7 \pm 2\%$ , ARED:  $5 \pm 2\%$ ), and DP (FW:  $2 \pm 1\%$ , ARED:  $2 \pm 1\%$ ) after training. There were no between-group differences in muscle strength or volume.

**CONCLUSIONS:** The increase in muscle volume and strength following ARED training is not different than FW training. These findings indicate that ARED will likely protect against spaceflight-induced muscle atrophy and strength loss.

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**2255 Board #143 May 28 3:30 PM - 5:00 PM**  
**Influence Of Physical Activity On Muscle And Fat Depots Assessed By pQCT**

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The location and mass of adipose tissue affects disease risk, especially when located centrally. Although physical activity (PA) can attenuate fat accumulation over the total body and trunk, effects on fat depots in the limbs is limited. Analysis of the soft tissues of the limbs, including adipose depots, is possible with magnetic resonance imaging (MRI) and peripheral quantitative computed tomography (pQCT). Specifically, intermuscular adipose tissue (IMAT), the adipose tissue within the fascia surrounding muscle, has been explored (Miljkovic-Gacic et al. *Am J Clin Nut* 2008). MRI analysis has shown associations between higher concentrations of IMAT and insulin resistance, type II diabetes, and reduced muscular strength. However the relationship of PA with IMAT has not been fully explored.

**PURPOSE:** To evaluate the influence of PA on IMAT, subcutaneous fat, and muscle area of the non-dominant foreleg in comparison with total and central body fat.

**METHODS:** 70 pre-menopausal women (Mean age  $\pm$  SD  $38.4 \pm 4.7$  yr) underwent dual energy X-ray absorptiometry (DXA) scans to assess total and central fat and pQCT measurements at a point 66 percent from the tibial distal end to quantify muscle and fat cross-sectional areas. Four day self-reported PA and pedometer step count was translated into MET level x time and then averaged. Subjects were divided into PA tertiles; low active (n=23;  $249.4 \pm 82.1$  MET-min/day; BMI= $28.1 \pm 6.1$  kg/m<sup>2</sup>) and high active were compared (n=23;  $786.7 \pm 150.5$  MET-min/day; BMI= $22.2 \pm 2.1$  kg/m<sup>2</sup>). Independent t-tests were performed between scores for highest and lowest PA tertiles; PA, fat, and muscle scores were correlated, after normalization for BMI.

**RESULTS:** Low active subjects had greater BMI\*, subcutaneous fat/BMI\*, total\* and central body fat\*. High active subjects had greater muscle area/BMI\* and IMAT/BMI\*. IMAT was positively correlated with MET-min/day ( $r=0.46^*$ ) and muscle area/BMI ( $r=0.35^*$ ), but was negatively correlated with total ( $r=-0.46^*$ ) and central body fat ( $r=-0.42^*$ ). \_\_\_\_\_ \* $p < 0.05$

**CONCLUSIONS:** When data was adjusted for body size, IMAT is greater in high active subjects as with muscle area and may suggest a physiological adaptation to increased habitual PA. IMAT may be a useful index for evaluating localized training effects on metabolic adaptations in skeletal muscle.



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**2256 Board #144 May 28 3:30 PM - 5:00 PM**  
**Skeletal Muscle Gene Expression After A Follicular Based And A Luteal Based Training In A Female Athlete**

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(No relationships reported)

**PURPOSE:** Each phase of the menstrual cycle is characterized by a certain profile of different hormones. Menstrual cycle specific regulation of many hormones is not clear so far. This is especially true for the interaction between estradiol, human growth hormone (hGH), and IGF-1, all of them possible anabolic hormones on the level of the muscular cell and therefore important supporting factors during strength training. We, therefore, decided to conduct a pilot study in order to investigate possible different effects of follicular phase-based (FT) versus luteal phase-based (LT) strength training on the gene expression profile of skeletal muscle.

**METHODS:** One healthy eumenorrheic woman completed a strength training program for 3 menstrual cycles (approx. 12 weeks). The subject performed FT with muscle groups of the right side of the body and LT with muscle groups of the left side of the body. FT was organized 4 times a week in the follicular phase and once a week in the luteal phase, and LT was organized 4 times a week in the luteal phase and once a week in the follicular phase. Gene expression profile was determined in skeletal muscle biopsy samples (m. vastus lateralis, both legs prior to and after 3 months of either FT or LT, respectively) via microarray encompassing 1.14 million exon probes (Exon Chip) and subsequent Gene Ontology Analysis.

**RESULTS:** Microarray analysis revealed an increase (at least 1.5 fold) in 414 genes and a decrease in 87 genes after FT. LT only induced an increase in 82 genes and a decrease in 75 genes. Most up-regulated genes belonged to processes like cellular metabolism, oxidoreductase activities, generation of precursor metabolites and energy, electron transport, translation, cellular biosynthetic processes, transmembrane receptor activities, electron carrier activity, NADH dehydrogenase (ubiquinone) activity, and mitochondrial electron transport.

**CONCLUSIONS:** The much higher number of activated genes after FT is in accordance with recently published findings of higher maximal strength gains and gains in muscle mass after FT as compared to LT. This is probably due to the specific hormonal milieu during each phase of the cycle. More subjects have to be included in order to further analyze menstrual cycle specific training effects.

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**2257 Board #145 May 28 3:30 PM - 5:00 PM**  
**Serum Creatine Kinase Response To Initiation Of Resistance Training Predicts Hypertrophic Response In Men**

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**PURPOSE:** Myofibrillar damage that is incurred as a result of resistance exercise is hypothesized to be a precursor to skeletal muscle hypertrophy. Serum creatine kinase activity (CK) responds to acute exercise in proportion to the extent and severity of muscle injury. In a subset of subjects from the FAMuSS study, we tested the hypothesis that the increase in CK measured upon the initiation of training is correlated with the upper arm muscle hypertrophic response observed after 12 weeks.

**METHODS:** 51 men and 51 women ages 18-39 who were previously untrained underwent 12 weeks of resistance training exercise in the nondominant arm. Serum CK was measured at baseline prior to bout 1; 48 h following bout 1 and before bout 2; and 96 h following bout 1, which was also 48 h after bout 2. Upper arm muscle size was measured using magnetic resonance imaging (MRI) at baseline and week 12.

**RESULTS:** Women and men significantly increased upper arm muscle cross sectional area and total volume. Men demonstrated a wider range of peak CK response (11 to 6040 units) compared to women (26 to 915). CK increases were log transformed for correlational analyses. Data are mean  $\pm$  sd.

Group	Whole Muscle CSA, pre (mm <sup>2</sup> )	D Whole Muscle CSA, (mm <sup>2</sup> )	Whole Muscle Volume pre (mm <sup>3</sup> )	D Whole Muscle Volume (mm <sup>3</sup> )	CK, peak (units)	Highest Correlation, CK vs. D Mass
Women	5314 $\pm$ 1590	385 $\pm$ 330	494306 $\pm$ 145903	36171 $\pm$ 31043	142 $\pm$ 180	0.14 (PeakCK 2 vs. D WM Vol)
Men	6245 $\pm$ 1544	751 $\pm$ 506*	575998 $\pm$ 135659	66386 $\pm$ 44689 *	378 $\pm$ 852 *	0.35† (Log [PkCK] vs. D WM Vol)

\* p<0.05 women vs. men; † p=0.012

**CONCLUSIONS:** The CK response to the initiation of training predicted the muscle hypertrophy response at 12 weeks in men. The data support the hypothesis that muscle injury is a precursor to the increase in muscle size in men but not women, at least in previously untrained subjects undertaking 2x per week resistance training according to standard guidelines.

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**2258 Board #146 May 28 3:30 PM - 5:00 PM**  
**Is Artificial Gravity An Effective Countermeasure To Microgravity**

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(No relationships reported)

**PURPOSE:** It is well known that microgravity can produce substantial losses in muscle mass and strength, bone mass, and orthostatic tolerance. It has been hypothesized that artificial gravity might represent an important countermeasure for preventing such changes. In this context, the primary goal of this study was to test the hypothesis that hypergravity resistance training (HRT) can produce training adaptations similar to those found using a 1 G<sub>x</sub> 10 repetition maximum resistance training program.

**METHODS:** Subjects were healthy male subjects who exercised no more than 2-3 times per month prior to the study (N=18, aged  $22.7 \pm 0.4$  yrs, height  $176 \pm 2$  cm, mass  $80 \pm 3$  kg, means  $\pm$  S.E.M.). Subjects completed a two-week resistance training program (9 sessions) using either HRT [Space Cycle (SC), n=9] or free weights (FW, n=9). Each workout entailed 3 sets of 10 squats at 70, 80, and 90 % of pre-training 10 repetition maximum for the 1st, 2nd, and 3rd sets, respectively. Torque-velocity relationships were determined before and after the completion of the two-week resistance training program. Muscle biopsies were taken from the right vastus lateralis shortly before, 4 and 24 hrs after the first and last workouts.

**RESULTS:** The improvements in torque-velocity relationships were similar (~7-8%) between the two training groups. The muscle biopsy data were used to assess cellular/molecular markers of growth. Analyses demonstrated that there were significant increases ( $P<0.01$ ) in total RNA for both groups. Both groups also produced acute changes in myogenin mRNA levels, however, comparisons of pre and post training data were not significant.

**CONCLUSION:** This study represents an initial step in testing the HRT hypothesis. Importantly, we found similar adaptations between the HRT and free weight groups, and this offers encouraging evidence for pursuing the potential role of artificial gravity as a countermeasure to microgravity.

*This work is Supported by the National Space Biomedical Research Institute through NASA MA00403 (VJC) and NIH 2T32AR047752 (VJC) and M01 RR00827.*

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**2259 Board #147 May 28 3:30 PM - 5:00 PM**  
**Effect Of Satellite Cell Events Adaptation To Moderate Endurance Training In White Gastrocnemius of Rats**

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*(No relationships reported)*

Moderate endurance training is widely regarded as a natural pharmacology to improve physical health. However, few studies have investigated the satellite cell adaptation to it.

**PURPOSE:** To investigate the adaptive changes of satellite cells and myogenic events to moderate endurance training. Given previous evidence of their predominant role in endurance training induce oxygen availability and cytoprotection respectively, vascular endothelial growth factor (VEGF) and heat shock proteins 70(HSP70) content will also be examined.

**METHODS:** Twenty-eight male Sprague-Dawley (SD) rats were randomly assigned to 4 weeks of exercise trained group (4T), 4 weeks of control group (4C), 8 weeks of exercise trained group (8T), and 8 weeks of control group (8C) (n=7, respectively). The training protocol consisted of treadmill running at 20 m/min for 30 min on a 0% grade, for 3 days/wk. At the end of each training period, exercise-trained rats were sacrificed together with their control counterparts. Immunohistochemistry stain and stereological equations were used to analyze in the white gastrocnemius muscle.

**RESULTS:** Mean density in HSP70, VEGF, c-met positive satellite cells, and Myf-5 myogenic response were greater in 4T than those in the 4C ( $9.69 \pm 2.77$  vs.  $4.61 \pm 2.13$ ;  $1.26 \pm 0.08$  vs.  $1.21 \pm 0.08$ ;  $11.47 \pm 2.77$  vs.  $7.16 \pm 2.49$ ;  $1.51 \pm 0.19$  vs.  $1.33 \pm 0.2$ , respectively,  $p<0.05$ ). VEGF, c-met, and Myf-5 in the 8T were less than those in the 4T ( $1.22 \pm 0.07$  vs.  $1.26 \pm 0.08$ ;  $9.46 \pm 2.69$  vs.  $11.47 \pm 2.77$ ;  $6.6 \pm 2.4$  vs.  $9.69 \pm 2.77$ ,  $p<0.05$ ), but more than those in the 8C ( $1.22 \pm 0.07$  vs.  $1.16 \pm 0.08$ ;  $9.46 \pm 2.69$  vs.  $7.22 \pm 2.23$ ,  $p<0.05$ ) except Myf-5 ( $6.6 \pm 2.4$  vs.  $6.73 \pm 2.95$ ,  $p>0.05$ ). In addition, HSP70 in the 8T group was greater than that in the 4T ( $1.63 \pm 0.19$  vs.  $1.4 \pm 0.18$ ,  $p<0.05$ ). Muscle fiber area in the 8T was greater than that in the 8C ( $3478.41 \pm 719.63$  vs.  $3079.63 \pm 695.00 \mu m^2$ ,  $p<0.05$ ).

**CONCLUSIONS:** Moderate endurance training could stimulate satellite cell activation and promote myogenic response at the initial training stage, and it suggests that these activated satellite cells and myogenic events following training is prepared for subsequent muscle hypertrophy. The training-increased response was attenuated when training adaptation occurs, which might partly mediated by upregulation of HSP70 that enhance cytoprotection.

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**2260 Board #148 May 28 3:30 PM - 5:00 PM**  
**Improvements In Plantarflexor Size And Function Following Rehabilitation After Lower Leg Injury**

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*(No relationships reported)*

Rehabilitation following injury and immobilization has a positive impact on muscle recovery. However, muscle atrophy and weakness and recover at different rates following immobilization.

**PURPOSE:** To determine changes in plantarflexor (PF) muscle size and strength in subjects with lower extremity fractures, who underwent immobilization followed by a structured rehabilitation program.

**METHODS:** Subjects included 10 males and 7 females [(20-46 yrs, BMI  $24.8 \pm 4.0$  (mean  $\pm$  std)] who sustained lower leg fractures and were immobilized for at least 4 weeks. Subjects participated in a 6-week rehabilitation program that began immediately following immobilization. The program consisted of progressive resistance training of the ankle PFs and progressive treadmill walking. Measurements were taken immediately prior to and following rehabilitation. T1-weighted, axial images of the lower leg were obtained from MRI (1.5T or 3T) and were used to determine the maximal cross-sectional area (CSA) of the PFs. Maximal voluntary isometric torque of the ankle PFs was measured on a Biodex dynamometer. Peak torque and Time to Peak Torque were analyzed using Acknowledge software.

**RESULTS:** Subjects experienced 23% improvement in PF CSA values after rehabilitation in the injured limb compared to a 4% increase in the noninjured limb. Muscle strength measures also showed an improvement, with a 30% increase in peak torque in the injured limb and 14% in the noninjured limb. Time to Peak Torque showed similar results with a 20% improvement in the involved limb and 15% improvement in the uninvolved limb.

**CONCLUSIONS:** Following a period of immobilization and rehabilitation, muscle size tends to recover to a lesser extent than muscle strength. Improvements in muscle size are observed in the injured limb, whereas substantial muscle strength gains are seen in both the injured and uninjured limbs, which may indicate an improvement in neuromuscular recruitment of the PFs following rehabilitation.

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**2261 Board #149 May 28 3:30 PM - 5:00 PM**  
**Effect Of Slow-speed Vs. Traditional Resistance Training Regimens On Myonuclear Domain And Satellite Cell Content**

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*(No relationships reported)*

**PURPOSE:** The purpose of this study was to investigate muscle fiber adaptations in myonuclear domain and satellite cell content in conjunction with varying degrees of fiber hypertrophy following slow-speed vs. "normal-speed" resistance training protocols.

**METHODS:** Thirty-four healthy adult females ( $21.1 \pm 2.7$  yr.) were randomly divided into four groups: slow-speed (SS), traditional strength (TS), traditional muscular endurance (TE), and non-exercising control (C). Workouts, consisting of 3 sets each of 3 exercises (leg press, squat, and knee extension), were performed 2d/wk for the first week and 3d/wk for the remaining 5 weeks. For each training session, the SS group performed 6-10RM (6-10 repetitions maximum) for each set with 10s con and 4s ecc contractions for each repetition. TS and TE performed 6-10RM and 20-30RM, respectively, at "normal" speed (1-2s/con and ecc contraction). Both TE and SS trained at the

same relative intensity (40-60% 1RM), whereas TS trained at 80-85% 1RM. Pre- and post-training vastus lateralis muscle biopsies were analyzed for fiber cross-sectional area (CSA), myonuclear domain and number, NCAM+ (anti-neural cell adhesion molecule) satellite cells, and fiber type.

**RESULTS:** 1) As previously reported, the CSA of all major fiber types (I, IIA, and IIX) increased post-training for TS, whereas only the fast fiber types increased in size for SS. No significant change in fiber size was found for either the TE or C groups. 2) Myonuclear domain was significantly larger post-training in TS for all major fiber types, whereas only Type IIA domain increased in SS. There were no changes in myonuclear domain for TE or C. 3) Myonuclear number did not differ significantly from pre- to post-training in any group. 4) Satellite cell content increased post-training for TS in all major fiber types, while only NCAM+ nuclei associated with Type IIX and Type IIA fibers increased in SS. No changes in the satellite cell population were observed for TE or C.

**CONCLUSIONS:** Slow-speed resistance training resulted in a larger degree of fiber hypertrophy, increased myonuclear domain, and stimulus to muscle stem cells compared to training with a similar resistance at a normal speed. However, training at a higher intensity (80-85% 1RM) at normal speed resulted in the greatest overall fiber response for each of these variables.

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**2262 Board #150 May 28 3:30 PM - 5:00 PM**

**High Intensity Interval Training Rapidly Increases Skeletal Muscle Oxidative Capacity In Previously Sedentary Middle-aged Adults**

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(No relationships reported)

There is growing appreciation of the potential for high intensity interval training (HIT) to rapidly stimulate metabolic adaptations that resemble traditional endurance training, despite a low total exercise volume (*Exerc Sports Sci Rev* 36:58-63, 2008). However, much of this work has been conducted on young active individuals ( $\leq 30$  yr) and the results may not be generalized to older, less active populations. In addition, many studies have employed "all out", variable-load exercise interventions (e.g., repeated Wingate Tests) that may not be safe, practical or well tolerated by certain individuals.

**PURPOSE:** To determine the effect of a short program of low-volume, submaximal, constant-load HIT on skeletal muscle metabolic adaptations in sedentary middle-aged individuals who may be at higher risk for inactivity-related disorders.

**METHODS:** Inactive but otherwise healthy men ( $n=3$ ) and women ( $n=4$ ) with a mean ( $\pm$ SE) age, body mass index and peak oxygen uptake ( $\text{VO}_{2\text{peak}}$ ) of  $45 \pm 2$  yr,  $27 \pm 2$  kg·m<sup>-2</sup> and  $30 \pm 1$  ml·kg<sup>-1</sup>·min<sup>-1</sup> took part in the study. Subjects performed 6 training sessions over 2 wk. Each session consisted of 10 x 1 min cycling at 60% of peak power elicited during a ramp  $\text{VO}_{2\text{peak}}$  test ( $\sim 90\%$  of maximal heart rate) with 1 min recovery between intervals. Needle muscle biopsy samples (v. lateralis) were obtained before training and  $\sim 72$  h after the final training session.

**RESULTS:** Muscle oxidative capacity, as reflected by the maximal activity of citrate synthase, increased by 22% after training ( $12.9 \pm 0.7$  vs.  $10.6 \pm 0.6$  mmol·kg protein<sup>-1</sup>·h<sup>-1</sup>), which is comparable to changes previously reported after 2 wk of Wingate-based HIT in young active subjects.

**CONCLUSIONS:** A short program of low-volume, constant-load HIT is a time-efficient strategy to rapidly increase skeletal muscle oxidative capacity in previously sedentary middle-aged men and women.

Supported by CIHR.

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**2263 Board #151 May 28 3:30 PM - 5:00 PM**

**Lean And Fat Mass Effects On Bone Mineral Density In Female Athletes And Non Athletes**

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There are many factors that effect bone mineral density (BMD) including physical activity, lean body mass, and fat mass. However, controversial evidence has been found regarding contribution of lean mass and fat mass on BMD in young, premenopausal women.

**PURPOSE:** To investigate the impact of fat mass and lean mass on BMD in college female athletes (ATH) and non athletes (NONATH).

**METHODS:** 111 college females (60 ATH:  $19.3 \pm 1.09$ y; 51 NONATH:  $20.1 \pm 1.40$ y) were assessed for lean body mass (LBM), fat mass (FM), body fat percentage (BF) and BMD by whole body dual-energy X-ray absorptiometry (DXA). A stepwise multiple regression analysis was conducted to determine the impact of body weight (BW), Age, LBM, FM, and BF on BMD for ATH and NONATH.

**RESULTS:** Although BW ( $67.96 \pm 12.49$  kg vs.  $65.32 \pm 9.88$  kg,  $p>0.05$ ) and FM ( $18,976 \pm 9,238$  g vs.  $25,460 \pm 27,890$  g,  $p>0.05$ ) did not differ between ATH and NONATH, ATH had significantly lower BF ( $28.1 \pm 8.7\%$  vs.  $33.9 \pm 8.15\%$ ,  $p<0.05$ ), higher LBM ( $45,750.5 \pm 4,904.10$  g vs.  $40,427.2 \pm 4,709.40$  g,  $p<0.05$ ) and BMD ( $1.24 \pm 0.08$  g/cm<sup>2</sup> vs.  $1.18 \pm 0.08$  g/cm<sup>2</sup>,  $p<0.05$ ) compared with NONATH. For ATH, 48% of the variance in BMD was accounted from LBM ( $R^2=0.33$ ,  $p<0.05$ ), BW ( $R^2=0.06$ ,  $p<0.05$ ) and FM ( $R^2=0.08$ ,  $p<0.05$ ). For NONATH 45% of the variance in BMD was accounted for from BW ( $R^2=0.45$ ,  $p<0.05$ ).

**CONCLUSION:** Although body mass is highly associated with increased BMD in college-aged females, our data suggests increased LBM is a more significant contributor in female athletes. Young women should focus on maintaining healthy body mass and body fat levels while increasing LBM in order to enhance peak bone mass. A higher peak bone mass at this age may prevent BMD losses as women age.

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**2264 Board #152 May 28 3:30 PM - 5:00 PM**

**Sport Specificity And Training Influence Bone And Body Composition In Women Collegiate Athletes**

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This is a novel descriptive study to characterize off-season, pre-season, and post-season bone and body composition measures in women collegiate athletes.

**PURPOSE:** To quantify changes in women collegiate athletes' bone mineral content, bone mineral density (BMD), arm BMD, leg BMD, pelvis BMD, spine BMD, and body composition (i.e., total body mass, lean mass, fat mass, and percent body fat) within each sport through the seasonal periods, and among the sports at each seasonal period.

**METHODS:** 67 women collegiate athletes from softball ( $n=17$ ), basketball ( $n=10$ ), volleyball ( $n=7$ ), swimming ( $n=16$ ), and track jumpers and sprinters ( $n=17$ ) were scanned using dual energy x-ray absorptiometry (DXA) at three seasonal periods: 1) before pre-season training defined as off-season (OFF), 2) at end of preseason training (PRE), and 3) after the competitive season (POST).

summary of **RESULTS:** Repeated measures ANOVA within-sport seasonal changes in table; PRE/POST = highest value measured at PRE or POST.  $\alpha < 0.05$  for all tests of significance.

	Seasonal Period	%Body fat	BMD (g/cm2)	Pelvis BMD (g/cm2)	Spine BMD (g/cm2)
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Softball	OFF	27.1±5.0*	1.254±0.081*	1.385±0.127	1.216±0.149
	PRE/POST	25.7±5.0	1.261±0.082	1.405±0.141	1.268±0.154
Basketball	OFF	25.5±5.5*	1.333±0.064*	1.469±0.123*	1.356±0.178
	PRE/POST	22.7±5.6	1.349±0.055	1.494±0.119	1.391±0.146
Volleyball	OFF	27.7±4.1	1.284±0.065*	1.366±0.139	1.254±0.102*
	PRE/POST	27.1±5.1	1.310±0.071	1.371±0.149	1.360±0.121
Swimming	OFF	22.0±4.3	1.112±0.067	1.110±0.104*	1.063±0.127*
	PRE/POST	21.9±4.1	1.121±0.067	1.124±0.105	1.105±0.126
Track Jumpers and Sprinters	OFF	15.4±4.6*	1.292±0.075*	1.432±0.124*	1.280±0.135*
	PRE/POST	14.3±3.9	1.307±0.080	1.470±0.128	1.337±0.140

Values are means ± standard deviations. \*Significant difference between off-season and pre or post-season

ANOVA for differences by sports at the PRE/POST period showed results for both pelvis BMD and spine BMD as follows: softball = basketball = volleyball = track > swimmers.

**CONCLUSION:** These data serve as sport-specific benchmarks for comparisons at in-season and off-season training periods among women collegiate athletes in various sports. They also serve to document changes in body composition and bone density with training, and may serve to guide coaches in the development of sport specific nutritional and strength and conditioning programs to optimize athletic performance.

*Research supported in part by the Sydney & J.L. Huffines Institute for Sports Medicine and Human Performance*

**2265 Board #153 May 28 3:30 PM - 5:00 PM**  
**Bone Mineral Density And Body Composition Of Collegiate Modern Dancers**

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Weight bearing physical activity is known to increase bone mineral density (BMD) in young women. However women involved in dance often engage in behaviors such as disordered eating that contribute to menstrual dysfunction and decreased BMD. The interrelationships among bone demineralization, menstrual dysfunction, and disordered eating have been studied in ballet dancers but not modern dancers. In question is the degree to which modern dancers exhibit components of the triad as well as if modern dance offers enough impact to increase bone accrual.

**PURPOSE:** To investigate body composition (BC) and BMD in collegiate modern dancers.

**METHODS:** 31 female collegiate dancers (D), 18-25 years of age, and 30 age-matched controls (C) participated in the study. BC and BMD were measured using dual energy x-ray absorptiometry (DXA); upper and lower body strength was assessed by chest and leg press 1-repetition maximum tests. Subjects completed 3-day food records; diet was analyzed using nutritional software. Menstrual dysfunction (MD) and history of eating disorders (ED) was collected via questionnaires. BC and BMD variables were analyzed using MANCOVA & frequency of ED and MD by Chi-Square analysis.

**RESULTS:** Hip and spine BMD were greater in D than C ( $p < 0.05$ ). Total body fat % was lower in D than C ( $25.9 \pm 4.2\%$  vs.  $32.0 \pm 5.9\%$ ;  $p < 0.05$ ), and % of fat distributed in the android region was also lower in D than C ( $28.0 \pm 6.2\%$  vs.  $37.6 \pm 8.6\%$ ;  $p < 0.05$ ). With regard to diet composition only % fat intake was lower in D than C ( $27.54 \pm 6.8\%$  vs.  $31.5 \pm 7.4\%$ ,  $p < 0.05$ ). A greater incidence of ED was reported by D than C ( $12.9\%$  vs.  $0\%$ ;  $p < 0.05$ ), as well as a greater incidence of secondary amenorrhea ( $41.9\%$  vs  $13.3\%$ ;  $p < 0.05$ ). No differences existed for incidence of primary amenorrhea, oligomenorrhea or use of birth control. Correcting for body mass, strength was greater in D than C for both chest press ( $30.1 \pm 0.9$  kg vs.  $28.4 \pm 1.0$  kg;  $p < 0.05$ ), and leg press ( $170.7 \pm 4.2$  kg vs.  $163.1 \pm 3.9$  kg;  $p < 0.05$ ).

**CONCLUSION:** This study indicates that college-aged modern dancers, on average, possess a healthy body weight, yet a higher incidence of ED and MD than found in non-dancing college-aged women. Despite this elevation of two triad components, these dancers possess a high BMD that may be attributed to the imposed impact as well as the strength gains associated with practicing modern dance.

**2266 Board #154 May 28 3:30 PM - 5:00 PM**  
**Musculoskeletal Health Of Male And Female Apprentice Jockeys**

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The typical jockey is small in stature and light in weight. In order to remain within specific weight limits, jockeys often engage in unhealthy weight-loss behaviours that rely on rapid, short-term weight loss and have an increased propensity to engage in disordered eating. Engaging in activities and behaviours that restrict the attainment of peak bone mass during growth produces deleterious musculoskeletal effects in later life. Musculoskeletal responses to prolonged demands of elite physical performance in young adults who regularly experience energy drain from physical activity and disordered eating are relatively unknown. Delayed growth, coupled with intensive training, may predispose apprentice jockeys to repetitive microtraumatic injury to the musculoskeletal system.

**PURPOSE:** (i) to profile the musculoskeletal health of male and female apprentice jockeys and less active, age- and sex- matched peers (control group).

**METHODS:** Two groups of 25 young adults ( $n = 50$ ) (age range 15 - 38 years) comprised of male and female apprentice jockeys, and male and female controls. Peripheral Quantitative Computed Tomography (pQCT) was used to assess musculoskeletal health of the distal tibia and distal radius. Trabecular area and density, cortical area and density, and stress strain index was calculated.

**RESULTS:** After covarying for limb length and weight, apprentice jockeys displayed lesser tibial cortical area and stress strain index at 14%, 38% and 66% sites measured distally ( $p=0.001$ ). No differences between groups were found in cortical density, trabecular area, and trabecular density at the tibia. Apprentice jockeys displayed greater trabecular density at the ultra-distal radial site ( $p=0.001$ ) and greater stress strain index at 66% site measured distally ( $p= 0.01$ ). Control participants showed greater cortical area at 66% radial site ( $p=0.03$ ) and greater stress strain index at the ultra-distal radius ( $p=0.006$ ).

**CONCLUSIONS:** Apprentice jockeys displayed compromised musculoskeletal health at the distal tibia and radius compared to control participants. Only trabecular density at the ultra-distal radius and stress strain index at radial mid-shaft was greater in apprentice jockeys.

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**2267 Board #155 May 28 3:30 PM - 5:00 PM**  
**Dose-dependent Effects And Feasibility Of A Home-based Jumping Program For Bone Health In Women**

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(No relationships reported)

**PURPOSE:** While several studies have shown jumping exercises to benefit the skeleton and may reduce osteoporosis risk later in life, an exercise prescription for improving bone has not been established. Simple, well-tolerated, cost-effective solutions for improving bone mass prior to menopause may potentially improve public health. In preparation for a much larger dose-response study, this pilot study sought to evaluate the feasibility and effectiveness of a home-based jumping program in premenopausal women.

**METHODS:** A total of 31 premenopausal women (aged  $38.5 \pm 9.4$  y) were randomly assigned across 4 jumping groups (8" or 12" step; 10 or 50 jump repetitions), or control for the 15-week study. Women assigned to a jumping group were instructed to step up onto and jump down from their step (two-foot landing) with bare feet on a hard surface, three days per week. Controls maintained their regular physical activity. Women were excluded for medications/conditions known to affect bone, irregular menses, smoking, BMI > 30 kg/m<sup>2</sup>, and regular high-impact activity participation in the past 12 months.

**RESULTS:** Twenty six (84%) women completed the study. Five dropped out due to injuries NOT associated with the program but that prevented their continuation (two from the 12" x 50 group, one from the 8" x 10 group, two from the 8" x 50 group). Overall compliance averaged  $88.4 \pm 11.9\%$  (range 60-100%) and was similar across groups. Subjects tolerated the program well (only one expressed minor joint discomfort). Subjects stated the program was "easy" and only took 30 sec-2 min to complete. Not surprisingly, there were no group differences at baseline and no group effect was observed for measures of femoral neck, greater trochanter, or total hip bone mineral density after the study ( $p > 0.05$ ). Collapsing all jump groups still produced no differences compared to controls.

**CONCLUSIONS:** This pilot study demonstrates that a simple at-home jumping program provides a feasible means to implement safe and controlled impact exercise into the weekly routine of most premenopausal women. The effectiveness of such a program on improving bone mass cannot be established based on this pilot study due to its short duration (15 weeks), but is being investigated in a much larger cohort of premenopausal women over a 9-month period.

*Supported by a Faculty Research Award.*

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**D-34 Free Communication/Poster - Musculoskeletal Mechanics II**

MAY 28, 2009 1:00 PM - 6:00 PM  
ROOM: Hall 4F

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**2268 Board #156 May 28 2:00 PM - 3:30 PM**  
**Influence Of Femoral Anteversion On Hip And Knee Motions During Landing**

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(No relationships reported)

Dynamic malalignment of the hip and knee has been suggested to be predictive of knee injury. While increased femoral anteversion (FA) results in an inward torsion of the femur, it is unknown whether increased FA contributes to dynamic lower extremity malalignments during activity.

**PURPOSE:** To compare hip and knee motions during the entire landing phase of a drop jump in those with above (FA<sub>HIGH</sub>) and below (FA<sub>LOW</sub>) average FA.

**METHODS:** FA was measured on the dominant limb of 52 recreationally active females ( $21.7 \pm 2.7$  yrs,  $163.4 \pm 6.4$  cm,  $59.7 \pm 7.8$  kg). Three-dimensional hip and knee kinematics were measured during 5 bilateral drop-jump landing trials from a height of 45cm. The initial landing phase (initial contact to peak knee flexion) of each trial was normalized to 101 data points, then averaged across the 5 trials for analysis. Subjects were classified as FA<sub>HIGH</sub> or FA<sub>LOW</sub> based on the average FA in the overall sample (12.8°). Separate group (FA<sub>HIGH</sub>, FA<sub>LOW</sub>) by time (% landing phase) repeated measures ANOVA compared FA groups on frontal and transverse plane hip and knee motions across the entire landing phase. For significant group by time interactions, post hoc comparisons for each 10% increment determined where in the landing phase groups differed.

**RESULTS:** No main effect for group was identified across the entire landing phase for any joint motion (all  $P$  values > 0.10). Group by time effects were observed for both frontal and transverse plane knee motions ( $P < 0.001$ ). FA<sub>LOW</sub> knees moved into slight knee varus (~2°) whereas FA<sub>HIGH</sub> remained near neutral from 0-20% of the landing. FA<sub>HIGH</sub> then moved into (21-50%) and remained in (51-70%) greater knee valgus, resulting in ~5° greater valgus than FA<sub>LOW</sub> at mid landing. For knee rotation, both groups internally rotated similar amounts (~6°) from 0-30%, then FA<sub>HIGH</sub> knees externally rotated (~4°) while FA<sub>LOW</sub> knees remained near neutral rotation from 41-100% of the landing phase.

**CONCLUSIONS:** Greater structural FA may influence tibiofemoral orientation resulting in more knee valgus and external rotation motion during landing. This work is limited to a single alignment measure and ongoing work is examining a more complete lower extremity postural profile on dynamic malalignments that are known to be predictive of lower extremity injury.

*Supported by NIH-NIAMS Grant R01- AR53172*

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**2269 Board #157 May 28 2:00 PM - 3:30 PM**  
**Possibility For Assessing Low-force Muscle Activation With Real-time Magnetic Resonance Imaging Combined With Vascular Occlusion**

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Magnetic resonance imaging (MRI) offers a great potential for understanding neuromuscular characteristics and activation of human skeletal muscle. The assessment of muscle activation has been made with non real-time MRI, but was possible only for muscle contractions with moderate to high-force production. We hypothesized that an application of real-time MRI combined with vascular occlusion may overcome this limitation.

**PURPOSE:** The purpose of this preliminary study was to explore the possibility for using real-time MRI combined with vascular occlusion for assessing muscle activation during low-force contractions (< 20% of maximum voluntary contraction, MVC).

**METHODS:** Healthy young adults performed isometric plantar flexion in a 1.5-Tesla MR magnet, using a custom-built MRI-compatible foot-pedal device. The isometric plantar flexion was at low intensities (5, 10, and 20% of MVC) for 1 min with and without vascular occlusion at the proximal end of the thigh by means of a pressure tourniquet (100 mmHg). The knee joint was fully extended and the ankle joint was in the neutral position. Axial mid-calf echo-planar images (repetition time/echo time, 6,000/15.4 ms, 1 cm slice thickness, 40 x 40 cm field-of-view, 64 x 128 imaging matrix) were acquired for 1 min (6 s x 10 phases) before and during the low-intensity plantar flexion. Mean signal intensity (SI) was calculated from the central portion of the medial gastrocnemius muscle at rest and during contractions at each force level with and without vascular



occlusion.

**RESULTS:** With an increase in force level, SI remained low or increased only slightly (4.8~6.2%) without the vascular occlusion in the two tested subjects. With vascular occlusion, SI showed a remarkable elevation (7.0~8.2%) with an increase in force during each contraction in both subjects.

**CONCLUSION:** The preliminary results demonstrated a possibility that real-time MRI may be utilized for assessing muscle activation even during low-force contractions based on enhanced increases in signal intensity if it is combined with vascular occlusion.

*Supported by Tateishi Science and Technology Foundation.*

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**2270 Board #158 May 28 2:00 PM - 3:30 PM**  
**Prolonged Alterations In Hindlimb Emg Following Acl Transection In An Experimental Model Of Osteoarthritis**

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*(No relationships reported)*

Alterations in knee joint loading and hind limb kinematics following anterior cruciate ligament transection (ACLT) have been associated with the onset of osteoarthritis (OA) through a reduction in joint loads. Knee joint loads have been directly measured nine days following ACLT, and subsequent changes in joint kinematics have been documented over the span of one year. However, the magnitude and duration of muscle activation adaptations in the hindlimb remain unknown following ACLT.

**PURPOSE:** To quantify long-term changes in cat hindlimb muscle activation patterns following ACLT.

**METHODS:** In this pilot study, indwelling bipolar electromyographic (EMG) electrodes were surgically implanted in four synergist muscle pairs on the cat hindlimb: rectus femoris (RF) and vastus lateralis (VL); semitendinosus (ST) and semimembranosus (SM); extensor digitorum longus (EDL) and tibialis anterior (TA); and medial gastrocnemius (MG) and soleus (SOL). EMG and high speed video data were recorded during level treadmill walking before ACLT and at 1, 2, 3, 4, and 6 weeks, and at 2, 6, 8, and 9 months following ACLT.

**RESULTS:** Following ACLT, there was a reduction in mean EMG activation of the VL during stance, with an immediate increase in mean EMG amplitude in the RF during swing phase only. Both the SM and ST increased activity during stance phase for nine months after ACLT. Following ACLT, the EDL exhibited an extra burst of activity just prior to, or at paw strike in addition to the increased activity at paw off. Activity in the MG also increased during stance up to nine months, and the onset of muscle activation occurred earlier following ACLT for the SOL and MG.

**CONCLUSION:** Following ACLT the knee flexor and extensor muscles demonstrate compensatory activation patterns that may stiffen the hindlimb, and predispose the knee joint to increased loads. The two-joint EDL muscle is recruited at paw strike following ACLT, suggesting that this muscle may function to assist in stabilizing the ACL deficient joint as a knee extensor in co-contraction with the hamstring muscles. Furthermore, long term increases in activation of the dorsiflexor and plantarflexor muscles during stance may further contribute to increasing joint loads leading to OA.

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**2271 Board #159 May 28 2:00 PM - 3:30 PM**  
**Effect Of Tendon Stiffness And Leg Stiffness On Running Economy In Well-trained Middle Distance Runners**

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**PURPOSE:** Previous research suggests that a stiff 'leg spring' during running can provide significant energy savings from the elastic properties in the leg's soft tissues. Knowing that the absorption and recovery of elastic energy in muscle-tendon units is important in determining the energy cost of running, researchers have used the leg stiffness measured during the ground contact phase in running as a surrogate for muscle-tendon stiffness. However, no research has examined both the leg spring stiffness and the stiffness of the major tendons simultaneously. The aim of the present study was to examine how leg stiffness and the mechanical properties of the primary ankle and knee tendons influence running economy.

**METHODS:** Eleven well-trained male middle distance runners volunteered for the study. Medial gastrocnemius (MG) and vastus lateralis (VL) tendon force-elongation properties were measured during an isometric maximal voluntary contraction. Tendon forces were determined from joint moments measured by isokinetic dynamometry, corrected for agonist-antagonist co-contraction and joint rotation. Tendon elongation was measured using B-mode 2-D ultrasonography. Eccentric leg stiffness was measured during over-ground running using a previously published kinetic model. Total leg stiffness of the entire ground contact phase was derived from kinetic and kinematic measures. Running economy was measured using a standardised incremental treadmill protocol.

**RESULTS:** Analysis revealed no correlation with MG or VL tendon stiffness and either eccentric ( $r = -0.03$  and  $r = -0.07$ , respectively) or total leg stiffness ( $r = -0.06$  and  $r = 0.16$ , respectively). Leg stiffness was not correlated with running economy; however, MG tendon stiffness and peak ankle joint moment were significantly correlated with economy ( $r = -0.66$  and  $r = -0.68$ , respectively).

**CONCLUSIONS:** Leg stiffness does not appear to be a surrogate for tendon stiffness and is not predictive of running economy in well-trained runners. Leg stiffness might be influenced by changes in leg mechanics or muscular co-contraction. Interestingly, Achilles tendon stiffness tends to be greater in more economical runners. Faster tendon recoil, indicative of stiffer tendons, could benefit power generation at the ankle joint during high speed running.

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**2272 Board #160 May 28 2:00 PM - 3:30 PM**  
**Effects Of Different Landing Conditions On Vertical Impact Forces**

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*(No relationships reported)*

Impact loading has been shown to be an effective means to stimulate bone adaptation. Both the size of the forces and the rate of the forces are important for bone changes.

**PURPOSE:** To determine how vertical impact forces are affected by different landing strategies.

**METHODS:** Sixteen subjects aged 18-25 years with no previous landing training were recruited. Three different landing strategies were randomly assigned on three different days: natural (N), hard (H), and soft (S) landing. Subjects stepped off of boxes at 26cm (Low) and 56cm high (High) with and without shoes in each of the three conditions onto two Kistler force plates set at 600 Hz. Shoes, instructions, and defined "good landings" were standardized. Five good trials were collected for each condition. Peak vertical ground reaction force (maxFz) and rate of maximum force development (RFD) were normalized for body weight (BW) and are given for a single leg. All results were analyzed for the stepping side leg using a repeated measures factorial design with  $p < 0.05$ .

**RESULTS:** Most measures were influenced by strategy and height, but not shoes. MaxFz differed by strategy (3.2±0.2, 4.0±0.2 and 1.9±0.1 BW for N, H, and S, respectively) by shoes (2.9±0.1 and 3.1±0.1 BW for shoes and no shoes, respectively) and by height (2.6±0.1 and 3.4±0.1 BW for Low and High, respectively) ( $p < 0.05$ ). The time to the maximum Fz differed by strategy (0.05±0.002, 0.04±0.004 and 0.06±0.004 s for N, H, and S, respectively), by height (0.06±0.002 and 0.04±0.002 s for Low and High,

respectively), and illustrated an interaction between the two ( $p < 0.05$ ). The downward phase time showed differences based on strategy and on height ( $p < 0.05$ ). There was also an interaction between strategy and height ( $p < 0.05$ ). RFD showed differences based on strategy and height ( $p < 0.05$ ).

**CONCLUSIONS:** The various landing conditions clearly illustrated an effective manner in which large magnitude forces can be applied to the lower extremity. Additionally, the rate of this force development is quite large and thus, training involving these landings could be a useful tool for bone adaptation.

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**2273 Board #161 May 28 2:00 PM - 3:30 PM**  
**Eccentric Exercise Alters The Kinematic Structure Of Pointing Movements**

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(No relationships reported)

It is known that the performance of eccentric muscle contractions often leads to delayed muscle soreness accompanied by declines in strength and isometric force steadiness. However, the effect of eccentric exercise on the performance of a dynamic motor task is not clear.

**PURPOSE:** To examine the effects of a bout of eccentric exercise on kinematic measures related to accuracy (i.e. submovements) during spatially-constrained pointing movements.

**METHODS:** 17 untrained subjects (10 M, 7 F;  $26 \pm 3$  yrs.) performed 20 rapid discrete elbow-extension pointing movements with their right arm before, immediately after (fatigue and muscle damage), and 24-hours after (muscle damage only) fatiguing eccentric exercise on a isokinetic dynamometer. Endpoint (fingertip) movement kinematics were obtained for each pointing trial and examined for secondary submovements identified by zero crossings in the tangential velocity and acceleration profiles.

**RESULTS:** MVC force declined by 44% immediately after eccentric exercise and remained depressed (22%) 24-hrs after the exercise indicating the existence of muscle damage. Movement times were slower and peak velocity decreased immediately after, and only partially recovered 24-hrs after the exercise compared with before ( $222 \pm 40$ ,  $248 \pm 37$  and  $238 \pm 42$  ms,  $P < 0.05$ ;  $3.4 \pm 0.6$ ,  $3.1 \pm 0.6$  and  $3.3 \pm 0.7$  m/s,  $P < 0.01$ ). Only 8% of the trials exhibited submovements before the eccentric exercise, however that number grew to 87% of trials immediately afterward and 29% of trials 24 hrs after. In those trials requiring submovements, subjects traveled  $85 \pm 8$ ,  $64 \pm 6$  and  $72 \pm 11\%$  ( $P < 0.001$ ) of the total movement time before using a secondary submovement.

**CONCLUSIONS:** These results demonstrate that kinematic measures associated with movement accuracy are altered from eccentric exercise and only partially restored after 24 hrs.

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**2274 Board #162 May 28 2:00 PM - 3:30 PM**  
**Effects Of Drop Landing Height On Lower Extremity Joint Contact Forces**

Danielle D. Barkema, W. Brent Edwards, Timothy R. Derrick. *Iowa State University, Ames, IA.* (Sponsor: Philip E. Martin, FACSM)

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(No relationships reported)

The impact phase of loading has long been associated with osteogenesis and lower extremity skeletal injuries. Although reaction forces increase with drop landing height, they comprise only a small portion of the joint loading environment. The true loading experienced by the joints can only be realized when muscle forces are taken into consideration.

**PURPOSE:** To determine the effects of drop landing height on lower extremity joint contact forces

**METHODS:** Nine subjects completed ten landings from three heights in a random order (26, 39, and 52 cm). Electromyographical, force platform and kinematic data were collected concurrently. Musculoskeletal modeling and computer optimization techniques were used to determine muscle forces of the lower extremity. Electromyographical data were used to validate muscle optimizations, and joint contact forces at the hip, knee, and ankle were calculated by summing the reaction and muscle forces at each joint. Peak instantaneous joint contact forces during the impact phase (200 ms) were determined. Differences in joint contact forces were compared between conditions using a repeated measures ANOVA with Tukey's post-hoc tests.

**RESULTS:** The knee and hip contact forces significantly increased with drop height. The ankle contact force during the 52 cm drop height was significantly larger than the 26 cm drop height. Respectively, joint compressive contact forces for the 26, 39, and 52 cm drop heights were as follows: ankle 6.8, 7.7, and 8.7 body weight (BW), knee 9.5, 10.5, 12.1 BW, hip 8.6, 9.9, 11.8 BW. Ground reaction forces contributed 20 to 28% of joint contact forces during drop landings.

**CONCLUSION:** The results show an evident increase in ground reaction forces and joint contact forces with an increase in drop landing height. However, ground reaction forces account for only a small portion of joint loading during drop landings. Muscle forces substantially contribute to the joint loading environment. The results suggest that conventional methods using external forces and ground reaction forces may drastically underestimate force experienced by the joint.

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**2275 Board #163 May 28 2:00 PM - 3:30 PM**  
**Evidence Of Central And Peripheral Fatigue After A Functional Fatigue Protocol**

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(No relationships reported)

Muscle fatigue often occurs during athletic participation, and may lead to injury. The mechanisms that produce muscular fatigue during intermittent, multi-directional exercise (e.g., soccer or basketball) remain unknown. We propose that central activation failure (CAF) will account for a major portion of the decrease in muscle force production that occurs during a functional fatigue protocol (FFP) designed to simulate high-level activities.

**PURPOSE:** To determine the extent of central and peripheral fatigue during a FFP in unimpaired individuals.

**METHODS:** Fourteen (7 M, 7 F) recreationally-active participants volunteered for this study (age:  $21 \pm 2$  years, height:  $175 \pm 9$  cm, mass:  $68 \pm 8$  kg). The FFP consisted of a maximum-effort timed 90m agility course and 5 standing broad jumps for maximum distance. The FFP was repeated (with a 5-sec rest between each repetition) until the time to complete the agility course exceeded 150% of the initial repetition. Voluntary (MVC) and electrically-elicited (EEC) peak isometric quadriceps torque, and maximum vertical jump height (VJ), were measured pre- and post-FFP. Central fatigue was assessed by using the twitch superimposition technique to measure CAF in the quadriceps. A 130V, 10 pulse train of electrical impulses (lasting 100ms) were delivered via two electrodes placed over the quadriceps during a 3s MVC. Peak torque was calculated 100ms prior to, and immediately after the initiation of the electrical pulses. CAF was calculated as the change in peak torque (EEC-MVC) divided by the EEC torque. Peripheral fatigue was assessed by examining the change in EEC torque. Paired t-tests and bivariate correlations were performed to analyze the results between conditions.

**RESULTS:** CAF increased post-fatigue (pre:  $3.5 \pm 2.8\%$ ; post:  $10.2 \pm 6.2\%$ ,  $p = 0.004$ ). Both MVC ( $166.4 \pm 40.1$  Nm to  $139.1 \pm 42.3$  Nm,  $p = 0.010$ ) and EEC ( $172.7 \pm 41.8$  Nm to  $153.7 \pm 40.7$  Nm,  $p = 0.018$ ) decreased post-fatigue. The change in CAF was highly correlated to the loss of MVC torque ( $r = 0.797$ ), explaining 59.4% of the variance ( $p = 0.002$ ). VJ also decreased post-fatigue ( $48.5 \pm 8.3$  cm to  $45.4 \pm 11.8$  cm,  $p = 0.034$ ).

**CONCLUSION:** This FFP produces significant levels of central and peripheral fatigue and decreases isometric quadriceps force and VJ height. The loss of voluntary muscle force is significantly related to the change in CAF.

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**2276 Board #164 May 28 2:00 PM - 3:30 PM**

## Contribution Of The Deltoid To The Early Stages Of Shoulder Abduction

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The deltoid is the largest muscle on the lateral portion of the pectoral girdle and it is considered an agonist in many shoulder movements. There is some question, however, about the extent to which it contributes to the early stages of various shoulder movements.

**PURPOSE:** To investigate the joint moment produced by the deltoid in the first 90 degrees of shoulder abduction.

**METHODS:** The shoulder abduction moment of 31 subjects (16 males mean + SD age: 19.0 + 1 y; height: 1.7 + 0.2 m; body mass: 70 + kg, and 15 females mean + SD age: 20.0 + .75 y; height: 1.52 + 0.1 m; body mass: 54 + 10 kg) was tested with selective deltoid stimulation using a monophasic surface electrical generator. The shoulder abduction moment in the frontal plane was measured at shoulder joint angles of 5, 30, 60, and 90 degrees. The peak torque (Nm) of each trial was recorded by an isokinetic dynamometer.

**RESULTS:** The mean torque was highest (14.03 + 7.23 Nm) when the shoulder joint angle was 5 degrees and decreased in a linear fashion as the shoulder moved to 90 degrees, where the mean torque was 3.13 + 2.21 (Nm). There were no differences by gender.

**CONCLUSION:** The deltoid appears to contribute substantially to shoulder abduction in the early stages of the movement. The initial phases of shoulder abduction apparently create a favorable length for the moment arm of the deltoid, which facilitates its work in the early stages of abduction.

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## 2277 Board #165 May 28 2:00 PM - 3:30 PM

### Simulated Reduction in Hip Abductor Muscle Forces Increase Femoral Neck Stress During Running

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(No relationships reported)

**PURPOSE:** Koch's model of the hip indicates that during the single support phase of gait the hip abductor muscles must counter the varus torque created by the weights and inertial forces of the head, arms and torso. If these muscles become fatigued (especially gluteus medius) they may fail to counter the large varus bending moment in the neck of the femur and thus increase the stress on the superior neck. The purpose of this study was to quantify the increased stress in the superior femoral neck as a result of reduced gluteus medius tension during running.

**METHODS:** Ten experienced male runners (age 22.2 ± 3.2 yrs, height 1.8 ± 0.1 m, mass 69.8 ± 6.5 kg) ran ten trials at their preferred running velocity (4.4 ± 0.5 m/s). Motion-capture (120 Hz) and force platform data (1200 Hz) were collected and three dimensional moments were calculated at the hip, knee, and ankle joints using inverse dynamics. Kinematics were imported into a scaled SIMM model to estimate maximal forces, muscle orientations, and muscle moment arms for 44 lower extremity muscles. Estimations of actual muscle forces using a static optimization procedure found the set of forces that minimized the sum of the muscle stresses squared. Femoral neck geometry was assumed to be an effective hollow cylinder with radii that were chosen such that a scaled FEM model produced stresses that were matched to those calculated from beam theory (radius=1.7 cm). Gluteus medius forces were then reduced in the beam model from about 2 body weights (BW) to 0 BW in 10% increments. Peak superior femoral neck normal stresses were noted.

**RESULTS:** Femoral neck stresses increased from 25.6 MPa with no reduction of the abductors to 43.3 MPa when the abductors were completely removed. This was a 1.8% increase in stress for every 10% reduction in abductor force.

**CONCLUSIONS:** Even though the hip contact forces were reduced from 14 to 12 BW's as gluteus medius forces were reduced, stress on the superior femoral neck was substantially increased. The gluteus medius produced a valgus bending moment at the neck that countered the varus moment caused by the upper body. A fatigued gluteus medius may have decreased force production and therefore femoral neck stress fracture potential may be increased.

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## 2278 Board #166 May 28 2:00 PM - 3:30 PM

### Vastus Lateralis Fascicle, Muscle-tendon Complex, And Tendon Length During Three Resistance Training Exercises

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(No relationships reported)

Closed kinetic chain resistance exercises are thought to be more beneficial than open chain because they are more functional. This benefit could be attributed to differences of muscle-tendon complex (MTC), fascicle (FAS) and tendon (TEN) length changes during closed and open chain exercises.

**PURPOSE:** To compare the vastus lateralis (VL) MTC, FAS, and TEN length changes between the eccentric and concentric components of squat, leg press, and leg extension exercises.

**METHODS:** Eleven female subjects (21-25yrs) performed 4 repetitions of each exercise with an 8 RM load at a self-selected speed. While performing each exercise, FAS length and pennation angle of the VL were measured using ultrasonography. Knee angle was monitored with an electrical goniometer and VL EMG with surface electrodes. The MTC was calculated from knee angle and femur length. TEN was calculated as the difference of MTC length and the cosine function of FAS length. The length changes were compared over a knee flexion range of motion of 20-90° in each exercise.

**RESULTS:** MTC, FAS, and TEN length changes were not different between concentric and eccentric contractions in any of the exercises nor were there differences among exercises, but, in general, length changed as expected during the motion. MTC length changed significantly between 20-90° (26.2±1.7 vs. 31.7±1.3, p<0.05) with a greater change from 20-55° than 55-90°. FAS length changed significantly between 20-90° (6.6±1.0 vs. 10.2±0.9, p<0.05) with a greater change from 20-55° than 55-90° in the leg extension and squat but not leg press. TEN length changed significantly only between 20-55° (20.0±1.9 vs. 21.7±1.4, p<0.05). Angular velocity was greatest during squat (squat 76±26°/s, leg press 58±24°/s, leg extension 52±13°/s, p<0.05) and concentric muscle action (71±24°/s vs. 53±15°/s eccentric). The rate of fascicle shortening and lengthening was greatest during the squat (squat 4.9±2.7cm/s, leg press 3.5±1.8cm/s, leg extension 2.1±0.8cm/s, p<0.05), but there was no difference in absolute rate between concentric and eccentric actions.

**CONCLUSIONS:** Despite the inherent differences in weight bearing and differences in angular and fascicle velocity in the 3 exercises, there were no differences in VL MTC, FAS, and TEN length between exercises or between concentric and eccentric muscle actions.

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## 2279 Board #167 May 28 2:00 PM - 3:30 PM

### Neurological Insufficiency: The Biceps Brachii Potential In Pronated Elbow Flexion

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(No relationships reported)

Studies have shown that elbow flexors, such as the biceps brachii (BB), have varying roles of contribution based on radio-ulnar positioning. Specifically, the BB is suggested to be least active during elbow flexion in a fully-pronated position. The mechanism of this decrease in the BB's contribution is unclear, but may be attributed to a selective de-recruitment, resulting from possible insufficiency at the radio-ulnar joint. Given the established relationship between muscle activity and internal and external counter-moments,

it is logical to suggest that by increasing the external pronation moment, the BB will in turn increase its contribution to elbow flexion.

**PURPOSE:** To determine the recruitment potential of the BB during a fixed external elbow moment using variable external pronation moments.

**METHODS:** Eight healthy males (Age= 25.5 ± 8.38 years) served as participants, and gripped a weighted bar (2.49kg & 77cm) with the dominant elbow flexed at 90° and the radio-ulnar joint in a fully pronated position. The bar was held statically in 3 positions for 2 seconds each: Position 1) the bar's center of mass (COM) - No Pronation Moment (NPM), Position 2) 18.5 cm from the bar's COM - Pronation Moment 1 (PM1), and Position 3) 37.5cm from COM - Pronation Moment 2 (PM2). Participants' percent maximal volitional isometric contraction (%MVIC) electromyography (EMG) data were collected. A repeated measures ANOVA was conducted to determine if there was a difference in the magnitude of pronation moment and activity of the BB.

**RESULTS:** A significant difference in BB activity was noted amongst the three conditions, ( $F_{1,7} = 42.40$ ,  $p < .001$ ,  $h^2 = .867$ ). Post hoc testing demonstrated a significant difference between PM1 and NPM ( $p < .05$ ), a significant difference between PM1 and PM2 ( $p < .01$ ), and a significant difference between PM2 and NPM ( $p < .001$ ).

**CONCLUSIONS:** The results indicate the relationship between external pronation moments and the increase in the BB's muscle activity for the same elbow resistance. Future research will investigate pronator muscle strengthening programs which could result in a neurological increase in the BB's contribution as an elbow flexor in a pronated position, applicable to various physical activities and occupations.

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**2280 Board #168 May 28 2:00 PM - 3:30 PM**

**The Effect Of Isolated Gastrocnemius Contracture And Surgical Gastrocnemius Recession On Strength And Function**

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Isolated gastrocnemius contracture (IGC), characterized as reduced ankle dorsiflexion with full knee extension, has been linked to foot injuries limiting function and activities of daily living. Patients with IGC may be unable to produce normal plantarflexion force. Gastrocnemius recession surgery has been shown to increase function and dorsiflexion range of motion, but the impact on force production is unknown.

**PURPOSE:** To determine the effect of gastrocnemius recession surgery on function and force production.

**METHODS:** 7 legs with IGC (51 years, 83.78 kg, 1.69 m) and 23 control legs (48 years, 74.19 kg, 1.72 m) performed isometric plantarflexion at maximum ankle dorsiflexion with full knee extension. Subjects with IGC were tested pre- and 3 months post-surgery at their maximum ankle dorsiflexion angle. The Foot and Ankle Ability Measures (FAAM) questionnaire was used to evaluate function. Passive ankle dorsiflexion range of motion (PROM) was measured with the knee in full extension using a bi-plane goniometer.

**RESULTS:** Post-surgery, subjects with IGC had significantly ( $p < 0.01$ ) increased self reported function (91% vs. 59%) and global rating (86% vs. 48%) scores, but these were slightly lower than scores reported by control subjects. PROM significantly ( $p < 0.001$ ) increased post-surgery from 0° to 13°, and was not different from control subjects (14°). There was a 10% increase in isometric plantarflexion strength post-surgery, however significant ( $p < 0.05$ ) weakness persisted compared to control subjects (~ 35 %).

**CONCLUSION:** Gastrocnemius recession surgery is a beneficial treatment option for patients with IGC. Increased function, dorsiflexion range of motion, and plantarflexion strength were observed post-surgery. Although improvements were noted following gastrocnemius recession, subjects were still weaker than controls and therefore may benefit from organized post-surgical rehabilitation. Supported in part by Synthes, Inc. and NIHR01AR040408.

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**2281 Board #169 May 28 2:00 PM - 3:30 PM**

**Effect Of Knee Joint Angle On Quadriceps Muscle Force Steadiness**

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Force control is often assessed by evaluating the steadiness of force/torque curves during submaximal isometric contractions. The effect of knee angle (muscle length) on quadriceps force steadiness is unclear; however, evidence suggests that the CNS compensates for changes in contractile properties associated with changes in muscle length by modulating motor unit recruitment and discharge properties. Researchers have suggested that these same motor unit properties are primary determinants of muscle force steadiness.

**PURPOSE:** To assess the effect of knee angle on quadriceps force steadiness and muscle activation strategies.

**METHODS:** Twenty people (26.5 ± 4.4 years) with no significant knee injuries underwent quadriceps muscle force steadiness testing at 30° & 90°. The subjects' objective was to precisely match linear torque targets of 2%, 10%, 20%, 30%, and 50% maximum that were presented independently in random order. Force steadiness was quantified using the coefficient of variation (COV) and percent error of the subjects torque curves. The muscle activation strategies of five thigh muscles used during testing were evaluated in both time and frequency domains using surface electromyography.

**RESULTS:** The COVs and percent errors for the subjects' torque curves at 90° of knee flexion were significantly greater ( $P < 0.05$ ) than those for their torque curves recorded at 30° of flexion. The magnitudes of quadriceps (agonist) and hamstrings (antagonist) muscle activity were also significantly higher at 90° of knee flexion ( $P < 0.05$ ). Although there were significant differences in antagonist activity at submaximal force-levels, antagonist muscle activity did not differ between 30° & 90° of knee flexion during MVIC trials ( $P = 0.4$ ). The median frequency of the quadriceps muscle activity recorded at 30° of knee flexion was significantly higher than that recorded at 90° of flexion ( $P < 0.05$ ).

**CONCLUSIONS:** Knee angle has a significant effect on quadriceps force steadiness and muscle activation during isometric knee extension. The reduced force steadiness and increased muscle activation at 90° of knee flexion may be related to increased motor unit synchronization at longer muscle lengths and/or the use of different neuromuscular control strategies at the two angles.

Supported by NIH Grant K12 HD055931.

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**D-35 Free Communication/Poster - Physical Activity and Cognitive Function**

MAY 28, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**2282 Board #170 May 28 3:30 PM - 5:00 PM**

**Aerobic Fitness And Cognitive Variability In Children**

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It has been suggested that aerobic fitness mediates the executive control of attention in preadolescent children. Recently, it has been found that cognitive variability is

uniquely predictive of cognitive function in adult populations. However, it is not clear if aerobic fitness provides similar mediation to cognitive variability in children.

**PURPOSE:** To examine the influence of aerobic fitness on cognitive variability in preadolescent children during performance of a task requiring activation of the three attentional networks.

**METHODS:** 46 children were separated into a higher fit (n= 24; age 9.8 years) or a lower fit (n=22; age 9.9 years) group based on VO<sub>2</sub> max testing results using a modified Balke protocol. To assess cognitive function participants completed the Attention Network Test (ANT), which combines the cued reaction time paradigm and the Eriksen flanker task. Mean response time (RT) and standard deviation (SD) were calculated along with the coefficient of variation (CV) to control for group differences in response time.

**RESULTS:** Examination of mean RT revealed no significant group differences. Examination of RT variability revealed that the higher fit participants had lower relative variability compared to the lower fit participants in the neutral condition (0.217 vs. 0.245), but not the congruent (0.222 vs. 0.234) or the incongruent conditions (0.206 vs. 0.199) of the flanker task.

**CONCLUSIONS:** Aerobic fitness appears to selectively mediate cognitive variability in children during task components requiring simple stimulus discrimination, but not during task components requiring activation of the executive attention network.

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**2283 Board #171 May 28 3:30 PM - 5:00 PM**  
**Physical Activity And Cognitive Processing In Older Men And Women**

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Survey data indicate that physical activity is associated with higher cognitive processing in older individuals, but this has not been assessed using accelerometry.

**PURPOSE:** To determine if physical activity assessed with accelerometry is associated with cognitive processing in older men and women.

**METHODS:** Twenty two subjects performed a battery of neurocognitive tests that included: simple reaction time, code substitution, code substitution delayed, logical reasoning, mathematical processing, running memory, and Sternberg memory recall. The outcome variables for the specific tests, with the exception of simple reaction time, were response speed (RES), number of correct responses (COR), and throughput (THR) (correct responses/minute). Subjects wore an accelerometer (ActiGraph) for 7 days to measure moderate and vigorous lifestyle and walking/running physical activity. Accelerometer data were processed using the Crouter 2 Regression model.

**RESULTS:** Subjects were (mean  $\pm$  SD) 72  $\pm$  6 years and had a Mini Mental State Exam (MMSE) score of 28  $\pm$  2. Minutes of vigorous intensity lifestyle (2  $\pm$  3 min/day), moderate intensity (4  $\pm$  6 min/day), and vigorous intensity (0 min/day) walking/running physical activity were excluded from the analysis due to low volume. We found no relationship between moderate lifestyle physical activity and simple reaction time (RES: r = -0.30, p = 0.17; THR: r = 0.33, p = 0.13), code substitution (RES: r = 0.02, p = 0.94; COR: r = 0.06, p = 0.80; THR: r = 0.10, p = 0.66), code substitution delayed (RES: r = -0.03, p = 0.90; COR: r = -0.25, p = 0.27; THR: r = -0.09, p = 0.69), logical reasoning (RES: r = -0.07, p = 0.77; COR: r = -0.38, p = 0.08; THR: r = -0.01, p = 0.95), mathematical processing (RES: r = -0.08, p = 0.74; COR: r = -0.29, p = 0.21; THR: r = -0.19, p = 0.40), running memory (RES: r = -0.32, p = 0.15, COR: r = -0.24, p = 0.30; THR: r = 0.01, p = 0.98), and Sternberg memory recall (RES: r = 0.03, p = 0.88; COR: r = -0.25, p = 0.26; THR: r = -0.02, p = 0.92).

**CONCLUSION:** We found no relationship between moderate physical activity and cognitive processing. Potentially, our findings resulted from the high levels of cognitive function and/or low levels of vigorous physical activity in this sample.

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**2284 Board #172 May 28 3:30 PM - 5:00 PM**  
**The Effects Of Acute Exercise And Nutrition On Cognition In Healthy Older Adults**

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Normal aging is associated with declines in cognition (e.g. executive function, attention). Long-term exercise has been shown to enhance cognitive function in older adults and acute exercise has been shown to improve cognitive function in young adults. Selected nutrients and dietary patterns have also been related to improved cognitive function.

**PURPOSE:** To compare cognition after a moderate exercise bout (EX) and a nutrient dense meal (ND) to cognition after a low nutrient dense meal (LND) in older adults.

**METHODS:** Nineteen adults (70  $\pm$  5 yrs old; 5 males) each completed three randomized visits. A cognitive function battery was done 3 hours after meal consumption and/or 10 minutes after exercise. The computerized battery of 9 tests included both executive function and attention tasks; accuracy and speed were measured. The visits were (1) EXND (EX= 30 mins of exercise at 50-60% heart rate reserve after a high nutrient density meal (ND= plant-based foods rich in unsaturated fats including N-3 fatty acids, fiber, folate, K+, antioxidants, and low saturated fat, (2) consumption of ND meal and (3) consumption of a low nutrient dense meal (LND= animal based food including high saturated fat, methionine, and low unsaturated fats, fiber, K+, folate, and antioxidants).

**RESULTS:** EXND and ND did not result in better cognitive scores compared to LND (see table). Executive function during a card prediction task was more accurate in ND compared to EXND (p=0.02).

**CONCLUSIONS:** A single bout of exercise did not improve cognitive function in older adults. Furthermore a single ND meal did not improve cognitive function as compared to a single LND meal but it does not rule out that chronic exercise or ND meal pattern may improve cognitive function in older adults.

	VISIT TYPE		
	LND	ND	EXND
COGNITIVE TEST	Speed (mean $\pm$ SD, log transformed)		
Attention	2.62 $\pm$ 0.10	2.67 $\pm$ 0.09	2.64 $\pm$ 0.08
Executive function	3.19 $\pm$ 0.17	3.23 $\pm$ 0.12	3.25 $\pm$ 0.16
Spatial learning	3.46 $\pm$ 0.15	3.47 $\pm$ 0.15	3.45 $\pm$ 0.14
Reaction time	2.75 $\pm$ 0.08	2.73 $\pm$ 0.06	2.73 $\pm$ 0.06
	Accuracy (mean $\pm$ SD, arcsine transformed)		
Attention	1.13 $\pm$ 0.13	1.13 $\pm$ 0.11	1.16 $\pm$ 0.17
Executive function	0.98 $\pm$ 0.15	0.98 $\pm$ 0.09	0.90 $\pm$ 0.11
Spatial learning	0.74 $\pm$ 0.25	0.72 $\pm$ 0.27	0.74 $\pm$ 0.24



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2285 Board #173 May 28 3:30 PM - 5:00 PM

**Effects Of Square-stepping Exercise On Behavioral Speed In Older Adults**

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Square-stepping exercise (SSE), which was recently developed as a challenging exercise form, could improve the functional fitness of the lower extremities in older adults. We found that this form of exercise lowered the risk of falling. One reason for the decrease in falls could be improvements in the factors influencing behavioral speed, such as visual search time and accuracy of short movements.

**PURPOSE:** The effects of SSE on behavioral speed have not been examined; we therefore investigated this issue based on the assumption that deterioration in the speed increases the risk of falling.

**METHODS:** Fifty adults, aged 65 to 74 years, were randomly assigned to SSE and control groups. The SSE group participated in a 70-min SSE program twice a week for a period of 3 months. The control group was given a supervised walking instruction to be performed once a week for 70 min for a period of 3 months. The participants in this group were also encouraged to increase their daily walking steps. Behavioral speed was assessed by a modified Trail Making Test, in which the time required for pushing 25 buttons was measured. The buttons were numbered from 1 to 25 and randomly presented on a computer screen. The test consisted of two parts (Parts A and B). Buttons were stationary in Part A, while in Part B, they were randomly relocated after a correct button was pushed. Therefore, Part A required behavioral speed and short-term memory, and Part B, only speed.

**RESULTS:** Data were expressed as the average time (in seconds) required for pushing a correct button. In the SSE group, the time decreased from  $1.79 \pm 0.47$  s to  $1.69 \pm 0.36$  s in Part A, while in the control group, it changed from  $1.83 \pm 0.40$  s to  $1.85 \pm 0.37$  s. Two-way ANOVA revealed that the time (intervention) effect and interaction were not significant. In the SSE group, the time decreased from  $2.93 \pm 0.36$  s to  $2.75 \pm 0.41$  s in Part B, while in the control group, it changed from  $3.08 \pm 0.49$  s to  $3.02 \pm 0.39$  s. The time (intervention) effect was significant.

**CONCLUSIONS:** Along with the benefits derived from walking, SSE contributes to improve behavioral speed by reducing visual search time and increasing accuracy of movements.

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2286 Board #174 May 28 3:30 PM - 5:00 PM

**A Matched-pair Prospective Study On The Effect Of A Defined In-hospital Sports Program On Cognitive Functions In Patients Suffering From Cancer**

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(No relationships reported)

**PURPOSE:** The diagnosis and treatment of cancer is, for most people, the greatest challenge by which they are confronted in their lives. It is associated with physical and psychological changes such as anxiety, depression, reduced physical performance or fatigue. The combination of a life-threatening illness and a physically and emotionally exhausting therapy may also have negative effects on cognitive function during the course of the disease. Physical exercise has many positive effects on alterations resulting from the disease or therapy. Therefore we were interested in the effect of a defined sports program on the cognitive functions of cancer patients

**METHODS:** 16 patients were included in the study. The training group (TG, n=8) participated in the program 2-3 times a week for 60-90 min over 3 months. The control group (CG, n=8) was not involved in any form of physical activity. Body composition as a marker for the physical training effect was measured in both groups by BodPod analysis at the start and after completion of the study. A questionnaire (QLQ-C30) was used to evaluate changes in quality of life affected by the program as well as psychological and social effects of the training.

Cognitive capabilities were evaluated by FEDA questionnaire at the start of the study and when training was completed.

**RESULTS:** Evaluation after 3 months showed a significant improvement in the physical performance in the TG compared to the CG. BodPod analysis revealed a significant change in body composition with an increase in muscle of an average of 5.2 % compared to a reduction of 1.6 % in the CG.

Evaluation of quality of life showed a significant improvement in fatigue, physical function, emotional and social function, dyspnea and loss of appetite compared to the CG where no changes in any of the tested items could be detected.

The FEDA questionnaire showed a significant improvement of the cognitive abilities within the TG on all 3 scales:

1. Distraction and slowing down of mental processes
2. Tiredness and sluggishness in practical tasks
3. Lack of motivation and apathy

In contrast, the non-active CG showed even worse results in scale 1 and 2 after 3 months but no significant changes on scale 3

**CONCLUSIONS:** A defined moderate physical activity for cancer patients may prevent cognitive impairment during the course of cancer disease and treatment.

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2287 Board #175 May 28 3:30 PM - 5:00 PM

**The Influence Of Exercise On Neurotrophines, Neurotransmission And Cognitive Functioning**

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(No relationships reported)

A great body of literature demonstrates that physical active individuals show improved cognitive functions. Nevertheless, the mediating factors are still in discussion. Possible candidates are neurotrophines, like the brain derived neurotrophic factor (BDNF), or neurotransmitters, like dopamine or serotonin. In animal studies, they are up-regulated by physical exercise and therefore are considered to influence synaptogenesis and signal transduction processes.

**PURPOSE:** To investigate the influence of a 4-week endurance exercise training on serotonergic and dopaminergic neurotransmission, on the peripheral BDNF level, and on several cognitive functions, like working memory test and information processing.

**METHODS:** 21 healthy and untrained males were assigned to either an exercise or a control group. Subjects who participated in the exercise group performed a 4-week indoor cycling training (3 times per week). Prior and after the exercise training, participants were scanned in a 1.5 Tesla fMRI scanner and participated in a serotonergic challenge test (Es-Citalopram). Furthermore, peripheral BDNF and Prolactine levels were assessed. For assessing cognitive functioning, participants performed a n-back working memory paradigm and a vigilance test.

**RESULTS:** We found that the 4-week indoor cycling training lead to a significant decrease of peripheral BDNF levels, an increased cortisol response in the serotonergic challenge test, an increase of neuronal activation in the thalamus and a significant reduced performance in the conducted vigilance test. The described parameters remained unaffected in the control group.

**CONCLUSION:** These findings demonstrate that a 4-week endurance exercise training affects neurochemical parameters, like neurotrophines, neurotransmitters and neuronal activation, as well as information processing. Nevertheless, the present data show that the underlying mechanisms are subject to a complex interplay. Therefore, future studies will need to address the issue of the interaction between neurotransmitters, neurotrophines, exercise and cognitive functioning.

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**2288      Board #176    May 28            3:30 PM - 5:00 PM**  
**Short-Duration Quercetin Supplementation Does Not Alter Cognitive Function Following Submaximal Exercise In Untrained Men**

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(No relationships reported)

**PURPOSE:** To investigate the effects of short-duration quercetin supplementation on post-exercise cognitive performance.

**METHODS:** Using a double-blind, pretest-posttest, control-group design, 30 recreationally-active, but not endurance-trained, men were randomly assigned to Quercetin and Placebo groups. Cognition was measured before and after 9-16 d of supplementation with 1 g/d of quercetin in a fruit-punch beverage or a placebo beverage. Three cognitive tests were administered prior to and following 60-min cycling at 50% VO<sub>2</sub>max and a 10-min simulated time trial.

**RESULTS:** Acute exercise facilitated men's performance on tests of executive function ( $F(1,28)=11.25$ ,  $p=0.002$ ), choice-reaction time ( $F(1,27)=10.09$ ,  $p=0.004$ ), and perceptual discrimination ( $F(1,28)=3.99$ ,  $p=0.055$ ). No effects of quercetin on cognitive function were observed.

**CONCLUSION:** Dietary quercetin supplementation with 1 g/d for 9-16 d does not alter young men's cognitive performance following a 70-min acute bout of submaximal cycling.

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**2289      Board #177    May 28            3:30 PM - 5:00 PM**  
**The Effect Of Using An Active Workstation On Cognitive Function And Simple Motor Skill**

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**PURPOSE:** To assess the ability of subjects to perform tasks requiring selective and divided attention, short term memory, and simple motor skills while using an active workstation.

**METHODS:** Each participant ( $n=50$ ) completed three tests to assess divided attention, short term auditory verbal memory, selective attention, and simple motor skill while the subjects were sitting, standing and walking while using an active workstation at a speed of 1 mph. The Auditory Consonant Trigram test (ACTT) was used to assess divided attention and short term auditory verbal memory; the Stroop Color Word Test (SCWT) was used to measure selective attention; and the Digital Finger Tapping test (FTT) was used to measure motor skill and motor control.

**RESULTS:** A 6 x 3 Mixed Model MANOVA (test order by experimental condition) w/repeated measures on the second factor found no effects associated with test order or order of postural condition. A series of one-way ANOVAs with repeated measures found no significant differences in the sitting, standing, and walking scores for the ACTT ( $52.70 \pm 5.58$ ,  $53.32 \pm 5.39$ ,  $53.04 \pm 5.16$ , mean  $\pm$  SD respectively) or the SCWT ( $55.02 \pm 11.90$ ,  $54.76 \pm 10.72$ ,  $55.38 \pm 10.83$ , mean  $\pm$  SD respectively). A significant difference ( $p<.05$ ) was found between the sitting, standing, and walking scores for the FTT ( $57.15 \pm 8.36$ ,  $56.95 \pm 8.02$ ,  $55.80 \pm 8.04$ , mean  $\pm$  SD respectively). Post-hoc means testing found significant differences ( $p<.05$ ) between sitting and walking and standing and walking. No significant difference was found between sitting and standing. The difference between sitting and walking represents approximately a 2% decrement in simple motor skill.

**CONCLUSION:** There is a decrement in simple motor skill but not divided attention, short term auditory verbal memory, or selective attention when subjects are using an active workstation at a speed of 1 mph. Given that many people find time to be a barrier to engaging in physical activity, alteration of the work environment to increase activity may be effective in producing behavior change. This study supports the feasibility of using active workstations to promote physical activity in the work environment.

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**2290      Board #178    May 28            3:30 PM - 5:00 PM**  
**The Association Between Study Time, Grade Point Average And Physical Activity Participation In College Students**

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Previous studies have assessed physical activity in college students, but few investigators have examined the relationship between academic behaviors/performance and physical activity participation.

**PURPOSE:** The purpose of this study was to assess the association between study time, grade point average (GPA) and meeting current recommendations for vigorous and moderate physical activity in college students.

**METHODS:** 141 undergraduate students completed an online survey at the beginning of the Fall 2007 semester. Physical activity was defined as vigorous ( $\geq 20$  minutes of activity that made you sweat and breath hard on  $\geq 3$  days per week) or moderate ( $\geq 30$  minutes of activity that did not make you sweat and breathe hard on  $\geq 5$  days per week). Academic behavior was assessed as the amount of time spent studying per day (study time:  $\leq 1$  hour, 2 hours,  $\geq 3$  hours). Academic performance was assessed as cumulative GPA (GPA: no GPA,  $<3.0$ ,  $3.0-3.5$ ,  $\geq 3.5$ ). Adjusted odds ratios and 95% CIs were calculated to assess the relationship between study time/GPA and vigorous/moderate physical activity while controlling for gender, race, class standing, major, and varsity sport participation.

**RESULTS:** Results suggest that when compared to students who studied  $\leq 1$  hour per day, those who studied  $\geq 3$  hours per day were an estimated 3.5 (95%CI: 1.1-11.2) times more likely to participate in vigorous physical activity and 2.6 (0.9-7.5) times more likely to participate in moderate physical activity. When compared to students with a GPA  $<3.0$ , those with a GPA  $\geq 3.5$  were an estimated 3.2 (0.9-11.8) times more likely to participate in vigorous physical activity.

**CONCLUSIONS:** These results suggest a potential association between academic behaviors/performance and physical activity in college students. Specifically, students who spend more time studying or have a higher GPA are more likely to participate in physical activity. However, due to limited research, additional information is needed to explore this relationship in more detail.

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**2291      Board #179    May 28            3:30 PM - 5:00 PM**  
**Promoting Physical Activity By Integrating Exercise Into Academic Lesson Plans In Urban Middle-Schools**

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Due to a decrease in physical education and recess, it is imperative to identify innovative ways to get children active while at school. ExerLearning (ExL) is the integration of physical activity (PA) into standard cross-curricular lesson plans that aims to simultaneously increase PA while promoting enhanced academic performance.

**PURPOSE:** The purpose of this study was to examine differences in PA level during traditional academic tutoring (tutoring) and integrated ExL.

**METHODS:** Forty-two racially-ethnically diverse middle-school boys and girls (age  $13 \pm 0.9$  yrs; BMI,  $23.2 \pm 6.5$  kg m<sup>-2</sup>) were randomly assigned to receive tutoring and ExL two times per week for six weeks, at GoKids youth fitness research and training center at UMass Boston, in either a) math (n=23) or b) language arts (LA) (n=19). At each session, kids in each group received 30 minutes of tutoring and 30 minutes of ExL. PA at each visit was measured using an ActiGraph GT1M (AG) accelerometer that was worn on the right hip. AG data were converted to time spent in sedentary behaviors (SB), light PA (LPA), and moderate to vigorous PA (MVPA) using the Trueth equation. At the end of each session participants rated the ExL activities in math or LA (1 to 5 scale) for reinforcement of academic skill development, if the directions were easy to understand and follow, and enjoyment of learning academic skills.

**RESULTS:** On average, participants spent significantly less time in SB during ExL ( $14.0 \pm 4.2$  min) vs. tutoring ( $25.8 \pm 4.4$  min) ( $P < 0.001$ ) and significantly more time in LPA and MVPA during ExL (LPA,  $19.8 \pm 3.6$  min; MVPA  $3.6 \pm 2.2$  min) versus tutoring (LPA,  $9.1 \pm 3.4$  min; MVPA,  $0.7 \pm 0.9$  min) ( $P = 0.001$ ). Males on average, obtained 2.6 more minutes of MVPA than females during ExL ( $P = 0.001$ ). Those in the Math group, compared to the LA group, rated the lessons to help more with their academic skills (3.8 vs. 3.1;  $P = 0.014$ ) and felt the directions were easier to understand (4.3 vs. 3.9;  $P = 0.038$ ). Both groups enjoyed the activities and rated them as 3.8 (Math) and 3.5 (LA) out of 5 ( $P > 0.05$ ).

**CONCLUSION:** ExL has potential to be an effective school-based strategy to decrease SB and increase LPA and MVPA in middle school children, in a time efficient manner, while also teaching the needed core curriculum. Future work needs to examine the effect on academic outcomes and its' relation to improved PA with ExL.

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## D-36 Free Communication/Poster - Physical Activity, Fatigue and Pain

MAY 28, 2009 1:00 PM - 6:00 PM  
ROOM: Hall 4F

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### 2292 Board #180 May 28 2:00 PM - 3:30 PM The Effects Of 12-weeks Cross Training On Fatigue And Mood In Recent Breast Cancer Survivors

Melanie Poudevigne<sup>1</sup>, Janet Wojcik<sup>2</sup>, Betty Lane<sup>1</sup>, Marty Polovich<sup>3</sup>, Suzana Simonishvili<sup>4</sup>. <sup>1</sup>Clayton State University, Morrow, GA. <sup>2</sup>Winthrop University, Rock Hill, SC. <sup>3</sup>Duke Oncology Network, Durham, NC. <sup>4</sup>Emory University, Atlanta, GA. (Sponsor: Dr. Allen Jackson, FACSM)  
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Survivors tend to decrease their physical activity (PA) levels after their diagnosis of cancer, and most continue lower levels of PA through treatment and beyond, rarely returning to their prediagnosis levels of PA. Regular PA decreases feelings of fatigue and mood disturbances and can improve quality of life (QOL).

**PURPOSE:** Examine the adherence to a combined cardiorespiratory and resistance training at moderate intensity and to determine whether breast cancer survivors (BCS) would experience improved energy levels and QOL.

**METHODS:** Twenty sedentary BCS between 2-24 months post-treatment and the ages of 18 and 60 were recruited at three sites. The cancer treatments ranged from lumpectomies (23%), mastectomies (29%), radiations (32%) and chemotherapies (16%). The training consisted of a 12-week exercise program of 3 weekly sessions of 60 min duration, supervised by a certified personal trainer and divided into resistance (30 minutes) and aerobic training (5 minutes warm-up, 20 minutes training, 5 minutes cool-down). The aerobic intensity was set at 60%HRR and reevaluated every three weeks. Blood pressures were taken at baseline and every ten minutes during each cardiovascular exercise. The dependent variables were measured every 3 weeks and included: fatigue and mood disturbances measured by the subscale of the Profile of Mood States, QOL measured by SF-36 and work absenteeism.

**RESULTS:** The mean ( $\pm$ SD) attendance rate was 92 ( $\pm 8.0$ ) %. No musculoskeletal injuries and problematic symptoms occurred during the cross-training. Repeated measures ANOVA showed a large increase in QOL (22%) and significant decrease in fatigue (43%) across 12 weeks (eta squared range: .491 to .708; all p values < .05). No differences were found in work absenteeism. Blood pressure was unchanged after training.

**CONCLUSIONS:** This is the first pilot study- controlled study of the impact of cross training on recent sedentary breast cancer survivors' levels of energy. Combined moderate cardiorespiratory and resistance training during a brief duration is safe and improves QOL and energy levels in recent women BCS.

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### 2293 Board #181 May 28 2:00 PM - 3:30 PM Acute Effects Of Cycling On Mood And Eeg In Sedentary Young Adults With Persistent Fatigue

Nathaniel Thom, Brett Clementz, Timothy Puetz, Patrick O'Connor, FACS, Rod Dishman, FACS. University of Georgia, Athens, GA.  
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(No relationships reported)

**PURPOSE:** We previously reported that 6-weeks of exercise training increased feelings of vigor among inactive college students who reported persistent fatigue. The purpose of this study was to examine whether acute effects of exercise during the training period would be similar to those chronic effects. Further, we hypothesized that mood changes after exercise would be related to brain activity measured by electroencephalography (EEG).

**METHODS:** 36 males and females were randomly assigned to 20-min of moderate or low intensity (75% or 40% VO<sub>2</sub> peak) cycling or seated-rest. Measures were taken before and 10 min after 3 acute sessions, each separated by 2 weeks. Mood was measured using the POMS-SF. Four minutes of EEG data were sampled at 500 Hz with an analog filter of 0.1-200 Hz, and inspected offline for bad channels which were replaced by spherical spline interpolation. Data were digitized and filtered from 0.5 to 58 Hz and transformed to a Laplacian montage to improve spatial resolution. Artifacts were removed using independent component analysis. The data were Fast-Fourier transformed to absolute power ( $\mu V^2$ ) averaged over all 4 min, and expressed as  $\log_{10}(\mu V^2)$  in 4 bands: theta (4-7Hz), alpha (8-13Hz), low beta (13-20Hz), high beta (20-30Hz). Top-meridian plots consistently revealed active channels in clusters of anterior and posterior sites. Hypotheses were tested by a 3 group (low- or high-intensity EX or control) x 2 session (pre- vs. post-test) x 3 week (1, 3, 6) RM-ANCOVA, controlling for pre-test mood. EEG power was added as a time-varying covariate in each model to test relations with mood changes.

**RESULTS:** There were group effects for vigor ( $p = 0.001$ ), depression ( $p = 0.04$ ), and EEG activity in posterior regions in all frequency bands ( $p < 0.05$ , mean  $h^2 = 0.31$ ). Posterior theta activity accounted for changes in vigor, and posterior activity in all frequency bands accounted for changes in depression.

**CONCLUSION:** Transient increases in feelings of vigor after acute exercise paralleled the chronic effects. Changes in EEG oscillatory activity partially accounted for increased vigor and decreased depression after 3 acute bouts of moderate intensity exercise. Studies that otherwise manipulate mood and/or EEG activity during exercise are needed to determine whether EEG changes after exercise are causally linked with mood.

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**2294 Board #182 May 28 2:00 PM - 3:30 PM****Cortisol Contributes To Symptomatic Fatigue And Heart Rate Variability In Persons With Multiple Sclerosis**

Benjamin A. Ingraham<sup>1</sup>, Douglas Woo<sup>2</sup>, Ellen Heyer<sup>1</sup>, April Harkins<sup>1</sup>, Jennifer Dixon<sup>1</sup>, Alexander V. Ng, FACSM<sup>1</sup>. <sup>1</sup>Marquette University, Milwaukee, WI. <sup>2</sup>Medical College of Wisconsin, Milwaukee, WI.

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Symptomatic fatigue is one of the most common complaints in persons with multiple sclerosis (MS). Stress hormones have been hypothesized to be mechanisms that may lead to this symptom of fatigue. Chronically elevated cortisol could lead to hyperactivity of the sympathetic nervous system (SNS) through bi-directional effects of the hypothalamic-pituitary-adrenal (HPA) axis on the SNS.

**PURPOSE:** To test the hypothesis that cortisol is associated with symptomatic fatigue and HRV in persons with MS.

**METHODS:** We tested 7 persons with MS (5 Female, 2 Male) and 11 control (C) subjects (10 Female, 1 Male). The following questionnaire and clinical measures were obtained from all subjects: Symptomatic Fatigue (Fatigue Impact Scale), Depression (Beck Depression Inventory) and Multiple Sclerosis Functional Composite Measure (MSFC). Night-time salivary cortisol (11:00 pm) was measured using EIA. A 10 minute EKG was taken and heart rate variability (HRV), an indication of cardiac autonomic balance, was subsequently analyzed (low/high freq. ratio). Analysis was by unpaired t-test and Pearson correlations. Data are mean (SE). Significance was  $p \leq 0.05$ .

**RESULTS:** MS subjects compared to C reported greater fatigue ( $MS = 51(13)$ ,  $C = 5(2)$ ,  $p < 0.001$ ), and depression ( $MS = 7(3)$ ,  $C = 3(0.5)$ ,  $p = 0.001$ ), and had lower MSFC ( $MS = 2.2$ ,  $C = 2.8$ ). There were no differences between groups in cortisol or HRV. Within the control group, there were no significant correlations between cortisol, HRV, or fatigue. Within the MS group, cortisol was correlated with symptomatic fatigue ( $r = 0.75$ ,  $p = 0.05$ ) and HRV ( $r = 0.82$ ,  $p = 0.02$ ). In turn, fatigue was also correlated with HRV ( $r = 0.75$ ,  $p = 0.05$ ). The relationships observed with HRV are consistent with increased cardiac sympathetic activity influencing fatigue.

**CONCLUSIONS:** While the mechanisms underlying these correlations are unknown, these results implicate cortisol as an important mediator of fatigue in MS subjects. This could be a direct effect or via SNS.

Supported by National Multiple Sclerosis Society Grant PP1509

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**2295 Board #183 May 28 2:00 PM - 3:30 PM****Evaluation Of Three Distinct Models Of Exercise Performance Following Immune Mediated Fatigue In Mice**

Traci L. Barrilleaux, J. Mark Davis, FACSM, Julia E. Gambone, E. Angela Murphy, Jamie L. McClellan, Crystal Livingston, Martin D. Carmichael. South Carolina University, Columbia, SC.

(No relationships reported)

Various models of exercise have been used to evaluate fatigue in animals; however it is not uncommon for studies to utilize a single model in their investigations of this complex subject. Forced treadmill running (measure of maximal endurance capacity), voluntary wheel running (measures motivation/willingness to be active) and rotorod performance (measure of neuromuscular coordination) are commonly used exercise models of fatigue. However, the stimuli are very different and all are influenced disproportionately by peripheral and central factors.

**PURPOSE:** The purpose of this study was to evaluate the efficacy of three distinct models of exercise behavior following immune-mediated fatigue in mice.

**METHODS:** Fatigue was induced by a single lipopolysaccharide (LPS) (100ug i.p.) injection. In the treadmill experiment mice were assigned to either placebo or LPS treatment. Mice were run on a treadmill (40m/min and 5% grade) on days 1, 3, 5, and 7 following treatment and time to fatigue was recorded. In the voluntary wheel running and rotorod experiments baseline data was collected for each mouse prior to LPS administration. Voluntary activity was measured for 10 consecutive days and rotorod performance was measured on days 1, 3, 5, and 7 following LPS treatment.

**RESULTS:** LPS decreased performance across all three exercise models. Voluntary wheel running activity was affected to the largest extent and for the longest duration (~95% ( $P < 0.05$ ) which returned to baseline by 6-8 days). LPS administration reduced treadmill run time to fatigue by ~50% ( $P < 0.05$ ) which returned to baseline by day 5. Time spent on the rotorod was reduced by ~15% ( $P < 0.05$ ) following LPS injection and returned to baseline by day 7.

**CONCLUSION:** The data suggest that motivation or willingness to run is more affected by immune mediated fatigue than maximal endurance capacity or measures of neuromuscular coordination. Also, there are indications that voluntary wheel running is an effective model and the most sensitive measure to immune-mediated behavioral changes followed by forced treadmill running and rotorod performance. The data reinforce the importance of utilizing multiple models when investigating exercise behavior.

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**2296 Board #184 May 28 2:00 PM - 3:30 PM****Effects Of Carbohydrate Ingestion On Central Fatigue**

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(No relationships reported)

Carbohydrate availability is important for maintaining voluntary drive during fatiguing exercise, but little is known about the time course over which central fatigue is offset following feeding.

**PURPOSE:** This study examines the immediate and delayed influences of carbohydrate ingestion on voluntary drive and force production during fatiguing exercise.

**METHODS:** Right-handed males performed two separate bouts of continuous isometric elbow flexion exercise at an intensity equivalent to 15% of maximal voluntary contraction force (15%MVC) for 30 min. Participants performed maximal voluntary contractions (MVC) every 2 min during 15%MVC. At 60 s intervals throughout 15%MVC, and during each MVC, transcranial magnetic stimulation was used to stimulate the contralateral hemisphere to elicit a motor evoked potential and silent period (SP) in the exercising biceps brachii (BB). Force production and surface EMG of BB were monitored continuously, venous blood samples, heart rate and perceptual rating scales were collected every 4 min. After 11 min of exercise a carbohydrate solution (0.4 g·kg body mass<sup>-1</sup>; CHO) or an energy-free placebo solution (PLA) were administered in a randomized crossover, double-blind fashion. Participants mouth-rinsed each solution for 15 s before swallowing.

**RESULTS:** Fatigue was confirmed by decreased force production at 15%MVC and MVC ( $P = 0.01$ ), increased superimposed twitch force ( $P < 0.01$ ), and increased SP duration ( $P < 0.01$ ) in both trials. Comparisons between solutions were made in the period before feeding, following feeding (but prior changes in plasma glucose), and alongside systemic glucose appearance. Immediately after CHO ingestion, MVC tended to be larger and SP duration was shorter ( $P < 0.01$ ), suggesting an acute increase in voluntary drive. There were similar trends with subsequent plasma glucose inflection.

**CONCLUSIONS:** Carbohydrate ingestion improves maximal force production and the ability to generate voluntary drive during fatiguing exercise. These enhancements may occur before ingested carbohydrate is systemically available. Our findings provide insight into signaling mechanisms that regulate central drive according to substrate availability, both prior to, and after glucose appearance in blood.

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**2297 Board #185 May 28 2:00 PM - 3:30 PM****The Influence Of Scheduling And Fatigue On Injury Rates At The 2008 USA Cup**



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(No relationships reported)

The USA Cup Soccer Tournament, divided into the USA Cup Weekend and the USA Cup, is a large annual youth tournament that often requires a team to play more than one game a day. The game durations are shortened from regulation time for each age group. Little is known about the rate of injury as the tournament progresses with respect to the effect of playing more than one game a day or several games in a short time span. Hence, there is a need for research into the affect of tournament scheduling on injury rates in the younger athletes.

**PURPOSE:** To investigate the influence of multiple games on multiple days on tournament athlete injury rates.

**METHODS:** All athletes seeking medical attention for an acute or chronic game related tournament injury were surveyed by questionnaire immediately after registering for care at the on site medical facility. The survey questions were directed at the circumstances of each injury related to the timing of the injury with respect to the amount of soccer played by the injured participant.

**RESULTS:** In the USA Cup Weekend, there were 4.06, 5.14, and 3.92 injuries /1000 PH on July 11<sup>th</sup>, 12<sup>th</sup>, and 13<sup>th</sup> respectively. There was no significant difference in the incidence of injuries for the games on the 2<sup>nd</sup> or 3<sup>rd</sup> day compared to the 1<sup>st</sup> day. The injury rates of first games compared to second games of the day showed no difference (p=0.1259). In the Schwan's USA Cup, the injury rates were 5.65, 8.95, 7.83, 6.94, and 4.62 /1000 PH on July 15<sup>th</sup>, 16<sup>th</sup>, 17<sup>th</sup>, 18<sup>th</sup>, and 19<sup>th</sup> respectively. There were statistically significant differences in the incidence of injuries seen when comparing the 17<sup>th</sup> to the 15<sup>th</sup> (p=0.02; incidence ratio=1.38, 95% confidence interval=1.05-1.82) and the 16<sup>th</sup> to the 15<sup>th</sup> (p=0.0009; incidence ratio=1.58, 95% confidence interval=1.21-2.06). There was no significant difference on other days compared to the 15<sup>th</sup>. A linear test for trend from the 15<sup>th</sup> to the 19<sup>th</sup> was not significant (p=0.0922). The injury rates of first games compared to second games of the day showed no difference (p=0.38).

**CONCLUSION:** The USA Cup format limiting teams to two games per day and decreasing the length of games in each game of the tournament outside of the finals provides adequate protection to participants from injury as a result of fatigue and overuse in the environment conditions that prevailed during the tournaments.

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**2298 Board #186 May 28 2:00 PM - 3:30 PM**  
**Associations Between Pain, Fatigue, and Injury in Collegiate Baseball Pitchers**

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(No relationships reported)

Injury from pitching is common among collegiate aged baseball pitchers. Injury at a young age may lead to future complications and may decrease the current quality of life in these pitchers. The literature to date has mainly focused on biomechanical factors postulated to be associated with injury, and has paid scant attention to pitching volume as a injury risk factor.

**PURPOSE:** The primary purpose of this study was to examine the associations between pitching with pain, arm tiredness, and injury in collegiate baseball pitchers.

**METHODS:** A cross-sectional self-administered survey was used (N=628). College baseball pitchers (age=20.09±1.58) self-reported their pitching injuries to the arm, elbow, and shoulder that resulted in 7 or more days lost to pitching, and their experiences pitching with elbow or shoulder pain and/or arm tiredness in the past 12 months. Chi-square tests and odds ratios were used to examine the associations between pain, fatigue, and injury.

**RESULTS:** Significant associations were observed between pitching with pain and upper extremity injury (Chi-Square(1)=15.34; p<0.001), with individuals reporting pitching with pain being more likely to report an injury resulting in 7 or more days time-loss (OR=2.24; 95% CI: 1.487, 3.374). Pitching when the arm was tired was also significantly associated with injury (Chi-Square (1)=15.194; p<0.001); individuals who reported pitching when the arm was tired were more likely to report an injury resulting in 7 or more days time-loss (OR=2.74; 95% CI: 1.627, 4.629). Overall, 89% reported pitching when the arm was tired over the past year and 80% reported pitching with pain over the past year. Prevalence of elbow injury was 43%, shoulder injury was 32%, and arm injury was 12%.

**CONCLUSIONS:** Measures of pitching volume are high among college baseball pitchers. Our data yielded strong associations between measures of pitching volume and injury, consistent with the idea that regulating pitching volume and monitoring signs of over-pitching among baseball pitchers may lead to decreased injury risk among these pitchers.

*Funding: Yawkey Foundation*

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**2299 Board #187 May 28 2:00 PM - 3:30 PM**  
**Self-management Behaviors (physical Activity) Among Primary Care Patients With Pain And Depression**

Teresa M. Damush, Ph.D.<sup>1</sup>, Jingwei Wu, MS<sup>1</sup>, Matthew Bair, MD, MS<sup>1</sup>, Wanzhu Tu, Ph.D.<sup>1</sup>, Ellen Poleshuck, Ph.D.<sup>2</sup>, Kurt Kroenke, MD<sup>1</sup>. <sup>1</sup>Indiana University, Indianapolis, IN. <sup>2</sup>University of Rochester, Rochester, NY.  
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**PURPOSE:** To determine the long term effects of a combined pharmacological and behavioral intervention on self-management behaviors in primary care patients with musculoskeletal pain and depression.

**METHODS:** We conducted a randomized controlled trial and recruited 250 primary care patients from University affiliated and VA primary care clinics. At baseline, all patients met inclusion criteria of having chronic pain in low back, knee or hip, and half met criteria for clinical depression. Participants were randomized to either usual care or a stepped intervention that consisted up 12 weeks of optimized antidepressant therapy followed by a pain self-management (PSM) program delivered biweekly over 6 sessions during the following 12 weeks, and continuation of the antidepressant therapy over the remaining 6 months with 2 self-management booster sessions at 8 and 10 months. We assessed engagement in self-management behaviors (e.g., physical activity) using validated surveys both at baseline and 12 months later. We compared between group differences between intervention and usual care using intention to treat analyses. We analyzed the data using t-tests to compare group means.

**RESULTS:** Participants were 52% men; 62% White; 33% African-American and had a mean age of 59 years. Compared to usual care, participants in the intervention group significantly increased the time spent on performing self-management behaviors in the following areas: strength exercises (p<.03); stretching exercises (p<.00); progressive muscle relaxation (p<.00); visualizing (p<.02); and mental stress relaxation (p<.00). In addition, intervention participants reported more time spent in walking and engaging in positive thinking than those in usual care, but the differences were not significant.

**CONCLUSIONS:** A combined pharmacological and behavioral intervention may effectively increase the patient self-management behaviors in particular, physical activity, among urban, primary care patients with chronic musculoskeletal pain and depression.

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**2300 Board #188 May 28 2:00 PM - 3:30 PM**  
**Pain Coping Styles Of Nontraditional Female Athletes**

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Efforts to address psychological indices of female performance have increased in the last decade due to an observed increase in athleticism and a concomitant rise in the number of



severe injuries. There is, however, a paucity of studies directed toward nontraditional athletes involved in outdoor or extreme sports with a high potential for trauma.

**PURPOSE:** To quantify if differences in pain coping styles exist in athletes across type of individual sport (traditional, nontraditional).

**METHODS:** Following written informed consent, the Sports Inventory for Pain (SIP; direct coping, cognitive, catastrophizing, avoidance, body awareness, total coping response) was completed by 126 athletes involved in either nontraditional, non-NCAA individual sports (n=64; downhill skiing; rock climbing, skydiving, telemark skiing, rodeo, taekwondo; mean age=27.9±6.0 yrs) or traditional NCAA individual sports (n=62; swimming/diving, tennis, equestrian, track, golf; mean age=25.1±9.1 yrs). Multivariate analysis (MANOVA) using Wilks' Lambda criterion indicated no significant sport athlete effect ( $F_{3,123}=1.685$ ;  $p=0.314$ ;  $n-b=0.431$ ) across age ( $p=0.142$ ), number of injuries ( $p=0.131$ ), or number of seasons of sport experience ( $p=0.577$ ).

**RESULTS:** MANOVA indicated a significant main effect across type of athlete (Wilks' Lambda  $F_{6,120}=4.559$ ,  $p=0.0001$ ;  $n-b=0.984$ ). Post hoc procedures indicated that nontraditional sport athletes scored significantly lower on direct coping ( $p=0.0001$ ), cognitive ( $p=0.01$ ), catastrophizing ( $p=0.001$ ), and total coping response ( $p=0.025$ ) than traditional athletes, with no differences observed in avoidance or body awareness indices.

**CONCLUSION:** In conclusion, females participating in nontraditional individual, non-NCAA, less coach-structured sport activity where individualism, self-determination, and autonomy is prevalent, reveal lower pain coping styles than females participating in more traditionally, coach-structured individual NCAA sports. Sport science and medical personnel should consider the type of sport athlete prior to prescribing training, treatment, and rehabilitation for optimal performance and return to play.

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**2301 Board #189 May 28 2:00 PM - 3:30 PM**  
**Exercise Intensity As A Determinant Of Exercise Induced Hypoalgesia**

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(No relationships reported)

A number of investigations have observed a significant reduction in one's sensitivity to painful stimuli both during and after exercise. This phenomenon is referred to as Exercise-Induced Hypoalgesia (EIH). While EIH is well documented in the literature, a cadre of psycho-physiological variables have been identified as part of this complex phenomenon. Although several investigators have found the onset of EIH to be at or above 70% of one's V<sub>O2</sub>, the underlying physiological justification of this intensity has not been thoroughly described.

**PURPOSE:** The purpose of this investigation was to examine variations in pain perception during and following two bouts of exercise; one performed at an intensity equivalent to 10% above and 10% below the onset of blood lactic acid (A-OBLA and B-OBLA, respectively).

**METHODS:** A total of 27 trained males served as subjects in this investigation. Data was collected over the course of four laboratory visits. On day one, each subject completed a Bruce peak treadmill exercise test where OBLA was determined. On day two, subjects were familiarized with the cold pressor test. On days three and four, subjects completed 30 min of treadmill exercise at a workload that was either 10% A-OBLA or 10% B-OBLA. Time to pain threshold (PT) was determined using the cold pressor test, administered at baseline and 15 and 30 min during each exercise (Ex) bout, and at 15 and 30 min into recovery (Rec). A two-factor repeated measures ANOVA was used to determine differences due to the main effects, and their interaction. A significance level of  $P < 0.05$  was used for all statistical analyses.

**RESULTS:** A-OBLA PT scores were not significantly different than B-OBLA scores at any time point. Both conditions produced a significant increase in PT at 30 min Ex (A-OBLA-  $p=0.018$ ; B-OBLA-  $p=0.022$ ) and 15 Rec (A-OBLA-  $p=0.034$ ; B-OBLA-  $p=0.04$ ) as compared to baseline scores. No difference PT scores were observed at 15 min Ex and 30 min Rec as compared to baseline.

**CONCLUSIONS:** Based upon these data the effects of exercise on pain perception appear to be similar at exercise intensities both above and below OBLA. Because a hypoalgesic effect was not observed in either condition until 30 min of exercise had been completed, total exercise time appears to be an important factor in the augmentation of pain perception under these conditions.

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**2302 Board #190 May 28 2:00 PM - 3:30 PM**  
**Impact Of Protease Supplementation On Pain Perception And Exercise Affect During Cycle Ergometry With DOMS**

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(No relationships reported)

Delayed onset muscle soreness (DOMS) is a common occurrence following intense exercise. It has been suggested that protease supplementation may diminish the effects of DOMS. Additionally, feelings of soreness may adversely impact exercise affect.

**PURPOSE:** To examine the effects of protease supplementation on the perception of pain (PP) and exercise affect following the onset of DOMS.

**METHODS:** This study used a matched-pairs design. Twenty-four participants (12 males; Mean BMI =  $24.7 \pm 2.1$ ; 12 females; Mean BMI =  $20.8 \pm 2.3$ ) participated in this investigation. DOMS was induced by performing 6 sets of 10 reps of isokinetic eccentric exercise (EE) at -1.05 rad/sec. Each participant took either 2 protease tablets (PRO) or a placebo (PLAC) 4 times a day for 4 days (from 24 H pre-EE to 48 H post-EE). Supplementation was blinded and randomized. Each participant performed 2 identical, 35 min exercise sessions on a cycle ergometer, one pre-EE and one 2 days post-EE. Intensity for the exercise sessions was set during the initial session by asking each participant to exercise at a "13" on the Borg RPE scale. The ergometer resistance was recorded and used during the post-EE exercise session. Every 5 minutes during the exercise sessions, PP was assessed using Borg's CR-10 scale and affect was measured using the feeling scale (FS) and the felt-arousal scale (FAS). Results were analyzed using a repeated-measures GLM.

**RESULTS:** No differences were seen between the groups for PP, FS, or FAS during the pre-EE exercise session. Differences were seen for PP at the 5, 25, 30, and 35 minute mark of the post-EE exercise session with the PRO reporting less discomfort than the PLAC ( $p<0.05$ ). A significant difference was seen for FS with the PRO reporting greater feelings of pleasantness than the PLAC at the 20, 25, 30 and 35 minute mark of the post-EE exercise session ( $p<0.05$ ). A trend was seen for PP at the 20 minute mark ( $p=0.07$ ). No differences were seen between the groups for FAS.

**CONCLUSION:** Protease supplementation may positively influence an individual's responses to exercise following DOMS. This finding may be important in planning exercise programs, especially when considering return to activity following an intense exercise session.

*This work was supported through funding by Enzymatic Therapy Inc., Green Bay, WI.*

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**2303 Board #191 May 28 2:00 PM - 3:30 PM**  
**Relationships Between Exercise Behavior, Expected And Actual Muscle Pain, Kinesiophobia, And Self-care For Muscle Pain**

Erin A. Dannecker. *University of Missouri-Columbia, Columbia, MO.* (Sponsor: Marybeth Brown, PhD, PT, FACSM)

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(No relationships reported)

Several studies have shown negative relationships between adherence to therapeutic exercise regimes and pain in clinical samples. However, it is unknown if leisure-time exercise behavior is related to activity-related pain in healthy adults.

**PURPOSE:** This investigation examined associations between leisure-time exercise behavior, expected and actual exercise-induced muscle pain, kinesiophobia (fear of

movement), and use of exercise and rest as self-care treatments for delayed-onset muscle pain.

**METHODS:** Participants (N = 33, 23 yrs old (SD = 2.82), 42.5% women) completed the Leisure-Time Exercise Questionnaire (LTEQ) and ratings of highest expected delayed-onset muscle pain before isokinetic eccentric contractions were completed with the nondominant elbow flexors to induce muscle damage. Post-exercise measures of arm muscle pain, kinesiophobia for the painful arm, and appraisals of self-care for the induced muscle pain were collected across four days.

**RESULTS:** LTEQ mild, moderate, strenuous, and total scores were not significantly correlated to highest expected or actual arm muscle pain ( $r_s = -.03$  -  $(-.27)$ ,  $p > .05$ ). However, LTEQ total and mild scores were negatively associated with the highest fear of moving the nondominant arm ( $r_s = -.43$  -  $(-.49)$ ,  $p < .05$ ). Also, LTEQ total and moderate scores were positively related with the largest perceived benefit to exercising the arm to reduce muscle pain ( $r_s = .42$  -  $.51$ ,  $p < .05$ ). In addition, LTEQ mild scores were negatively correlated to the largest perceived benefit of resting the arm to reduce muscle pain ( $r = -.35$ ,  $p < .05$ ).

**CONCLUSIONS:** These results suggest that leisure-time exercise behavior is negatively associated with participants' fear of moving a painful arm and positively related to participants' cognitive appraisals of the benefits for continuing movement despite pain. Additional studies of these relationships for other modes of exercise in both laboratory and natural settings are needed to examine the role of activity-related pain as a barrier to regular exercise participation in non-clinical samples.

*Supported by NIAMS (KO1 AR050146) to E. A. Danneker, PhD, ATC.*

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**2304 Board #192 May 28 2:00 PM - 3:30 PM**

**Obesity Is Associated With Lumbar Pain Related Fear Of Movement And Self Reported Mobility Impairment**

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*(No relationships reported)*

Chronic low back pain (LBP) induces mobility impairment and disability. Obesity is a risk factor for LBP and disability. Pain evokes fear avoidance beliefs and behaviors, thereby worsening LBP. It is unknown whether obesity is associated with fear of movement.

**PURPOSE:** The purposes of this study were: 1) to compare the levels of fear of movement between obese and non-obese individuals seeking therapy for chronic LBP, and 2) to examine whether fear of movement predicted self-reported mobility impairment.

**METHODS:** This was a retrospective, exploratory study of individuals with chronic LBP (N=192; 48.2±18.8 yrs). Participants were stratified into obese (Body mass index [BMI] 36.9±7.1 kg/m<sup>2</sup>) or non-obese groups (BMI 24.5±3.4 kg/m<sup>2</sup>). The Tampa scale of Kinesiophobia (TSK; fear of movement), Short-Form 8 (SF8) and Oswestry Disability survey results were main outcome measures. Self-reported medication use and participation in exercise therapy sessions for LBP were collected. Outcome comparisons were made using univariate analyses of variance. Hierarchical regression modeling was used to determine the contribution of TSK scores to the variance of self-reported disability with walking.

**RESULTS:** TSK scores in obese patients were higher than in non-obese patients (26.2±7.5 vs 23.9±6.8 points;  $p=0.032$ ). The SF8 physical and mental subscores were 6-10% lower in the obese than non-obese patients. Total Oswestry survey scores were 28% higher in the obese patients prior to the exercise therapy program ( $p=0.0001$ ). Hierarchical regression modeling showed that fear of exercise was a significant contributor to self-reported disability with walking ( $p<0.0001$ ). Narcotic use was higher (32.4 vs 17.2%) and non-steroidal anti-inflammatory medication use was lower (18.6 vs 34.9%) in the obese than non-obese group ( $p<0.05$ ). Obese patients cancelled therapy sessions twice as frequently than non-obese patients ( $p=0.012$ ).

**CONCLUSIONS:** Obesity-related fear of movement is an important predictor of disability and participation in exercise therapy for chronic LBP. In addition to traditional exercise therapy protocols to combat LBP in obesity, adjunctive psychosocial strategies should be a serious consideration.

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**2305 Board #193 May 28 2:00 PM - 3:30 PM**

**The Effect Of Exercise Cessation In Well Trained Athletes On Non Articular Tenderness Masseurs.**

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*(No relationships reported)*

The effect of exercise cessation in well trained athletes on non articular tenderness masseurs and quality of life.

The term chronic multisymptom illness (CMI) includes fibromyalgia (FM), chronic fatigue syndrome (CFS), and a wide spectrum of pain disorders. It is characterized by unexplained chronic pain, fatigue, and cognitive and mood complaints.

**PURPOSE:** The goal of the study was to examine the hypothesis that exercise cessation will be associated with symptoms similar to CMI in a well trained amateur athletes.

**METHODS:** The study population comprised of 26 asymptomatic healthy athletes who regularly exercise  $6.75 \pm 3.65$  hrs per week. All athletes were instructed to refrain from physical activity for 7 days. All participants underwent a complete physical exam, rheumatologic assessment including non articular tenderness threshold (using dolorimeter) and tender points. In addition they completed the SF-36 quality of life questionnaire. Assessments were conducted before exercise cessation and after 7 days.

**RESULTS:** Seven days after sports deprivation all subjects were significantly tender by all tender measures ( $p<0.001$ ) (dolorimeter thresholds and tender point count). As well, there was a significant reduction in the scores for physical role function ( $p<0.001$ ), emotional role function ( $p<0.001$ ) and summary sub-scales of the SF-36 questionnaire after exercise cessation.

**CONCLUSION:** Exercise deprivation is associated with change in non articular tenderness threshold and reduction in quality of life scores. This may be associated with the development CMI.

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**2306 Board #194 May 28 2:00 PM - 3:30 PM**

**Effect Of Caffeine Ingestion On Leg Pain During Maximal Knee Extension Exercise**

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*(No relationships reported)*

A number of recent studies have tested the effect of caffeine (CAF) on perceived muscle pain during exercise, yet few have assessed its hypoalgesic properties under simulated performance conditions.

**PURPOSE:** The goal of this study was to examine the effect of ingested CAF on leg muscle pain during short-term, high-intensity exercise.

**METHODS:** Subjects consisted of seven active, young men (mean  $\pm$  SD age, body mass, and physical activity =  $27.7 \pm 4.2$  yr, body mass  $77.3 \pm 7.4$  kg, and  $5.1 \pm 1.3$  hr/wk). They ingested one of two CAF solutions or placebo over three separate trials that were conducted a week apart. CAF solutions (2 mg/kg and 5 mg/kg) were ingested in a randomized, single-blind, crossover design. Subjects refrained from intense exercise, CAF ingestion, and alcohol consumption 48 hours pre-trial. Initially, they completed a familiarization trial. On a separate day, they completed two all-out bouts of 40 repetitions of knee extension and flexion on an isokinetic dynamometer at 180 deg/sec. There was a three minute recovery between bouts. Perceived pain intensity was assessed utilizing a category-ratio scale from 0 - 10 with verbal anchors. Rating of perceived exertion (RPE) was also recorded using a standard 0 - 10 scale. During exercise, pain perception was assessed at 15 and 35 repetitions and 2.5 min into recovery, and RPE was recorded after 25 repetitions. Two-way ANOVA with repeated measures was used to assess differences in pain and RPE across time and treatment.

**RESULTS:** From 15 to 35 repetitions, pain sensation (mean  $\pm$  SD) was increased in the 5 mg/kg ( $3.3 \pm 2.2$  to  $5.7 \pm 2.1$ ), 2 mg/kg ( $2.6 \pm 1.3$  to  $5.6 \pm 1.6$ ), and placebo condition ( $3.1 \pm 1.7$  to  $5.7 \pm 2.3$ ). RPE was also enhanced ( $p < 0.05$ ) from bout 1 ( $5.6 \pm 1.7$ ,  $5.0 \pm 1.4$ , and  $5.1 \pm 1.8$ ) to bout 2 ( $6.7 \pm 1.4$ ,  $6.4 \pm 1.1$ , and  $6.3 \pm 2.0$ ) in the 5 mg/kg, 2 mg/kg, and placebo condition. No effect of treatment ( $p > 0.05$ ) on RPE or pain was observed.

**CONCLUSIONS:** These preliminary data show no effect of CAF ingestion on pain or RPE during maximal knee extension and flexion in young, active men who are regular caffeine consumers. Yet, both RPE and pain sensation were significantly augmented with completion of maximal knee extension and flexion. Further study is merited to elucidate analgesic effects of caffeine during short-term exercise dependent upon nonoxidative metabolism.

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**2307 Board #195 May 28 2:00 PM - 3:30 PM**

**Low Dose Caffeine Does Not Decrease Perceived Exertion And Leg Pain During Exhaustive Cycling**

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(No relationships reported)

A number of studies have demonstrated that caffeine may alter an individual's perception of effort and strain during exercise. Stay Alert™ chewing gum (100mg caffeine/piece) has been used by military personnel during sustained operations to enhance performance.

**PURPOSE:** The purpose of the current investigation was to determine if low dose (200mg) caffeine administered via chewing gum at different time points would decrease ratings of perceived exertion (RPE) and leg pain (LP-RPE) during cycling to exhaustion.

**METHODS:** Eight apparently healthy, college aged ( $25.5 \pm 4$  yr), physically active ( $45.5 \pm 5.7$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) males volunteered to participate in the present investigation. Participants reported to the exercise science laboratory on five separate occasions, and all trials were separated by a one week washout period. On the first visit, subjects underwent a graded exercise test (Excalibur 1300Wcycle ergometer) to determine maximal oxygen consumption. For the next four visits participants at 85% VO<sub>2max</sub> until exhaustion. Ratings of perceived exertion (RPE) and leg pain (LP-RPE) measures were obtained prior to and every ten minutes during cycling. Two pieces of chewing gum, placebo (PLA) vs. Stay Alert™ (CAFF) was administered in a randomized, counterbalanced, double blind manner at 3 time points (35 min pre-exercise, 5 min pre-exercise, and 10 min following starting of exercise). For the fourth visit PLA gum was administered at all three time points.

**RESULTS:** Dose schedule (PLA, CAFF; at -35, -5, 15min of exercise) by time (Pre-, 10, 20, and 30 min-post initiation of exercise) repeated measures ANOVAs revealed no significant main or interaction effects for dose schedule for RPE and LP-RPE ( $p \geq 0.89$ ).

**CONCLUSION:** These data suggest that low dose caffeine administered via Stay Alert™ does not alter an individual's perception of effort or pain during exhaustive cycling.

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**2308 Board #196 May 28 2:00 PM - 3:30 PM**

**Effects Of Water-based Exercise Program Among Frail Elderly Women With Lower Limb Pain**

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(No relationships reported)

Knee osteoarthritis and lumbar spinal stenosis are common musculoskeletal disorders in the elderly. Pain and impairment on those parts frequently leads to moderate to severe limitations of participation in daily life and decreased quality of life (QOL). Water-based exercise (WE) provides several water-specific benefits to reduce pain and improve functional decline.

**PURPOSE:** To examine the effect of WE program on functional fitness and health-related QOL (HRQOL) among frail elderly women with lower limb pain on the community-based setting.

**METHODS:** Participants were 51 elderly women (age=72.1 $\pm$ 4.6years) with confirmed knee and/or low back pain, which were randomly assigned to either WE group (WEG; n=26) or wait-list control group (CG; n=25). WEG first participated in a 12-week WE program. CG was provided the same program immediately after the intervention as a cross-over design. Timed up and go test (TUG), 5-meter walk test (5WT), one-legged standing with eyes open (OLS-O), 5-time sit and stand test (SS5), and grip test, and the Japanese version of SF-8 were assessed at baseline and post-intervention. Both groups completed the same assessment at 3 months after their own WE programs. Mixed factorial and repeated measures ANOVA were utilized for analyses. Effect sizes were calculated.

**RESULTS:** No significant differences at baseline were found between WEG and CG in all variables. TUG (pre=6.6 $\pm$ 0.8s; post=6.2 $\pm$ 0.09), SS5 (10.4 $\pm$ 2.4s; post=9.1 $\pm$ 1.6s), OLS-O, BP (pre=41.9 $\pm$ 6.6; post=47.7 $\pm$ 6.6), and PCS (pre=42.1 $\pm$ 6.2; post=45.9 $\pm$ 6.8) for WEG significantly improved from pre- to post-intervention ( $p < 0.05$ ) whereas did not change in CG ( $p > 0.05$ ). WEG significantly increased in GH following intervention (pre=46.5 $\pm$ 5.9; post=50.0 $\pm$ 6.9;  $p = 0.04$ ) whereas the CG significantly decreased from pre- to post-intervention (pre=48.8 $\pm$ 5.5; post=54.1 $\pm$ 5.9  $p = 0.02$ ). Improvement of TUG, SS5, 5WT, OLS-O, BP, GH, and PCS significantly maintained for 3 months after WE programs ( $p < 0.05$ ). Effect sizes of each measure for the effectiveness of WE and its sustainability were small to moderate and moderate to large, respectively.

**CONCLUSIONS:** WE can not only improve functional mobility and lower muscular strength, but also enhance general health perception and reduce bodily pain perception on HRQOL among elderly women with lower limb pain.

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**D-37 Free Communication/Poster - Protein and Amino Acid Metabolism**

MAY 28, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**2309 Board #197 May 28 2:00 PM - 3:30 PM**

**Relationship Between Animal Protein Intake And Muscle Mass Index Independently Of Physical Activity Levels.**

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(No relationships reported)

The amount, the quality and the type of protein intake could play a role in regard to the level of skeletal muscle mass.

**PURPOSE:** To examine the relationship between the type of protein intake and the level of muscle mass in healthy omnivore and vegetarian Caucasian women.

**METHODS:** Observational and cross-sectional study. Twenty-two omnivores and 20 vegetarians were recruited. Muscle mass index (urinary creatinine), dietary intake (5-day dietary records), and biochemical analyses (urinary estrogen metabolites; plasma sex hormone, phytoestrogen and lipid profiles) were obtained in four seasons. The groups were compared with non-parametric Mann-Whitney test and using a GLM multivariate with SHBG and vegetal protein intake serving as covariables. Correlations were performed between muscle mass index and significant variables. A stepwise regression model was used to determine the predictor of muscle mass.

**RESULTS:** We found differences between groups for muscle mass ( $p = 0.010$ ), muscle mass index ( $p = 0.002$ ), animal protein intake in g/d ( $p = 0.001$ ) and in g/kgBW/d ( $p = 0.003$ ), vegetal protein intake in g/d ( $p = 0.015$ ) and in g/kgBW/d ( $p = 0.007$ ), the animal/vegetal protein intake ratio ( $p = 0.001$ ) and SHBG ( $p = 0.001$ ). Muscle mass index still correlated with animal protein intake in g/d ( $p = 0.001$ ) and in g/kgBW/d ( $p = 0.008$ ), and the animal/vegetal protein intake ratio ( $p = 0.007$ ) even after controlling for SHBG and vegetal protein intake. Finally, animal protein intake (g/d) was the independent predictor of muscle mass index (adjusted  $r^2 = 0.42$ ). These differences are likely independent of physical activity levels.

**CONCLUSION:** A vegetarian diet is associated with a lower muscle mass index than is an omnivore diet at the same protein intake. The best predictor of the muscle mass index is the animal protein intake. These results are important because the loss of muscle mass is associated with functional limitations, falls and fractures.

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**2310 Board #198 May 28 2:00 PM - 3:30 PM**  
**Effect Of Protein Supplement Timing On Strength, Power And Body Compositional Changes In Resistance-trained Men**

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**PURPOSE:** The effect of 10-weeks of protein supplement timing on strength, power and body composition was examined in 33 resistance-trained men.

**METHODS:** Subjects were randomly assigned to either a protein supplement provided in the morning and evening (AM/PM;  $n = 13$ ), or provided immediately prior to and immediately post workouts (PRE/POST;  $n = 13$ ). In addition, seven subjects agreed to serve as a control (CTR) group and did not use any protein or other nutritional supplement. During each testing session subjects were assessed for strength (one repetition maximum [1-RM] bench press and squat), power (assessed by analyzing power performance of 5 repetitions performed at 80% of 1RM in both the bench press and squat exercise) and body composition (DEXA).

**RESULTS:** A significant main effect for all three groups in strength improvement was seen in 1RM bench press ( $120.6 \pm 20.5$  kg vs.  $125.4 \pm 16.7$  at week 0 and week 10 testing, respectively) and 1RM squat ( $154.5 \pm 28.4$  kg vs.  $169.0 \pm 25.5$  at week 0 and week 10 testing, respectively). However, no significant between group interactions were seen. Significant main effects were also seen in both upper and lower body peak and mean power, but no significant differences were seen between groups. No changes in body mass or body fat % were seen in any of the groups.

**CONCLUSIONS:** Results indicate that the time of protein supplement ingestion in resistance-trained athletes during a 10-week training program does not provide any added benefit to strength, power or body compositional changes.

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**2311 Board #199 May 28 2:00 PM - 3:30 PM**  
**Influence Of Spirulina Intake On Muscle Protein Of Rats Recovering From Protein Malnutrition**

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**PURPOSE:** The present study aimed to evaluate the effects of the blue green alga *spirulina* as the sole dietary source of protein on muscle protein of rats recovering from malnutrition.

**METHODS:** Young (30 days) Wistar rats were separated into 5 groups: I- Casein 17% (C17) from 30 to 150 days of age (d/a); II- *Spirulina* 17% (S17) from 30 to 150 d/a; III- Casein 6% (C6) from 30 to 150 d/a; IV- Casein 6% from 30 to 90 days and *Spirulina* 17% from 91 to 150 d/a (C6/S17) and V- Casein 6% from 30 to 90 days and Casein 17% from 91 to 150 d/a (C6/C17). We investigated the muscle total protein and DNA contents as well as the protein synthesis and degradation to infer on muscle growth and on muscle protein metabolism, respectively. The alkaline phosphatase enzyme (APE) activity was determined as an index of cell activity.

**RESULTS:** The C6 group presented lower total protein and DNA contents in the soleus muscle (g/100g) if compared to the other groups (Anova two-way test, Bonferroni post-hoc;  $P < 0.05$ ). The nutritional recovery, using both diets, re-established these parameters (Total Protein Contents: C6=1.4 $\pm$ 0.2; C6/S17=2.6 $\pm$ 0.3; C6/C17=2.5 $\pm$ 0.2; S17=3.5 $\pm$ 0.4; C17=3.5 $\pm$ 0.3; DNA Contents: C6=0.139 $\pm$ 0.014; C6/S17=0.149 $\pm$ 0.014; C6/C17=0.145 $\pm$ 0.013; S17=0.147 $\pm$ 0.009; C17=0.148 $\pm$ 0.012). *Spirulina* and casein diets were able to reduce protein degradation (pmol/mg.h<sup>-1</sup>) (C6=457.6 $\pm$ 49.4; C6/S17=338.2 $\pm$ 28.4; C6/C17=344.3 $\pm$ 48.3; S17=290.4 $\pm$ 17.1; C17=294.8 $\pm$ 32.3), to reduce APE activity (mU/g) (C6=8.4 $\pm$ 1.4; C6/S17=6.4 $\pm$ 1.3; C6/C17=6.2 $\pm$ 1.5; S17=6.6 $\pm$ 1.2; C17=6.8 $\pm$ 1.5) and to increase the protein synthesis (pmol/mg.h<sup>-1</sup>) (C6=26.4 $\pm$ 4.0; C6/S17=35.4 $\pm$ 4.1; C6/C17=34.3 $\pm$ 3.5; S17=34.1 $\pm$ 4.2; C17=33.7 $\pm$ 4.1) in the soleus muscles of the previously malnourished rats.

**CONCLUSION:** *Spirulina* proved to be an adequate protein source to recovery malnourished rats, since the soleus muscle APE activity was restored to control levels concomitant to the re-establishment of the protein and DNA contents, the increase of the protein synthesis and the decrease of the protein degradation rates.

Supported by CAPES, Fapesp and CNPq (Brazilian Foundations).

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**2312 Board #200 May 28 2:00 PM - 3:30 PM**  
**Intake Of Water-soluble Protein During An Interval Of Repeated Strenuous Exercises Can Improve Serum Myoglobin Levels**

Chiaki Sanbongi<sup>1</sup>, Seigo Baba<sup>1</sup>, Hisataka Ambe<sup>2</sup>, Takeshi Oyama<sup>3</sup>, Kenichi Suijo<sup>4</sup>, Yuki Sakamoto<sup>2</sup>, Katsura Takahara<sup>2</sup>, Mihoko Ishizaka<sup>1</sup>, Kunihiro Kurihara<sup>1</sup>, Yoshiharu Fujieda<sup>2</sup>. <sup>1</sup>Meiji Seika Kaisha, Ltd., Tokyo, Japan. <sup>2</sup>Tokyo Gakugei University, Tokyo, Japan. <sup>3</sup>Gunma Prefectural Maebashi Nishi High School, Gunma, Japan. <sup>4</sup>Tokyo Medical University, Tokyo, Japan.  
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(No relationships reported)

Many athletes consume protein both immediately after exercise and before sleeping to build up the body and to recover from strenuous exercise. Little is known about the effects of protein supplementation during exercise because protein can have a bitter taste. Recently, athletes have been consuming a sports drink containing good tasting and rapidly absorbed water-soluble protein, without evidence of any obvious benefit.

**PURPOSE:** To determine whether intake of water-soluble protein during exercise has a favorable effect on muscle damage, performance, and soreness.

**METHODS:** Japanese trained male athletes ( $n=7$ ) performed two sessions of high intensity cycle ergometer exercise. In each session, subjects did five repetitions of 10 s of maximal intensity riding interrupted by 50 s of resting. Subjects consumed protein (14.1 g/400 mL) either during exercise or immediately after exercise. Blood lactic acid, serum myoglobin, CK, and LDH were measured pre- and post-exercise. Perceived muscle soreness and psychological mood change (Profile of Mood State: POMS) were investigated.

**RESULTS:** Serum myoglobin, CK, and LDH increased significantly 2 h after exercise. Intake of water-soluble protein during exercise (relative to protein intake after exercise) decreased myoglobin, CK, and LDH. POMS scores (fatigue, total scores) were also improved.

**CONCLUSIONS:** In contrast to supplementation after exercise, supplementation during exercise attenuated post-exercise muscle damage and fatigue. The results suggest that ingestion of protein during exercise may be important.



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**2313 Board #201 May 28 2:00 PM - 3:30 PM****Supplementing Water-soluble Protein Can Improve Repetitive High Intensity Anaerobic Performance With Suppressed Serum Myoglobin Elevation**

Yoshiharu Fujieda<sup>1</sup>, Taksehi Oyama<sup>2</sup>, Hisataka Ambe<sup>1</sup>, Chiaki Sannbongi<sup>3</sup>, Seigo Baba<sup>3</sup>, Kenichi Suijo<sup>4</sup>, Yuki Sakamoto<sup>1</sup>, Katsura Takahara<sup>1</sup>, Soutaro Hayashi<sup>1</sup>, Mihoko Ishizaka<sup>3</sup>, Kunihiro Kurihara<sup>3</sup>. <sup>1</sup>*Tokyo Gakuji University, Tokyo, Japan.* <sup>2</sup>*Gunma Prefectural Maebashi Nishi High School, Gunma, Japan.* <sup>3</sup>*Meiji Seika Kaisha, Ltd, Tokyo, Japan.* <sup>4</sup>*Tokyo Medical University, Tokyo, Japan.*  
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(No relationships reported)

Many studies have revealed the effects of supplementing protein on endurance exercise performances or attenuating muscle damage derived from resistance training, whereas the evidences of protein supplementation for strenuous intermittent exercise are still insufficient.

**PURPOSE:** To investigate the effects of a protein beverage on anaerobic performances and muscle damage through double-blind manner.

**METHODS:** Subjects consisted of 7 Japanese male collegiate athletes (age; 21.4 ± 0.5yrs, height; 176.9 ± 4.8cm, weight; 70.2 ± 5.8kg) underwent twice the same intermittent anaerobic exercise protocol on the different 2 days under supplementing either water-soluble protein of 14.1g or placebo in crossover research design. Both on the 1<sup>st</sup> and the 2<sup>nd</sup> day, all the participants accomplished repetitive high-intensity sprint exercises composed of 2 sessions, and consumed protein or placebo before and after the 1<sup>st</sup> session. Each session included 5 bouts of 10 sec. cycle pedaling with maximal efforts at the workload of 0.075 kp. per body weight and 50 sec. intervals. Measuring serum myoglobin, CK and LDH was done before and after exercise to evaluate muscle damage.

**RESULTS:** ANOVA revealed significant differences in both anaerobic powers and changing patterns of serum myoglobin level. In contrast to the condition of taking placebo, subjects demonstrated not only higher achievement of total power outputs (6856 ± 669 vs. 6730 ± 693 watts, p<0.05) but also lower serum myoglobin concentrations at 2-hour (39.0 ± 10.8 vs. 52.0 ± 16.3 ng/ml, p<0.05) and 3-hour (33.8 ± 8.9 vs. 44.3 ± 14.3 ng/ml, p<0.05) after exercise under supplementing protein.

**CONCLUSIONS:** Supplementing water-soluble protein can improve repetitive highly-demanding anaerobic performance with suppressed serum myoglobin elevation.

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**2314 Board #202 May 28 2:00 PM - 3:30 PM****The Effects Of Branched Chain Amino Acid Supplementation On Total Lower Body Workout Volume.**

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(No relationships reported)

Historically, research on BCAAs has been conducted to determine its effects on central fatigue, peripheral fatigue, and most recently its effects on cell-signaling properties leading to an increase in protein synthesis. In relation to high intensity activities, such as resistance exercise, few published data exist investigating the short-term effects of BCAA supplementation on resistance exercise performance.

**PURPOSE:** To determine the effect of BCAA supplementation on total workout volume achieved during an acute bout of lower-body resistance exercise in comparison to a placebo.

**METHODS:** In a randomized, double blind, placebo controlled design, 14 recreationally active males were divided into a BCAA (n = 7) and a placebo (n = 7) group (BCAA = 25.6 ± 4.7 yrs, 180.7 ± 6.6cm, 89.1 ± 10.7 kg; placebo = 20.0 ± 0.8 yrs, 174.5 ± 6.2cm, 80.1 ± 11.6 kg). The participants ingested either 80 mg/kg of BCAAs divided into 2 equal doses or a similar tasting placebo in conjunction with a lower body resistance exercise (RE) bout. The RE bout consisted of 4 sets of leg press followed by 4 sets of knee extension at 80% 1RM to failure. Only those participants who were able to achieve a minimum of 8 repetitions at 80% of 1RM on every set were included in the analysis. However, all participants were required to attain volitional fatigue. Rest periods between sets and exercises were approximately 150 seconds. Supplementation was administered 30 minutes prior and immediately before RE. Total lower-body workout volume between groups was analyzed via an independent samples t-test using SPSS for Windows version 15.0.

**RESULTS:** Data are reported as means ± standard deviation. Total lower-body workout volume for the BCAA and placebo groups was 18,754 ± 1,573 kg and 18,260 ± 6,519 kg, respectively. Independent samples t-test revealed that there were no significant differences between the two groups ( $t_{(12)} = .169$ ,  $p = .869$ ).

**CONCLUSION:** At a dosage of 80 mg/kg of bodyweight, it appears that BCAA supplementation does not increase total lower-body workout volume at an intensity of 80% 1RM to volitional exhaustion during an acute bout of resistance exercise.

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**2315 Board #203 May 28 2:00 PM - 3:30 PM****Leucine Associated With Exercise Reduces Body Weight And Improves The Lipid Profile Of Obese Rats**

Francisco L. Tores-Leal, Miriam Fonseca-Alaniz, Daiana Vianna, Gabriela F. Teodoro, Ivanir S. Pires, Mariana D. Capitani, Lucas C. Pantaleão C. Pantaleão, José Donato Jr, Julio Tirapegui. *University of São Paulo, São Paulo, Brazil.*

(No relationships reported)

Leucine, as an essential amino acid and activator of mTOR (mammalian target of rapamycin), promotes protein synthesis and suppresses protein catabolism. However, the effect of leucine associated with exercise on weight loss and improvement on cholesterol metabolism remains unclear, and whether leucine has beneficial effects as a long-term dietary supplement has not been examined.

**PURPOSE:** To evaluate the effect of leucine associated with exercise on weight loss and metabolism of cholesterol in rats previously submitted to a high-fat diet.

**METHODS:** Initially fifteen Sprague-Dawley rats were to fed with high-fat diet for 15 weeks. Subsequently, they were distributed in two groups, exercise group (EG) (n = 8) and exercise + leucine (GEL) (n = 7). Both groups rats were submitted to a swimming exercise for 60 minutes per day for 6 weeks, and GEL rats received supplementation with 5% of leucine. After 21 weeks the animals were sacrificed and samples for analysis were collected. Test t was done for statistical analysis with p<0.05.

**RESULTS:** There was a significant variation in body weight of GEL compared with GE (-32.50 ± 37.05 vs. 30.87 ± 7.82 respectively; p<0.03), equivalent to -6.15% vs. 1.73%. In addition, GEL compared with the GE showed a significant increase in HDL-c (43.46 ± 5.81 vs 32.34 ± 12.27 respectively; p<0.04). The values of triglycerides (TG), total cholesterol and ratio of triglycerides to HDL-cholesterol (TG/HDL-c) showed no significant difference, 88.19 ± 20.03 (GEL) vs. 98.42 ± 33.12 (GE), p>0.490; 69.89 ± 17.30 (GEL) vs. 60.04 ± 12.06 (GE), p>0.218; 2.06 ± 0.40 (GEL) vs 2.64 ± 0.60 (GE), p>0.060; respectively.

**CONCLUSIONS:** The results of this study suggest that exercise when combined with supplementation with leucine favors the loss of body weight and increases the fraction of HDL-C in rats previously submitted to a high-fat diet via multiple mechanisms.

Supported by FAPESP, 07/59291-3 and 07/51964-9.

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**2316 Board #204 May 28 2:00 PM - 3:30 PM****Effect Of Leucine And Exercise On Fat And Metabolism Of Glucose In Previously Obese Rats**

Gabriela F. Teodoro, Francisco L. Torres-Leal, Miriam Fonseca-Alaniz, Daiana Vianna, Ivanir S. Pires, Mariana D. Capitani, Lucas C. Pantaleão, José



Donato Jr, Marcelo M. Rogero, Fábio B. Lima, Julio Tirapegui. *University of São Paulo, São Paulo, Brazil.*

(No relationships reported)

Several studies show evidence that supplementation with leucine favors reducing body fat in animals submitted to various experimental conditions, including food restriction and high fat diet. However, the effect of supplementation with leucine associated with exercise in animals submitted to high-fat diet remains poorly informed, as well, the effects of these interventions on reversion of the deleterious effects on metabolism of glucose caused by the high fat diet.

**PURPOSE:** To evaluate the effect of supplementation with leucine associated with exercise in body fat and in the metabolism of glucose in rats previously submitted to high-fat diet.

**METHODS:** Initially thirty Sprague-Dawley rats were fed with high-fat diet for 15 weeks. Subsequently, they were distributed into control group (CG) (n = 7), leucine group (LG) (n = 8), exercise group (EG) (n = 8) and group exercise + leucine (GEL) (n = GEL 7). CG and EG were fed with AIN-93M diet, and LG and GEL were supplemented with 5% of leucine. EG and GEL were exposed to 60 minutes per day of swimming exercise for 6 weeks. After 21 weeks the animals were sacrificed and samples for analysis were collected. Two-way ANOVA was performed for statistical analysis with  $p < 0.05$ .

**RESULTS:** When compared the factors exercised vs. sedentary and leucine vs. control, there was a significant difference in the sum of deposits of visceral fat ( $p < 0.022$  and  $p < 0.034$ , respectively). The same results were observed between LG vs. CG ( $6.01 \pm 1.18$  vs.  $7.79 \pm 2.18$   $p < 0.026$ ) and GEL vs. LG ( $6.14 \pm 0.78$  vs.  $7.79 \pm 2.18$ ,  $p < 0.019$ ). Significant differences were found among the factors exercised vs. sedentary ( $p < 0.011$ ) and leucine vs. control ( $p < 0.047$ ) for the morphometry of adipose tissue. The same was observed between the CG vs. LG ( $288.05 \pm 53.54$  vs.  $380.26 \pm 120.02$ ,  $p < 0.029$ ) and GEL vs. LG ( $269.49 \pm 36.70$  vs.  $380.26 \pm 120.02$ ,  $p < 0.010$ ). On the other hand there was no significant difference in insulin and HOMA index.

**CONCLUSIONS:** The results of this study suggest that supplementation with leucine does not reduce body fat nor the volume of adipocytes. Moreover, the effects of the association between leucine and exercise are attributed primarily to the exercise.

Supported by FAPESP, 07/59291-3 and 07/51964-9.

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**2317 Board #205 May 28 2:00 PM - 3:30 PM**

**Protein In Food Versus A Dietary Supplement After Strength Training In Collegiate Football Athletes**

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(No relationships reported)

Many athletes believe the utilization of protein supplements will increase their lean body mass while improving their overall performance. Many also believe meeting their established protein requirements through dietary intake alone can be difficult and even impossible without incorporating protein supplementation.

**PURPOSE:** The purpose of this study was to determine if muscle hypertrophy and strength gains differed between athletes consuming protein from dietary sources compared to those consuming protein in an exercise recovery supplement.

**METHODS:** Performance measures (bench press, back squat, hang clean, 10 yard sprint, and vertical jump) and body composition were compared in redshirt football players (age  $18.6 \pm 0.7$  years) who completed an eleven week protocol of weight training followed by either protein in supplement form (S, n=6, 28 grams protein) or protein in foods (NS, n=9, 8-28 grams protein) 3 days/week. Subjects completed 3-day diet records to determine macronutrient intake and had DEXA scans to determine body composition both pre- and post-training.

**RESULTS:** Without inclusion of the post-workout protein intake, both groups had similar protein intakes in their diets. Similar increases ( $P=0.003$ ) in lean body mass were measured in the S ( $72.2 \pm 6.6$  to  $73.0 \pm 6.3$  kg) and NS groups ( $69.3 \pm 8.6$  to  $70.9 \pm 8.8$  kg). No significant differences were found between the two groups in performance variables. For example, bench press increased ( $P=0.01$ ) from  $114 \pm 15$  to  $120 \pm 16$  kg in the S group and from  $111 \pm 12$  to  $116 \pm 13$  kg in the NS group.

**CONCLUSION:** The consumption of protein in the form of a recovery supplement shake did not offer any performance or lean body mass advantages over consumption of protein in the form of food.

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**2318 Board #206 May 28 2:00 PM - 3:30 PM**

**Dietary-energy/protein Optimum For N-balance And Muscle Hypertrophy During Two Weeks Of Resistance Training**

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(No relationships reported)

In a previous paper, dietary-protein needs for better muscle hypertrophy during 2-week resistance training were found to be between 1.5 and 2.5 g/kg/d (Maesta et al. Rev. Bras. Med. Esporte 2008). However, not only total energy adequacy but also energy-yielding nutrients are important.

**PURPOSE:** To determine adequate energy and the energy-yielding nutrient (CHO/Fat) ratio for N-balance and related muscle-mass gain in training body builders.

**METHODS:** forty-two healthy young men (18-35yrs), without exogenous anabolics and at least two years of body-building training were assessed at baseline (MO) for food intake, anthropometry (calculation of body fatness-BF and muscle mass-MM) and urinary nitrogen excretion (for N-balance, NB). The assessment was repeated after four weeks (M1) with a diet of 1.8g prot/kg/d and different proportions of kcal/prot and CHO/Fat along with a unique 6-day/wk resistance-training protocol. Statistics between groups and among moments were performed by ANOVA and Student's t test along with regression analysis (Pearson) with  $p=0.05$ .

**RESULTS:** Total energy intake correlated positively with NB ( $r=0.69$ ), BW ( $r=0.59$ ), MM ( $r=0.41$ ) and BF ( $r=0.34$ ), with  $\geq 30$  kcal/g protein giving greater gain of both MM and NB (than  $< 30$  kcal/g prot) without BF gain. Dietary CHO showed a strong positive relationship and dietary-fat a negative relationship with NB and MM. Dietary CHO/Fat (calorie) ratio  $> 6$  resulted in better MM gain (2.2kg) and BF loss (-1.1%) for the same BW.

**CONCLUSION:** For the best MM gain and NB during a short period of resistance training, the recommended diet would provide  $\sim 1.8$ g prot/kg/d,  $\geq 30$  kcal/g/prot in a proportion of CHO/Fat calories  $\geq 6$ .

Supported by Fapesp and CNPq

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**2319 Board #207 May 28 2:00 PM - 3:30 PM**

**Performance In The Heat Of Previously Fed Subjects Is Unaffected By Carbohydrate Or Protein Ingestion**

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(No relationships reported)

It has been suggested that exercise performance in the heat might be limited by central mechanisms. One of the proposed mechanisms associates increased central serotonergic activity to the onset of fatigue. Different nutritional strategies have been used in an attempt to decrease central serotonergic activity thus improving performance.

**PURPOSE:** To evaluate carbohydrates (CHO) or protein (PTN) ingestion effects on self-paced time trial performance in the heat when subjects were previously fed.

**METHODS:** Ten male subjects ( $26 \pm 1$  yrs;  $64.5 \pm 2.4$  kg; peak power output  $323 \pm 13$  W;  $\dot{V}O_{2max}$   $70.7 \pm 2.8$  mL  $O_2 \cdot kg^{-1} \cdot min^{-1}$ ) were asked to cycle 60 km as fast as possible in an environmental chamber (dry temperature  $32^\circ C$ ; 50% RH). Trials included four 1-km all-out sprints: after 14, 29, 44 and 59 km. Participants were randomly subject to three

different trials, during which they ingested: 1) water (H<sub>2</sub>O); 2) H<sub>2</sub>O+capsules containing a powder mixture of glucose and sucrose (CHOc 6.0%, 1.32g/kg body wt); 3) H<sub>2</sub>O+capsules containing a powder of whey-protein isolate (PTNc 3.9%, 0.85g/kg body wt). Both of trials with capsules were run on a double-blind fashion. Ingestion of fluids in all trials occurred at 5<sup>th</sup>, 15<sup>th</sup>, 30<sup>th</sup>, 45<sup>th</sup> and 55<sup>th</sup> km. Blood samples were collected through a catheter from a superficial forearm vein at pre-exercise period and at 9<sup>th</sup>, 24<sup>th</sup>, 39<sup>th</sup>, 54<sup>th</sup> and 60<sup>th</sup> km. Data (mean  $\pm$  SE) were analysed using a factorial ANOVA with repeated measures and a LSD *post-hoc* test where significant main effects were observed ( $p \leq 0.05$ ).

**RESULTS:** No differences in time taken to complete trials for either the 60 km (CHOc 137.5  $\pm$  6.1 min; PTNc 143.2  $\pm$  8.8 min vs H<sub>2</sub>O 138.4  $\pm$  5.3 min) or the 1-km all-out sprints were observed. Serum free fatty acids were higher at 54 km in H<sub>2</sub>O and in PTNc (0.73  $\pm$  0.10 and 0.68  $\pm$  0.06 mmol/L, respectively) when compared to CHOc (0.58  $\pm$  0.07 mmol/L). From km 9 to the end of exercise, the TRP/BCAA ratio was lower in CHOc and PTNc (0.085  $\pm$  0.009 and 0.073  $\pm$  0.009, respectively) than in H<sub>2</sub>O (0.117  $\pm$  0.014). Serum prolactin and rating of perceived exertion in all treatments increased in the same fashion.

**CONCLUSION:** Ingestion of CHOc and PTNc did not improve self-paced time trial performance in the heat and probably did not affect central serotonergic activity in previously fed subjects.

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**2320 Board #208 May 28 2:00 PM - 3:30 PM**  
**The Effect Of Leucine Supplementation On Total Lower-body Workout Volume**

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(No relationships reported)

**PURPOSE:** To determine the effect of leucine supplementation, as compared to a placebo, on total lower-body workout volume achieved following an acute bout of heavy resistance exercise.

**METHODS:** In a randomized, double blind, placebo controlled design, 11 recreationally active males were randomized into either a leucine supplementation group (20.8  $\pm$  2.4 yrs; 182.2  $\pm$  2.4 cm; 83.0  $\pm$  6.0 kg) or a placebo group (20.0  $\pm$  0.8 yrs; 174.5  $\pm$  6.2 cm; 80.1  $\pm$  11.6 kg). The participants ingested either 40 mg/kg of leucine (n = 4) divided into 2 equal doses or a placebo (n = 7) and then performed a lower body resistance exercise (RE) bout. Supplementation was administered 30 minutes prior, and immediately before RE. The RE bout consisted of 4 sets of leg press followed by 4 sets of knee extension at 80% 1RM to failure. Only those participants who were able to accomplish a minimum of 8 repetitions at 80% of 1RM on every set were included in the analysis. However, all participants were required to attain volitional fatigue. Rest periods between sets and exercises were approximately 2.5 minutes. Total lower-body workout volume between groups was analyzed using an independent samples t-test utilizing SPSS for Windows version 16.0.

**RESULTS:** Data are reported as means  $\pm$  standard deviation (SD). Total lower-body workout volume after leucine and placebo administration was 22584  $\pm$  1954 kg and 18260  $\pm$  6519 kg, respectively. Independent samples t-test revealed there were no significant differences between the two groups  $t_{(9)} = 1.268$ ,  $p = .237$ .

**CONCLUSIONS:** At a dosage of 40 mg/kg of bodyweight, leucine does not appear to increase total lower-body workout volume at an intensity of 80% 1RM to volitional exhaustion to a greater extent than an acute bout of resistance exercise alone.

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**D-38 Free Communication/Poster - Sport Science II**

MAY 28, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**2321 Board #209 May 28 3:30 PM - 5:00 PM**  
**Power Capabilities Of Elite Bicycle Motocross (BMX) Racers During Field Testing In Preparation For 2008 Olympics.**

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**PURPOSE:** Bicycle motocross (BMX) was a recent addition to the medal sports at the 2008 Summer Olympics and there is little information regarding the physiological demands of the sport. Specifically, the power capabilities of this population and demands of the discipline in the field have yet to be defined. Considerations include i) multiple heats of maximal effort and ii) gear ratios for supercross (Olympic) style courses. The purpose of this study was to test the effects of gear, trial and starting grade on performance of Olympic-caliber BMX racers in controlled field tests.

**METHODS:** Procedures were approved by Eastern Michigan's HSRC in which five elite male BMX racers from the 2008 US Olympic selection pool (including two Olympic medalists) performed controlled field testing over a 7 day period on their racing bicycles equipped with custom portable power meters (PM; SRM, CO). Tests included seven starts for three different gear combinations (-1, 0, +1) and two start conditions (Flat; FS vs Supercross; DS). Data collected from PM included power (W), relative power (W/kg), and cadence (CAD). Timing systems (ProGate, IL) were used to record performance time (PT) from start to 6 and 20m to mimic start conditions at the Olympic venue, while a paved surface was used as opposed to dirt to stabilize testing conditions. MANOVA and ANOVA were used to analyze dependent variables (SPSS, IL;  $\alpha=0.05$ ).

**RESULTS:** PT for DS were faster than LS to both 6 m and 20 m, respectively ( $p<0.001$ ), despite the fact that power was not different. Of note, peak power occurred within 6 m (2087 $\pm$ 156.8 W; 1.6 s) vs 20 m (1688 $\pm$ 193.5 W; 2.7 s) ( $p<0.001$ ), which was confirmed in tests on a full mock Olympic course. This is in contrast to a recent report in elite BMX racers from lab studies (Zabala, et al.) where PP occurred at  $>4$  s. For LS there was a significant effect for gear on PT to both 6 m and 20 m ( $p<0.001$ ), but not power. There was no effect for trial. For DS, there was an effect of gear on CAD with peak occurring in 6 m (212 $\pm$ 3.5, 207 $\pm$ 5.0, 203 $\pm$ 5.1) vs 20 m (174 $\pm$ 9.9, 173 $\pm$ 8.9, 169 $\pm$ 7.6), for -1, 0 and +1, respectively, but not power or time.

**CONCLUSION:** Study results may help future coaching and training decisions for Olympic-caliber BMX racers. Notably, the observation of peak power within the first 2 s in field studies contrasts lab data, and demonstrates the importance of field testing.

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**2322 Board #210 May 28 3:30 PM - 5:00 PM**  
**Intensity Of Brazilian Official Soccer Games**

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Soccer seems to be a high intensity intermittent activity, which varies with the players' position and category (age). The intensity during a soccer game can be assessed by several

variables, but heart rate (HR) is recommended as a practical way. No studies were found in which a great number of players were analyzed during some Brazilian official games.

**PURPOSE:** To evaluate the intensity of official soccer games in different positions using heart rate.

**METHODS:** Subjects from a Brazilian soccer club included male categories under 17 years old (n=26) and 20 (n=18) (U-17 and U-20, respectively); mean  $\pm$  SD; age 16.4 $\pm$ 0.5 and 18.2 $\pm$ 0.7 yr; body mass (BM), 68.1 $\pm$ 4.2 and 70.3 $\pm$ 4.9 kg; height, 175 $\pm$ 7 and 178 $\pm$ 8 cm; body fat, 9.5 $\pm$ 2 and 8.9 $\pm$ 1.4%; and VO<sub>2</sub>max 56.1 $\pm$ 2.0 and 59.2 $\pm$ 3.0 mL·O<sub>2</sub><sup>-1</sup>·min<sup>-1</sup>. Maximum HR (HRmax) was determined as the greatest HR achieved during game, or all out running 1000 m or 2400 m. HR was registered each 5 seconds during 14 official games using a set of HR monitors (Polar Electro Oy, Team System, Finland) and analyzed with respective program. Indirect VO<sub>2</sub>max was predicted from 2400 m running. Percentage of HRmax (%HRmax) was used to express players' effort. Zones of intensity were established regarding %HRmax: 1 (<70%); 2 (70-85%); 3 (85-90%); 4(90-95%); 5(95-100%). HR at the onset of blood lactate accumulation (OBLA) was determined using few 1000 m increasing speed running to achieve 4mM (Accusport Blood Lactate Analyzer).

**RESULTS:** Maximum heart rate (HRmax) was 201 $\pm$ 9 and 198 $\pm$ 7 bpm for the U-17 and U-20 categories, respectively. No differences were found between categories during the study (p>0.05). The mean intensity of the soccer game was 84 $\pm$ 5 %HRmax. The percentage of time spent in zones 1 to 5 during the games were respectively 6, 39, 24, 23, 8%. Forwards and the side-backs remained more time in zone1. Forwards were in zone2 more time than others. The mid-fielders achieved the greater percentage of time spent in zone3 and 4. The wing-backs were the ones who spent more time in zone5. OBLA was 87  $\pm$  5 %HRmax. The percentage of time of game spent above the OBLA intensity was 52  $\pm$  20%.

**CONCLUSIONS:** About two thirds of the game happened at high and one third at very high intensity heart rate responses. Mid fielders achieved greater intensities. The study demonstrated that professional Soccer is a high intensity intermitted activity.

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**2323 Board #211 May 28 3:30 PM - 5:00 PM**

**The Relationship Between Power And Lean Body Mass To Sport-specific Skills Of College Baseball Players**

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(No relationships reported)

Baseball is an anaerobic, power sport. Players need to perform the skills of hitting, throwing, and running explosively. Research suggests that these baseball-specific skills can be predicted from fitness and performance tests. Player profiles created with these types of data are of considerable interest to college baseball coaches because it greatly enhances the recruiting process. If coaches had information that may help predict successful baseball skill performance, they could possibly do a better job of recruiting players for scholarships. This could ultimately help teams win more games.

**PURPOSE:** To determine the relationship of various physiological characteristics to sport-specific skills of college baseball players.

**METHODS:** Thirty-seven members of an NCAA Division I men's baseball team (age = 19.7  $\pm$  1.3 yr) volunteered to be evaluated. Tests included percent body fat, lean body mass (LBM), grip strength, upper (1RM bench press and 1-arm dumbbell row) and lower body (1RM squat) strength, rotational power (medicine ball side toss), leg power (vertical jump), running speed (10, 30, 60 yd sprint), throwing velocity (TV), bat velocity (BV), and batted-ball velocity (BBV).

**RESULTS:** Correlation coefficients were calculated for all variables by utilizing a correlation matrix from raw scores. Significant (p < 0.05) and moderately high positive relationships were indicated between BV and BBV (r = 0.70); 60 yd sprint and 30 yd sprint (r = 0.77), 10 yd sprint (r = 0.70). Significant and moderately positive relationships were indicated between BV and vertical jump (r = 0.58), LBM (r = 0.43); medicine ball side toss and BV (r = 0.50), TV (r = 0.49), BBV (r = 0.45); 1RM squat and 1RM bench press (r = 0.58). Significant and moderately negative relationships were indicated between 60 yd sprint and vertical jump (r = -0.57). Coefficients of determination for all variables were also calculated. Of particular interest was BV and BBV (r<sup>2</sup> = 0.49), vertical jump (r<sup>2</sup> = 0.34), medicine ball side toss (r<sup>2</sup> = 0.25), LBM (r<sup>2</sup> = 0.18); medicine ball side toss and TV (r<sup>2</sup> = 0.24), BBV (r<sup>2</sup> = 0.20); 60 yd sprint and 30 yd sprint (r<sup>2</sup> = 0.59), 10 yd sprint (r<sup>2</sup> = 0.49), VJ (r<sup>2</sup> = -0.32).

**CONCLUSION:** Results suggest that strength training programs designed to improve baseball player's performance should emphasize increasing leg power, rotational power, and LBM.

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**2324 Board #212 May 28 3:30 PM - 5:00 PM**

**Physiological Changes Across A 3 Month Sprint Racing Season In Master Level Rowers**

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(No relationships reported)

**PURPOSE:** The aim of this study was to determine the physiological and performance changes in response to 3 months of specific training for sprint racing (1000 meter course) in master level rowers.

**METHODS:** On three occasions over a 3 month period, nine male rowers (44.9  $\pm$  1.7 yrs, 184.3  $\pm$  2.4 cm) participated in a maximal effort, graded exercise test on the rowing ergometer. Blood lactate concentration, heart rate, oxygen consumption (VO<sub>2</sub>) and rating of perceived exertion were recorded at each three minute stage, during a 30 second rest period, throughout the exercise test and at 3 and 6 minutes of an active recovery. Body composition, maximal vertical jump, core strength, hamstring flexibility and the profile of mood states questionnaire (POMS) were also measured at baseline and 3 months of training. Additionally, a 2000m performance test was performed 1 day apart from the graded exercise testing.

**RESULTS:** Three months of sprint training resulted in a decrease (p < 0.05) in body fat, fat mass and waist circumference and an increase in fat free mass (72.5  $\pm$  3.8 vs. 73.5  $\pm$  3.7 kg) and thigh circumference. The 3-month training program did not change vertical jump, core strength, peak [lactate], [lactate] during recovery, VO<sub>2</sub>peak or 2000m performance, but did improve hamstring flexibility. After 3 months of training the athletes were able to produce more power at lactate threshold (1 mmol/L above baseline) (218  $\pm$  9.5 vs. 243  $\pm$  12.1 watts), at 4 mmol/L of lactate (245  $\pm$  11.2 vs. 262  $\pm$  16.4 watts) and at the onset of blood lactate accumulation (OBLA) (274  $\pm$  12.2 vs. 299  $\pm$  14.7 watts).

**CONCLUSIONS:** Three months of sprint training resulted in increased fat free mass, hamstring flexibility and power at lactate threshold, 4 mmol/L of lactate and at OBLA in master level rowers.

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**2325 Board #213 May 28 3:30 PM - 5:00 PM**

**Physiological Responses To Running In Trained Male Collegiate And Master Level Distance Runners**

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(No relationships reported)

Performance for running events requiring a substantial aerobic energy contribution (i.e., 10 km) declines gradually from the early 20's to 50 yr, with a more pronounced decrease between 51 and 65 yr, followed by an exponential decrement thereafter (Tanaka, et al. (2003).

**PURPOSE:** This study examined the physiological responses to running in similarly trained male collegiate (C) (n=11; 20+1 yr) and master level (M) (n=9; 45+5yr) distance runners.

**METHODS:** Oxygen uptake (open-circuit spirometry, Parvo-Medic), heart rate (HR; telemetry), and blood lactate (YSI) responses to a series of submaximal (11.3, 12.9, 14.5,

and 16.1 km·hr<sup>-1</sup>) and one maximal run to volitional exhaustion were recorded. Body composition was also assessed (skinfolds).

**RESULTS:** Collegiate runners had a greater VO<sub>2</sub> max (60.9±2.2 vs 58.3±2.6 ml·kg<sup>-1</sup>·min<sup>-1</sup>), a higher HR max (193±6 vs 178±7 bpm), and a faster maximal running speed (19.8±0.7 vs 19.0±0.9 km·hr<sup>-1</sup>) compared to masters runners (P<0.05). However, peak blood lactate was similar (C=9.6±.8, M=10.6±2.6 mM) (P>0.05). At a fixed blood lactate of 4 mM, C had a slightly faster running speed than M (16.7±1.2 vs 15.5±1.6 km·hr<sup>-1</sup>) (P=0.09). HR was higher during the submaximal runs for C compared to M (P<0.05), while an ordinal interaction was found between age category and running speed for oxygen uptake (P<0.05) with M having higher VO<sub>2</sub> values at 14.5 and 16.1 km·hr<sup>-1</sup>. Although body weight was the same for each group (C=67.1±7.2, M=65.4±3.2 kg), the percent adipose tissue was lower for C (6.9±1.1%) compared to M (11.8±2.8%) (P<0.05).

**CONCLUSION:** The collegiate runners were characterized by a greater maximal aerobic power, better running economy, and tendency to sustain a faster running speed at a given metabolic load. Declines in physiological responses still occur with the aging process despite maintenance of training and competitive running.

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**2326 Board #214 May 28 3:30 PM - 5:00 PM**

**Physiological And Anthropometric Characteristics Of The Italian National Women Rugby Union Team**

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(No relationships reported)

**PURPOSE:** The aim of this study was to provide up to date normative data on selected, laboratory-based, functional and anthropometric variables of elite rugby union women players.

**METHODS:** 11 forwards (FW) and 11 backs (BK) from the Italian National team, regularly engaged in elite training and international competitions were tested in March 2007. We measured body mass, stature, % body fat and lean body mass (5-site plicometry), maximum oxygen consumption (incremental cycling test to exhaustion) and lower extremities power (vertical jumping test: squat, SJ, and countermovement jump, CMJ). Mean and standard deviation were calculated in FW and BK and in positional subgroups (i.e. front row FW: props, locks; back row FW: flankers, number 8, hooker; inside BK: fly-half, centre; outside BK: wings, full back). Data were compared by t test and Bonferroni correction (significance p< 0.05).

**RESULTS:** The athletes were 24±4 years old with a 9±6 years playing experience. Results are presented in the table. \* and § indicate, respectively, a significant difference between FW and BK and within forwards and backs subgroups.

group	#	mass (Kg)	stature (m)	fat (%)	lean mass (Kg)	VO2max (l*min-1)	VO2max (ml*Kg- l*min-1)	SJ (cm)	CMJ (cm)
FW	11	71±12*	1.68±0.1*	24±6	53±5*	3.0±0.4*	43±5	26±4*	29±3
BK	11	63±6	1.63±0.1	24±4	47±4	2.7±0.5	43±5	24±3	29±4
FR FW	5	79±14§	1.71±0.1§	28±6§	56±5§	3.1±0.3	41±6	25±2	28±2
BR FW	6	65±5	1.64±0.0	22±6	51±3	2.9±0.4	44±5	27±5	30±4
I BK	6	64±6	1.63±0.1	26±4	47±4	2.8±0.5	42±7	23±3	29±3
O BK	4	61±7	1.63±0.1	22±4	48±5	2.6±0.3	42±2	24±4	29±5

**CONCLUSION:** The study provides normative functional and anthropometric data for elite female rugby union players, with special reference to positional role. Role differences appear between forwards and backs and between forwards subgroups, suggesting that differences in physical requirements, related to playing positions, are similar for men and women. This normative database can support coaches for talent selection and to guide training to match the playing position demands. Furthermore, periodic monitoring of a variety of playing populations is necessary to quantify and compare the rapidly evolving demands of this game.

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**2327 Board #215 May 28 3:30 PM - 5:00 PM**

**Impact Of Visual Training On Complex Visual Reaction Time In Athletes**

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(No relationships reported)

Visual information is very important in competitive sports because of the velocity and selectivity of the tactical decisions that are needed to make.

**PURPOSE:** The aim of this study was to evaluate the impact of visual training on complex visual reaction time (CVRT) in athletes, to test the hypothesis that specific and systematic visual stimulation contributes to changes over a short period of time.

**METHODS:** A before and after design was used. Forty-one female and 33 male athletes (19 ± 5 yr, mean ± SD) who belonged to individual and team sports volunteered to take part in this study. A PC-based visual training program was performed within 5 weeks, with a training frequency of 3 sessions per week. Every session lasted 30 min and included the following visual skills: Saccadic Movements, Follow-up Visual Field, Stereopsis, Fusion, Peripheral Visual Field and Taquitoscope. Progressive incremental levels of complexity were stipulated for the training. Specific software was used to assess CVRT in both pre and post training tests. The evaluation of CVRT consisted of showing on a PC screen a sequence of 5 randomly-timed visual stimuli in the course of ~30 s, 3 of them (positives) to be responded by means of pressing the enter key on a keyboard, which was located under the dominant hand. Punishments of 200 ms were automatically added in case of failed responses. The subjects repeated the test 4 times, with rest intervals of 1 min. The average time of the 12 outputs was taken into account for the pre-post comparison. The training sessions and the tests took place at the same time of day (± 2 h). A paired t-test was used to determine the significance of the difference between the performances before and after training.

**RESULTS:** Statistical analysis revealed that visual training produced a significant decrease (p<0.05) in CVRT (335.6 ± 4.6 to 271.3 ± 4.0 ms, mean ± SE; 95% CI for the difference: 57.2 to 71.4). All subjects had higher performances in the post training test.

**CONCLUSIONS:** These results showed that visual training produced improvement in CVRT over a short period of time. It would be advisable to design field tests to evaluate the effect of the visual perceptual and visual motor interventions on the performance of the athletes in sports situations.

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**2328 Board #216 May 28 3:30 PM - 5:00 PM**

**Evaluation Of Yo-Yo Intermittent Recovery And Hoff Tests In Female Collegiate Athletes**

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The Yo-Yo Intermittent Recovery and Hoff tests are field tests that can be used to predict performance in soccer players. However, the physical requirements of these tests are



uniquely different and there is limited data on their usefulness for female soccer players.

**PURPOSE:** It was the purpose of this study to evaluate the Yo-Yo Intermittent Recovery and Hoff tests as they relate to each other and to maximal oxygen consumption in collegiate female soccer players.

**METHODS:** Fifteen female soccer athletes from an NCAA Division II university team volunteered to participate in this study. Anthropometric measurements of height, weight, and body mass index (BMI) were recorded. The athletes performed levels 1 and 2 of the Yo-Yo Intermittent Recovery test (YY1 and YY2) and a modified, 7-minute version of the Hoff test (HT). Maximal oxygen consumption ( $\text{VO}_{2\text{max}}$ ) was determined utilizing an open circuit technique during a graded treadmill protocol to voluntary exhaustion. Individual tests were performed at least 3 days apart to avoid residual fatigue. Pearson's  $r$  was calculated to determine the linear association between test results, laboratory results, and anthropometric data.

**RESULTS:** Age, height, and weight (Mean  $\pm$  SD) were  $19.6 \pm 1.29$  years,  $1.65 \pm .07$  m, and  $63.8 \pm 6.9$  kg, respectively. Performances in the field tests were: YY1 =  $840 \pm 311.2$  m, YY2 =  $260 \pm 67.9$  m, and HT =  $1032.9 \pm 80.5$  m.  $\text{VO}_{2\text{max}}$  averaged  $46.1 \pm 4.5$  ml $\cdot$ kg $^{-1}\cdot$ min $^{-1}$  while mean BMI was  $23.4 \pm 2.3$  kg/m $^2$ .  $\text{VO}_{2\text{max}}$  was significantly related to performance in the YY1 ( $r = .84$ ,  $p = .001$ ) and YY2 ( $r = .70$ ,  $p = .012$ ), but was not significantly related to HT ( $r = .37$ ,  $p > .05$ ). BMI was inversely related to YY1 ( $r = -.64$ ,  $p = 0.025$ ) and YY2 performance ( $r = -.62$ ,  $p = 0.018$ ), but did not relate to HT ( $r = -.07$ ,  $p = .82$ ). In addition, we observed significant relationships between YY1 and HT ( $r = .64$ ,  $p = 0.025$ ) and between YY1 and YY2 ( $r = .86$ ,  $p = 0.001$ ).

**CONCLUSIONS:** YY1 and YY2 were strongly associated with aerobic power and inversely related to BMI, reinforcing the concept that these are primarily fitness tests. Similarly, that HT was not strongly associated with aerobic power or BMI suggests that it is measuring something other than fitness, presumably sport specific skill.

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**2329      Board #217      May 28      3:30 PM - 5:00 PM**  
**Circulatory Strain And Hydration Status Of Cyclists Competing In Le Tour De Langkawi**

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**PURPOSE:** To investigate the circulatory strain and hydration status of cyclists in Le Tour de Langkawi - a 10-day cycling tour event covering a total distance of ~1,150 km in Malaysia.

**METHODS:** Six male elite cyclists (age  $24.5 \pm 5.7$  yr; mass  $61.6 \pm 4.7$  kg; stature  $1.68 \pm 0.04$  m,  $\text{VO}_{2\text{max}}$   $66.6 \pm 3.8$  mL $\cdot$ kg $^{-1}\cdot$ min $^{-1}$ ; HR $_{\text{max}}$   $185 \pm 4$  bpm) gave their informed consent to take part in the study. Prior to the tour,  $\text{VO}_{2\text{max}}$  and HR $_{\text{max}}$  were determined via an incremental cycling test to volitional fatigue on a cycle ergometer. Before the start of each stage body mass was measured and a HR monitor was strapped to each cyclist. At the end of each race stage the cyclists were reweighed and total body mass loss was used as an indicator of dehydration. The HR data was analyzed to determine the relative percentage of HR $_{\text{max}}$  (% HR $_{\text{max}}$ ) sustained throughout the tour. Five different % HR $_{\text{max}}$  were defined as follow: Recovery (<60% HR $_{\text{max}}$ ), Easy (60-69% HR $_{\text{max}}$ ), Moderate (70-79% HR $_{\text{max}}$ ), Hard (80-89% HR $_{\text{max}}$ ), Intense (>90% HR $_{\text{max}}$ ). The ambient temperature and relative humidity were recorded during each day of the tour.

**RESULTS:** The final stage of the race was cancelled due to heavy rain. Cyclists maintained a mean HR of 148 bpm over the 9 days duration of the event, although there was a considerable range of HR response throughout the tour. A total of 8.7 hours (31.6%) of the time racing in the tour was classified as "Hard" to "Intense" in terms of the HR response (>80% HR $_{\text{max}}$ ). Body mass of cyclists was significantly ( $P < 0.01$ ) lower at the end of each race stage with an observed mean stage body mass loss of  $1.6 \pm 0.6$  kg. In addition, total body mass loss was correlated to the distance of each stage ( $P < 0.05$ ). Mean maximum daily ambient temperature and relative humidity for the tour was  $37.2 \pm 3.8$  °C and  $60.9 \pm 20.1$  % rh.

**CONCLUSIONS:** This study found a significant mean 2.6% body mass deficit across all stages of the tour. Most of this loss can be attributed to the thermal stress of the hot-humid environment and associated sweat production. Increasing dehydration coupled with periods of intense physical effort contributed to a high mean heart rate of 80% HR $_{\text{max}}$  despite the cooling effect of airflow and availability of fluid. Part of this elevated HR response may be attributed to the well documented cardiovascular drift that is associated with prolonged exercise in hot conditions.

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**2330      Board #218      May 28      3:30 PM - 5:00 PM**  
**Rhythmic Gymnastics On Different Levels Of Qualification. A Comparative Study.**

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Rhythmic gymnastics is a sport that can be characterized for having athletes that achieve international status before becoming adults. Teenagers have a intensive training program in a period which can be associated to hormonal changes an body growing.

**PURPOSE:** To compare the structural, chronological and physical variables differences between Rhythmic gymnastics athletes from different levels of qualification.

**METHODS:** The sample was composed by the brazilian rhythmic team (international level)  $n = 07$ , National gymnasts (10 first places in the brazilian adult nationals)  $n = 10$ , State gymnasts (07 first places in the Rio de Janeiro state adult competition)  $n = 07$ . For the evaluation of the physical qualities the following protocols were used: coordination (test of coordination of Burpee), flexibility (goniometry test), explosive power (test of vertical impulse - Sargent jump). The statistic descriptive procedure used was the Shapiro wilk, and the inferencial one was the one-way ANOVA with Sheffe's post hoc. The study established  $p \leq 0.05$  to statistic significance.

**RESULTS:** showed significant statistic differences in the variables age between the international level and the other two ( $16.2 \pm 1.49$ ;  $13.7 \pm 1.25$ ;  $13.8 \pm 1.34$ ) and high between the international and the state gymnasts ( $162.2 \pm 6.87$ ;  $156.6 \pm 3.27$ ;  $155.6 \pm 2.93$ ). There were no significant statistic differences between the groups for weight ( $44.2 \pm 5.06$ ), Burpee ( $4.7 \pm 0.53$ ), Sargent jump ( $37.7 \pm 4.00$ ), Leg goniometry ( $33.0 \pm 11.20$ ).

**CONCLUSION:** Differences in age can be explained for Nationals and State championships allow juniors to participate. Most evaluated gymnasts narrated not having the menarch period yet or being late (after 15 years). At the same time, the best results in National and State competitions were achieved by the juniors. These results may be related to the late maturational period, considering that the presence of the strogenio hormone affects the athletes performance. In this study, there was found no difference for the physical variables, this way, the qualification difference is due to the thecnical and specific levels.

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**2331      Board #219      May 28      3:30 PM - 5:00 PM**  
**Urinary Androgens And Corticosteroids Changes In Elite Cyclists After High Intensity Efforts**

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Some research has shown that high intensity exercise induces physiological stress which alter hormonal profile. Urinary excretion of these hormones and its metabolites can be used in order to evaluate physical exercise load. Cortisol's metabolites and cortisone are determined for assess catabolic status, while testosterone and its metabolites as well as



suprarenal androgens are in relation with anabolic status.

**PURPOSE:** the aim of this study is to analyze if high intensity efforts provokes changes in urinary steroids profile in endurance trained subjects.

**METHODS:** Twenty male cyclists participated in this study (age:  $23.83 \pm 2.32$  years; height:  $176.00 \pm 3.65$  cm; weight:  $66.94 \pm 3.59$  kg; body fat %:  $8.57 \pm 1.22$ ;  $\text{VO}_2$  max:  $65.53 \pm 9.35$  ml/kg/min). The trial performed was an incremental ergometric test until exhaustion. Urine samples were collected before and after the test. All tests were conducted in a physiology laboratory, room temperature was  $23 - 25^\circ\text{C}$ , humidity was  $45 - 55\%$ . Urinary samples were analyzed by gas chromatography techniques in order to determine testicular androgens, suprarenal androgens and corticosteroids values. Sample urinary density was in the range of  $1.005 - 1.025$  g/mL, pH was between the normal range of  $4.7 - 7.8$ . Creatinine levels of all samples were determined in order to report the steroid concentrations relative to this urinary parameter. The Wilcoxon test was performed for statistical analysis. A  $p < 0.05$  was used to determine statistical significance.

**RESULTS:** We obtained statistically significant decreases ( $p < 0.05$ ) in testosterone ( $37.5 \pm 16.5$  to  $29.2 \pm 10.9$  ng/mg creatinine), androsterone  $2460.7 \pm 933.4$  to  $2004.8 \pm 819.3$  ng/mg creatinine), total testicular androgens ( $3709.3 \pm 1503.1$  to  $2960.7 \pm 772.3$  ng/mg creatinine), androstenedione ( $32.1 \pm 13.7$  to  $10.4 \pm 4.4$  ng/mg creatinine), total suprarenal androgens ( $229.16 \pm 120.3$  to  $154.5 \pm 134.3$  ng/mg creatinine) and in DHEA/THC ( $0.11 \pm 0.02$  to  $0.07 \pm 0.01$  ng/mL) and DHEA/THC<sub>ol</sub> ( $0.13 \pm 0.02$  to  $0.10 \pm 0.02$  ng/mL) ratios.

**CONCLUSION:** Results suggest that the decline in urinary excretion is due to a decline in the clearing of androgens by the liver because of the reduction in hepatic perfusion that accompanies intense exercise. The DHEA/THC y DHEA/THC<sub>ol</sub> ratios are some markers of the subjects' anabolic/catabolic status following the exercise session.

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**2332 Board #220 May 28 3:30 PM - 5:00 PM**  
**Comparison Of Walking Energy Expenditure On Field Tracks With And Without Poles**

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**PURPOSE:** The purpose of this study was to determine the effects of poles on the walking energy expenditure. The metabolic responses were examined for two walking condition: poles ( $W_{WP}$ ) and non-poles ( $W_{NP}$ ).

**METHODS:** Twenty healthy males volunteers walked at a self-selected pace in a 821 m pedestrian level ground field track (age  $22.70 \pm 2.89$  years; body weight  $77.90 \pm 11.19$  Kg; height  $176.55 \pm 5.90$  cm; body fat percentage  $14.59 \pm 5.99\%$ ). The subjects completed each trail in a randomized order. Return to metabolic rest values was respected between trails. The heart rate (HR), oxygen consumption ( $\text{VO}_2$ ) and energy expenditure (EE) were continuously recorded by a portable telemetric system. Rating of perceived exertion (RPE) was measured at the end of each trial by the modified Borg scale (1-10). The telemetric poles were adjusted individually to each subject.

**RESULTS:** Significant differences were found ( $P \leq 0.05$ ) in the comparisons  $W_{NP}$  vs  $W_{WP}$  for HR and walking speed. Mean walking speed was lower in the  $W_{WP}$ .

**CONCLUSIONS:** The results indicate that the use of walking poles does not increase the metabolic and perceptive demands ( $\text{VO}_2$ , EE and RPE) but do increase HR response. The use of poles does not seem to be an optimal strategy to influence the improvement of the physical fitness when walking on field level ground.

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**2333 Board #221 May 28 3:30 PM - 5:00 PM**  
**Effects Of Doms On Basketball Players' Shooting Accuracy, Flexibility, Jump Height, Hand Speed And Agility**

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Basketball players' success is largely dependent on physical conditioning and their ability to execute sport specific skills. Basketball players experience the effect of weight training induced delayed-onset muscle soreness (DOMS) and believe that negatively affects their playing ability.

**PURPOSE:** The purpose of this study was to examine the effects of weight training induced DOMS on several basketball specific tests.

**METHODS:** Fourteen college basketball players (9 males and 5 females) were recruited. Shooting accuracy, leg and shoulder flexibility, jump height, hand speed, agility, and perceived pain were assessed on days 1 and 2. On day 2, after the testing, the subjects performed a full-body weight training to induce DOMS. Twenty-four hours (24-h) and 48 hours (48-h) post DOMS, participants performed the same tests and soreness evaluation. Blood samples were collected prior to, half an hour, 24-h and 48-h after weight training induced DOMS and analyzed for creatine kinase (CK). A one-way repeated measure ANOVA was used to determine the effect of DOMS on shooting ability, flexibility, hand speed, agility, jump height, CK, and perceived pain throughout the three days of the study.

**RESULTS:** There was no significant difference in shooting percentage ( $P = 0.31$ ), agility ( $P = 0.39$ ), and hand speed ( $P = 0.22$ ) at any time. Leg flexibility significantly ( $P < 0.05$ ) decreased between pre and 24-h post weight training induced DOMS. At 48-h post DOMS, leg and shoulder flexibility and jump height were significantly decreased compared to pre-weight training values. Pain, measured with a visual analogue scale, significantly increased ( $P < 0.05$ ) during stretch and palpation for all muscle groups (gluteus and quadriceps, chest and triceps, back and biceps) except the abdominal, from pre-weight training to 24-h and peaked at 48-h after weight training. Average CK levels at 24-h and 48-h were significantly higher than the pre-weight training values.

**CONCLUSION:** These results in this population of college basketball players revealed that weight training induced DOMS does not negatively affect basketball players' shooting ability even though pain was significantly increased post weight-training. However, weight training induced DOMS may have an impact on their jumping ability and flexibility 48-h after weight training.

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**2334 Board #222 May 28 3:30 PM - 5:00 PM**  
**Comparison Of Different Drop Jump Heights On Vertical Jump Performance In Elite Team Handball Players**

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**INTRODUCTION:** Studies have shown that when compared to other kinds of vertical jump, drop jumps (DJ) can increase maximal jump height. However, landing from high levels can be detrimental to bone and joint structures and cause long-lasting injuries.

**PURPOSE:** To examine the effects of different drop heights on the performance of drop jump in Brazilian elite team handball players.

**METHODS:** Nine male team handball players (body mass  $90.7 \pm 12.1$  kg; body height  $184.3 \pm 8.9$  cm) were asked to drop from boxes 40, 60, and 80 cm high, and immediately perform a vertical jump as higher as possible. No arm swing was allowed. A force plate (Kistler - Model 9286A) was used to measure the vertical component of ground reaction force (GRF<sub>v</sub>), recorded by a customized LabView, which was also employed to calculate landing peak force (LPF1) and time to peak (TPF1) after the drop, contact time (CT), jump height (JH), and landing peak force (LPF2) and time to peak (TPF2) after the subsequent vertical jump.

**RESULTS:** Except for LPF1 there were no effect of dropping height (40, 60, and 80 cm) on TPF1, CT, JH, LFP2, and TPF2. The landing peak force (LFP1) after the drop jump was lesser when the participants dropped from 40 cm (DJ 40) when compared to dropping from other heights (DJ 60 and DJ 80).

		LPF1 (N)	TPF1 (ms)	CT (ms)	JH (cm)	LPF2 (N)	TPF2 (ms)
DJ 40	Mean	2850.9 *	28.7	482.4	36.4	6831.5	49.1
	SD	1343.1	13.3	87.1	8.3	2461.7	12.8
DJ 60	Mean	4877.7	25.9	483	36.2	6600.4	51.9
	SD	1470.5	14.9	122.9	7.4	1308.1	19.8
DJ 80	Mean	5421.1	18.3	525.9	35.3	5751.8	47.3
	SD	1823.6	12.6	93.9	7.8	1415.9	17.4

\* p < 0.05 among DJ conditions.

**CONCLUSION:** The results indicate that, no matter from what height the participants dropped, the final outcome (jump height) is similar. However, dropping from a higher place generates more peak force, and consequently, more stress in bones and joints structures. In conclusion, dropping from 40 cm can be more effective (same performance outcome and lower bone and joints overloads) than from higher heights.

**2335 Board #223 May 28 3:30 PM - 5:00 PM**  
**Anaerobic Power Profiles In Track And Field**

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**PURPOSE:** To evaluate the importance of lower body and upper body anaerobic power in relation to performance in track and field events where the importance and development of anaerobic power varies substantially from event to event.

**METHODS:** Thirty-two collegiate track and field athletes performed a standard Wingate Anaerobic Test to evaluate lower body anaerobic power (AnP-L) followed by a modified Wingate Anaerobic Test to evaluate upper body anaerobic power (AnP-U). Each athlete's personal records were converted to standardized values using the IAAF Scoring Tables of Athletics and the standardized values were correlated with AnP-L and AnP-U.

**RESULTS:** The highest levels of peak AnP-L were achieved in short sprints, 200 and sprint hurdles (9.78 W/kg, 9.76 W/kg, 9.62 W/kg). The lowest levels of peak AnP-L were achieved in 5,000/10,000, 1,500/Mile and 800 (8.17 W/kg, 8.34 W/kg, 8.92 W/kg). The highest levels of average AnP-L were achieved in horizontal jumps, 200 and short sprints (7.75 W/kg, 7.68 W/kg, 7.67 W/kg). The lowest levels of average AnP-L were achieved in 5,000/10,000, vertical jumps, 800 and 1,500/Mile (6.74 W/kg, 7.14 W/kg, 7.18 W/kg, 7.18 W/kg). The highest levels of peak AnP-U were achieved in 400, sprint hurdles and 200 (3.34 W/kg, 3.31 W/kg, 3.30 W/kg). The lowest levels of peak AnP-U were achieved in 5,000/10,000, 800 and 1,500/Mile (2.35 W/kg, 2.77 W/kg, 2.79 W/kg). The highest levels of average AnP-U were achieved in sprint hurdles, 200 and horizontal jumps (2.65 W/kg, 2.59 W/kg, 2.53 W/kg). The lowest levels of average AnP-U were achieved in 5,000/10,000, 1,500/Mile and 800 (1.98 W/kg, 2.23 W/kg, 2.29 W/kg). Peak AnP-L correlated most with performance for 1,500, 800, sprint hurdles, 200 and 400 (0.93, 0.90, 0.68, 0.59, 0.51). Average AnP-L correlated most with performance for 1,500/Mile, 800, 400, 200 and short sprints (0.97, 0.91, 0.80, 0.64, 0.39). Peak AnP-U correlated most with performance in vertical jumps and 1,500/Mile (0.75, 0.34). Average AnP-U correlated most with performance in 800, 1,500/Mile, horizontal jumps and 400 (0.96, 0.92, 0.57, 0.40).

**CONCLUSIONS:** The results suggest that anaerobic power may be a secondary consequence of training in a wide range of track and field events, but that excessive emphasis should not be placed on the development of anaerobic power for track and field events.

**2336 Board #224 May 28 3:30 PM - 5:00 PM**  
**Active And Passive Ranges Of Motion Of Collegiate Division I Soccer And Baseball Players.**

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**PURPOSE:** Kicking (soccer) and throwing (baseball) are ballistic tasks in which athletes may have specific flexibility profiles for the predominant joint used for each sport. The purpose of this study was to examine and compare active and passive ranges of motion (ROM) of the hip and shoulder joints for the dominant and non-dominant limbs of soccer and baseball players.

**METHODS:** Collegiate Division I soccer (n=10) and baseball (n=6) players (20.7±1.6 and 20.7±1.6 years; 179 ± 6 and 178 ± 6 cm; 79.3 ± 9.1 and 83.5 ± 14.5 kg for soccer and baseball players, respectively) volunteered for this study. Active and passive ROM, as well as the difference between end range of active and passive (D<sub>pass</sub>) motion were determined for: shoulder horizontal abduction (SHAB), shoulder horizontal adduction (SHAD), hip extension (HE), hip flexion (HF), and hip extension, abduction, and external rotation (Patrick's test).

**RESULTS:** Sport specific significant differences were found between the dominant and non-dominant limbs. Soccer players had a higher active HE in their dominant leg compared with the non-dominant leg (p<0.01); no differences were found in HF and PT. Baseball players demonstrated less active (p<0.001) and passive (p<0.05) SHAD and a greater active (p<0.05) and less D<sub>pass</sub> SHAB (p<0.05) in the dominant arm compared to the non-dominant arm.

**CONCLUSIONS:** Baseball and soccer players have specific flexibility profiles for the predominant joint used in their sport.

**2337 Board #225 May 28 3:30 PM - 5:00 PM**  
**The Effect Of Compression Socks On Recovery After A 30-sec Wingate Test**

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Compression socks appear to work by reducing venous pooling and improving deeper tissue oxygenation, and may also increase the ejection fraction of the calf muscle pump thereby possibly increasing circulation. Increasing the venous circulation may facilitate an increase in metabolic waste clearance. No research has been conducted on the effects

of compression socks during recovery after exercise.

**PURPOSE:** To examine heart rate (HR), oxygen consumption ( $\text{VO}_2$ ), perceived exertion (RPE) and lactate clearance after a 30-sec Wingate test.

**METHODS:** A Polar HR transmitter interfaced with a True One 2400 (ParvoMedics) metabolic analyzer and a Borg's 6-20 scale was used to collect HR,  $\text{VO}_2$ , RER and RPE of 17 subjects ( $28.6 \pm 9.0$  yrs,  $175.2 \pm 7.3$  cm,  $73.3 \pm 8.0$  kg,  $18.7 \pm 7.4$  %BF,  $44.7 \pm 9.6$  ml kg<sup>-1</sup> min<sup>-1</sup>  $\text{VO}_{2\text{max}}$ ) immediately after the Wingate test and 3, 6, and 10 min after, while cycling at 35%  $\text{VO}_{2\text{max}}$ . An Accutrend lactate analyzer was used to determine venous blood lactate at these same time points. Participants served as their own controls in this counter balanced design, once with and once without the knee-high graduated compression sock (OxySocks: 18-22 mmHg).

**RESULTS:** RMANOVA revealed no significant differences between the trials in any of the variables,  $p > .05$  (Table 1). A paired  $t$ -test did not reveal a significant difference in total work without ( $16349.7 \pm 323$  Joules) and with ( $15969.8 \pm 329$  Joules) the sock.

Table 1. Physiological and perceptual responses with and without compression socks after a 30-sec Wingate test						
		Pre	Wingate	3-min Post	6-min Post	10-min Post
HR (b/min)	NoSock	68.6±12.4	177.9±14.4	136.6±15.0	127.3±13.6	126.7±15.6
	Sock	71.9±9.98	179.7±13.2	138.0±12.9	130.3±12.4	128.9±12.0
VO2 (ml.kg.min-1)	NoSock	3.8±0.8	35.4±6.9	21.6±5.7	18.4±4.6	17.2±3.7
	Sock	4.1±0.9	34.7±8.1	20.8±5.6	20.0±5.5	17.6±5.2
Lactate (mmol/L)	NoSock	2.2±.04	9.8±3.2	11.8±2.8	10.5±2.9	8.6±2.8
	Sock	2.2±.05	9.1±2.5	11.9±1.9	10.5±2.3	9.0±2.8
RER	NoSock	.87±.09	1.15±.09	1.17±.10	.99±.08	.88±.06
	Sock	.88±.08	1.17±.10	1.20±.12	.99±.09	.88±.04
RPE	NoSock	----	17.0±2.3	10.9±1.4	9.0±1.5	8.1±1.3
	Sock	----	16.9±3.1	11.3±1.6	9.7±1.7	8.3±1.8

Note: Means ± SD

**CONCLUSIONS:** This study does not provide evidence that compression socks effect physiological or perceptual variables during recovery after a 30-sec Wingate test.

## 2338 Board #226 May 28 3:30 PM - 5:00 PM Effect Of One Session Of Hydrotherapy In The Physical Qualities In Soccer Players

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One of the fundamental principles of the modern training lies in a suitable balance between the stimulation caused by the loads of training and the later recovery. For this purpose, there have been created multiple modalities that try to accelerate the process of recovery from physical exercise; one of those is the hydrotherapy, nevertheless its use is based generally on anecdotal information more than in controlled studies.

**PURPOSE:** To assess the immediate effects of hydrotherapy in some physical qualities (strength, speed, jump capacity) and subjective perception of fatigue, in soccer players.

**METHODS:** During a clinical Pseudo-experimental research, the strength (isokinetic force), speed (40 meters sprint), jump capacity (Bosco's test) and subjective sensation of fatigue were measured in 7 soccer players for three non consecutive days: an initial evaluation (base); 16 hours later to a football match and after one session of 30 minutes of hydrotherapy (hydrotherapy); and 16 hours later to a football match without hydrotherapy (not hydrotherapy). The players were their own controls. The averages of the values obtained with the hydrotherapy and not hydrotherapy were compared with the base results.

**RESULTS:** The players were slower in the final speed (time in seconds from 20 to 40 meters) in the situation of not hydrotherapy compared with the base ( $2.40 \pm 0.10$  vs.  $2.35 \pm 0.10$  seconds,  $p < 0.05$ ); the maximum force of quadriceps diminished more in not hydrotherapy than in hydrotherapy with regard to the base ( $172.29 \pm 36.39$  vs.  $190.14 \pm 27.67$  Newton · meter,  $p < 0.05$ ); the explosive force increased in the hamstrings of the right knee with the session of hydrotherapy ( $137.14 \pm 26.94$  vs.  $120.57 \pm 21.19$  N·m of base,  $p < 0.05$ ); the players improved in the subjective perception of the physical condition after a session of hydrotherapy post game ( $30.4 \pm 13.96$  vs.  $26.81 \pm 16.55$  %,  $p < 0.05$ ).

**CONCLUSIONS:** A session of hydrotherapy immediately after a football match reduces the negative impact of a physical load over some qualities as the speed and the strength. The subjective perception of the physical condition improves after a session of hydrotherapy. The answers to a session of hydrotherapy were individual and did not generate adverse effects in the studied subjects.

## 2339 Board #227 May 28 3:30 PM - 5:00 PM Reliability Of The Power Profile Test: Assessing The Performance Capacity Of Road Cyclists

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(No relationships reported)

Successful road cyclists tend to produce numerous high-intensity efforts between 5 s and 10 min in duration. Quantification of the maximal power output that can be produced for progressively longer durations (Critical Power Tests) typically involve maximal efforts produced over multiple days. The Power Profile (PP) is a 60 min laboratory test

designed to assess the power producing capacity of competitive cyclists over a range of durations that compare directly with those typically experienced during mass start road racing.

**PURPOSE:** To establish the reliability of the PP test.

**METHODS:** 16 competitive cyclists (mean  $\pm$ SD, 21.5  $\pm$ 2.2 y, 70.6  $\pm$ 6.8 kg,  $\text{VO}_{2\text{peak}}$  4.9  $\pm$ 0.5 L.min<sup>-1</sup>) who had no prior experience with the test protocol completed two PP tests that were separated by >24 h and < 7 d. Cyclists were tested on a custom-built wind-braked ergometer and completed 7 maximal efforts of 6, 6, 15, 30, 60, 240 and 600 s duration incorporating active recovery periods of 54, 174, 225, 330, 480 and 600 s respectively. Cyclists were instructed to produce the highest average power output possible for each effort. Power output was continuously monitored (5Hz) with a dynamically-calibrated torque meter.

**RESULTS:** Average ( $\pm$ SD) maximal mean power for the PP were typical of nationally competitive male road cyclists (5s-1075  $\pm$ 135 W; 15s-865  $\pm$ 93 W; 30s-664  $\pm$ 70 W; 60s-519  $\pm$ 60W; 240s-375  $\pm$ 39W; 600s-329  $\pm$ 33W). The average  $\pm$ SD (range) Change in Mean, Typical Error and ICC between Test 1 and 2 for the 6 efforts lasting from 6 s - 600 s were 1.7  $\pm$ 1.6% (-0.2-3.9%); 3.6  $\pm$ 0.8% (2.3-4.5%) and 0.90  $\pm$ 0.03 (0.88-0.96) respectively. In addition, the Typical Error for the total work (kJ), anaerobic work capacity (kJ) and critical power (W) was 2.2%, 8.8% and 2.9%, respectively.

**CONCLUSIONS:** The reliability of the PP test is similar to other tests that require maximal efforts across similar durations. In addition, changes in average power for maximal sprints in the PP need to be greater than 3.3-6.4% to be considered "real" at the 68% level of confidence. These reliability data for the PP test suggest that this test is suitable for quantifying both anaerobic and aerobic power producing capacities of cyclists that are relevant to road cycling competition.

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**2340 Board #228 May 28 3:30 PM - 5:00 PM**  
**Variability In High Intensity Activities In Premier League Soccer**

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Traditional reliability checks on performance analysis systems tend to involve two observations made on the same player in the same game. Such an analysis does not include between-match variability, which would be present in any longitudinal or large scale cross-sectional soccer research. Few attempts to date have been made to provide a detailed analysis of this variation in key match performance activities in soccer.

**PURPOSE:** To determine the between-match variability in high-intensity running activity in elite soccer players and the influence of playing position and team success.

**METHODS:** A total of 7355 individual match work-rate observations were undertaken on 563 outfield players (median of 8 games per player; range = 1-57 games) competing in the English Premier League from 2003/2004 to 2005/2006 using a novel computerised tracking system (Prozone®, Leeds, England). Between-match coefficients of variation (CV) and associated 95% confidence intervals (CI) were calculated and compared between different player positions and team success levels using a general linear model.

**RESULTS:** The mean CV for high speed running and sprint distance covered during a game was 16.2  $\pm$  0.3% (95%CI = 15.7-16.8%) and 30.8  $\pm$  0.5% (95%CI = 29.9-31.7%) respectively. This variability was generally lower for attacking players but higher for defenders. The variability in number of sprints during a game was larger for sprints of greater distance (< 5m mean CV of 14.5  $\pm$  0.3%, 95%CI = 14.0-15.0%; 15-20m, 64.4  $\pm$  1.4%, 95%CI = 62.1-66.6%). Differences between levels of team success were small, although players from more successful teams showed less between-match variability in the number of sprints of 10-15m in length.

**CONCLUSIONS:** Match-to-match variability in performance characteristics of elite soccer players is high and not dependent on team success. This inherent variability means that research requires large sample sizes in order to detect real systematic changes in performance characteristics.

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**2341 Board #229 May 28 3:30 PM - 5:00 PM**  
**Maximal Oxygen Consumption Values In Female Ice Hockey Players**

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Aerobic metabolism contributes significantly to the energy demands of ice-hockey. Using an on-ice testing protocol Durocher et al., (J. Strength and Cond Res, 22, 1327-31, 2008) reported a maximal oxygen consumption ( $\text{VO}_{2\text{max}}$ ) value of 40.1  $\pm$  1.0 ml.kg<sup>-1</sup>.min<sup>-1</sup> in Division III female college hockey players. Due to the difficulties inherent in using on-ice testing procedures, the majority of aerobic tests involving ice-hockey players have used either a treadmill or cycle ergometer.

**PURPOSE:** To compare  $\text{VO}_{2\text{max}}$  values obtained during a treadmill running and a cycle ergometer test to previously published values obtained using an on-ice testing protocol.

**METHODS:**  $\text{VO}_{2\text{max}}$  was measured at the mid-point of the season using an incremental treadmill and cycle ergometer protocol in 12 female (Age 19.5  $\pm$  1.6 y; mean  $\pm$  SD) Division III college hockey players. The treadmill and cycle ergometer tests were undertaken on different days and were performed in a counter-balanced order. Oxygen uptake was measured using open circuit spirometry (MAX-II metabolic cart) and heart rate was continuously monitored using a Polar heart rate monitor.

**RESULTS:** Maximal heart rate (193.0  $\pm$  9.7 vs. 182.1  $\pm$  7.8 beats.min<sup>-1</sup>) and  $\text{VO}_{2\text{max}}$  (46.6  $\pm$  4.4 vs. 41.2  $\pm$  5.1 ml.kg<sup>-1</sup>.min<sup>-1</sup>) were higher (p<0.001) in the treadmill running than the cycle ergometer test. There was a trend (p<0.09) toward a higher rating of perceived exertion at maximal exercise in the cycle test than the treadmill test.

**CONCLUSION:** When compared to gender and age based norms the  $\text{VO}_{2\text{max}}$  values for the ice-hockey players in the present study are in the 80<sup>th</sup> percentile, or average category. In Division III female college hockey players the  $\text{VO}_{2\text{max}}$  determined during a cycle ergometer test is similar to the value obtained using an on-ice protocol. In contrast, the  $\text{VO}_{2\text{max}}$  determined using a treadmill protocol overestimates the  $\text{VO}_{2\text{max}}$  obtained using an on-ice protocol.

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**2342 Board #230 May 28 3:30 PM - 5:00 PM**  
**Determinants Of Maximal Aerobic Power In Trained Cyclists**

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(No relationships reported)

Peak aerobic power ( $\text{W}_{\text{max}}$ ) from a graded exercise test (GXT) is a strong predictor of cycling performance. Peak power is highly correlated with  $\text{VO}_{2\text{max}}$ , suggesting that  $\text{VO}_{2\text{max}}$  is a strong predictor of performance. However,  $\text{VO}_{2\text{max}}$  has typically only been shown to be a moderate predictor of performance, therefore factors other than  $\text{VO}_{2\text{max}}$  are likely contributing to  $\text{W}_{\text{max}}$ . Other factors that contribute to performance are the ventilation threshold, respiratory compensation point (VT1, VT2) and economy.

**PURPOSE:** This investigation was conducted to determine the roles that  $\text{VO}_{2\text{max}}$ , VT1, VT2, and economy play in the contribution of aerobic power. **SUBJECTS:** Fifty four (female n=9) trained cyclists served as subjects for this investigation. Subjects ranged from seasoned professionals to novice competitors.

**METHODS:** Each subject underwent a sub-maximal exercise bout at 200W (female = 150W) to determine cycling economy. Following the sub-maximal test each subject underwent a GXT to volitional fatigue for the determination of  $\text{VO}_{2\text{max}}$ , VT1 and VT2. The GXT protocol began at 70W and increased 35W.min<sup>-1</sup> until an rpm >70 could not longer be maintained. Expired gas was collected throughout the GXT. All  $\text{VO}_2$  variables were expressed in L.min<sup>-1</sup> and economy was expressed as WL<sup>-1</sup>.min<sup>-1</sup>. **ANALYSIS:** Stepwise multiple regression was used to model the variables contributing to  $\text{W}_{\text{max}}$ . Variables entered into the analysis were  $\text{VO}_{2\text{max}}$ ,  $\text{VO}_2$  at VT1,  $\text{VO}_2$  at VT2, and economy.

**RESULTS:** The  $\text{VO}_2$  at VT2 entered the regression model first (b = 0.567) followed by  $\text{VO}_{2\text{max}}$  (b = 0.431) and economy (b = 0.105). The  $\text{VO}_2$  at VT1 did not enter the regression model. The model significantly explained the variance in  $\text{W}_{\text{max}}$  (p= 0.00) with a multiple R<sup>2</sup> of 0.935.

**CONCLUSION:** The analysis indicates that  $\dot{V}O_{2\max}$ ,  $\dot{V}O_2$  at VT2, and economy each contribute uniquely to  $W_{\max}$ , but  $\dot{V}O_2$  at VT1 does not.

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**2343 Board #231 May 28 3:30 PM - 5:00 PM**  
**Dynamic Warm-up Optimizes Sprint Performance In Collegiate Track Athletes**

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(No relationships reported)

Previous research has shown that passive stretching negatively affects sprint performance (Nelson, A.G. et al., *J. Sports Sci.* 23:449-454, 2005) however, the affect of other stretching or warm-up methods on sprint performance is unclear.

**PURPOSE:** To compare the effects of no warm-up (NW), low volume proprioceptive neuromuscular facilitation stretching (LVPNFS), high volume proprioceptive neuromuscular facilitation stretching (HVPNFS), static stretching (SS), and dynamic warm-up protocols (DW) on 36.7 m sprint performance in National Collegiate Athletic Association Division II track athletes.

**METHODS:** Ten male healthy trained collegiate track athletes (mean  $\pm$  SD, age=20.9  $\pm$  0.97 y, height=183.6  $\pm$  5.9 cm, mass=78.96  $\pm$  7.29 kg, body fat=6.3  $\pm$  0.97 %) volunteered to participate in the study. Subjects completed each of 5 randomly assigned warm-up protocols to include: 1) NW, 2) LVPNFS, 3) HVPNFS, 4) SS and, 5) DW prior to 36.7 m sprint performance. Two and 5 sets of stretching were completed for the low and high volume PNF protocols respectively. The PNF stretching protocols used a contract (5 sec at 75% maximum effort) - relax (10 sec) - stretch (10 sec at moderate tension) sequence that targeted calf, hamstring, and quadriceps muscle groups. The static stretching protocol included 2 sets of the same stretching exercises held for 20 sec. The DW protocol consisted of high knees, gluteus maximus kicks, lunges, leg swings, and dynamic quadriceps and hamstring stretches. The best of two timed 36.7 m sprints was used to determine sprint performance following each protocol. One min rest was provided after each warm-up protocol and 3-5 min rest was given between sprints. A minimum of 48 h was required between testing sessions.

**RESULTS:** Repeated measures one-way ANOVA analysis with Tukey post-hoc tests indicated that average 36.7 m sprint performance using DW (4.860  $\pm$  0.131 sec) was significantly ( $p < 0.05$ ) lower than NW (4.953  $\pm$  0.184 sec), LVPNFS (5.079  $\pm$  0.148 sec), HVPNFS (5.043  $\pm$  0.185 sec), and SS (5.054  $\pm$  0.172 sec) warm-up methods.

**CONCLUSIONS:** We conclude that performing DW prior to a maximal effort 36.7 m sprint is significantly better than NW, LVPNFS, HVPNFS, and SS warm-up methods. The data from this project suggests that a dynamic warm-up protocol should be used to optimize sprint performance in collegiate track athletes.

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**2344 Board #232 May 28 3:30 PM - 5:00 PM**  
**High Reliability Of Jump Performance Assessed With A Linear Transducer In Elite Track And Field Athletes**

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Although the countermovement vertical jump (CMJ) has been extensively used, data about reliability parameters on a large subject sample (~50) of elite athletes are limited.

**PURPOSE:** To determine the reliability of CMJ performance in a large sample of track and field top athletes using a linear transducer.

**METHODS:** A group of 48 elite male sprinters and long-jumpers volunteered to participate in this study. Subjects performed three trials with 3 minutes of rest between each CMJ. This was accomplished by measuring jump performance using a linear transducer and a force platform simultaneously. The relationships between force-time dependent variables and CMJ performance were examined during the concentric phase using a Smith machine.

**RESULTS:** The present study demonstrated high intraclass correlations (ICC) values for maximum rate of force development (RFD<sub>max</sub>) accessed with linear transducer, however, the coefficient of variation (CV) was somewhat high (15-17%). Nevertheless, ICC of peak force (PF) and the maximum power measured with force platform were very high. The maximum negative velocity presents a somewhat smaller but likewise high degree of stability, although the CV is slightly high (9.9%). The trial-to-trial reliability of the CMJ measured by the force platform gave an ICC of 0.87-0.97 for PF, maximum power and maximum negative velocity. Similar ICCs of 0.93-0.98 for RFD<sub>max</sub>, PF, and for rate of force development at PF were observed by the linear transducer. The CVs were 3.6-17% and 5.8-9.9% with force platform and with linear transducer, respectively.

**CONCLUSIONS:** The present findings showed that the calculations derived from the linear transducer synchronized with a force platform were very similar and hence provided evidence of the reliability of this method in elite track and field athletes. Moreover, this method suggests that the linear position transducer offers a cost-effective, versatile, and valid means for the measurement of force in track and field top athletes.

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**2345 Board #233 May 28 3:30 PM - 5:00 PM**  
**Prescription For Aerobic High-Intensity Interval Training By Means Of Incremental Exercise Tests Markers**

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There is no standardized model described in literature for exercise prescription of aerobic high-intensity interval training (HIT). From a theoretical point of view it appears to be reasonable to prescribe aerobic HIT by means of individual markers determined from incremental exercise tests (IET): mean workload just below Lactate Turn Point 2 (LTP<sub>2</sub>) (consistent with maximal lactate steady state), recovery workload just below LTP<sub>1</sub> (optimal rate of lactate elimination) and workload at P<sub>max</sub> applying a defined workload duration (t<sub>w</sub>) and a calculated recovery duration (t<sub>rec</sub> = t<sub>bel</sub> (P<sub>LTP2</sub> - P<sub>max</sub>) / (P<sub>LTP1</sub> - P<sub>LTP2</sub>)). The LTP Concept and the Lactate Shuttle Theory were used as the scientific base for this study.

**PURPOSE:** To determine if the regulation of aerobic HIT by means of LTP<sub>1</sub>, LTP<sub>2</sub> and P<sub>max</sub> leads to a blood lactate steady state representing a consistent way of exercise prescription of aerobic HIT.

**METHODS:** Five young healthy male sports students (age: 24.6  $\pm$  1.5 yrs; Ht: 185.2  $\pm$  2.3 cm; Wt: 76.1  $\pm$  5.3 kg;  $\dot{V}O_{2\max}$ : 57.8  $\pm$  8.5 ml·kg<sup>-1</sup>·min<sup>-1</sup>) participated in the study. A maximal IET (40W; 20W·min<sup>-1</sup>) and subsequently 2 interval tests (IT) as aforementioned with workload durations of 20s and 30s and calculated recovery time were performed on an electronically braked cycle ergometer (Monark 839E, Monark, Sweden). Sessions were randomly assigned and interspersed by at least two separate days to ensure sufficient recovery between tests. Heart rate (PE4000, Polar Electro, Finland) and gas exchange variables (ZAN800, ZAN, Germany) were obtained at rest, throughout exercise and during recovery. Blood lactate concentration (Biosen S-line, EKF Diagnostik, Germany) was obtained from blood samples collected from ear lobe at rest, after each interval and during recovery.

**RESULTS:** During the last 20min, mean blood lactate values in the 30s-IT (7.0  $\pm$  1.5 mmol·l<sup>-1</sup>) were higher than in 20s-IT (5.5  $\pm$  1.1 mmol·l<sup>-1</sup>), but a lactate equilibrium was seen in this time period at each single test except for one 30s-test.

**CONCLUSION:** Due to the fact that during the last 20min 9 of 10 IT led to a blood lactate steady state, it may be suggested that setting aerobic HIT by means of LTP<sub>1</sub>, LTP<sub>2</sub> and P<sub>max</sub> obtained in IET is a consistent model of exercise prescription for aerobic HIT if workload durations of no longer than 30s are applied.

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**2346 Board #234 May 28 3:30 PM - 5:00 PM**



## Analysis Of The Efficacy Of Different Stretching Applications And Their Relation To Delayed Onset Muscle Soreness (DOMS).

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The use of stretching to increase flexibility, prevent injuries and decrease muscle pain, has been widely studied, but there are large divergences in the literature in relation to the time and duration of stretching.

**PURPOSE:** To evaluate if a stretching program is effective for attenuating the signs and symptoms of delayed onset muscle soreness (DOMS) caused by eccentric exercising.

**METHODS:** For 25 days, 33 active male individuals (between 20 and 31 years of age) underwent two sets of tests (AV<sub>1</sub> and AV<sub>2</sub>) and eccentric exercises (EE<sub>1</sub> and EE<sub>2</sub>) in order to trigger DOMS. AV<sub>1</sub> was performed before, 24h, 48h and 72h after EE<sub>1</sub> and consisted of: measurement of the range of motion (ROM) of knee flexion, thigh perimeter and subjective perception of pain. EE<sub>1</sub> was performed on the first day and consisted of four series of 12 repetitions of eccentric exercises on a leg extension machine at the level of 80% of one maximum repetition. After that, a 17-day stretching program began. After these 17 days, the volunteers were randomly assigned into three groups. Group A did not perform stretching, group B did one 10-second repetition of stretching and group C did three repetitions of 30 seconds. Following this, each group underwent a new set of evaluations and eccentric exercises (AV<sub>2</sub> and EE<sub>2</sub>) that followed the same patterns as used for AV<sub>1</sub> and EE<sub>1</sub>.

**RESULTS:** After the stretching program, there was decreased muscle pain. Group A reported less pain than did the other groups.

**CONCLUSIONS:** The stretching program decreased DOMS and increased the ROM. Furthermore, performing a stretching program without doing stretching immediately before the exercise is more effective for attenuating DOMS.

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## D-39 Free Communication/Poster - Ultra Endurance

MAY 28, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### 2347 Board #235 May 28 2:00 PM - 3:30 PM

#### Ultra-marathon Runners Have The Biggest Hearts: Fact Or Fiction?

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(No relationships reported)

Physiologic eccentric hypertrophy (left ventricular end-diastolic diameter [LVDd]  $\geq$  55mm) has been well documented in endurance-trained individuals. Traditionally, cycling, rowing and cross-country skiing have been associated with the "athlete heart syndrome." Nagashima et al. (2003) reported LVDd to be beyond normal limits in a considerable number of ultra-marathon runners (mean LVDd of 61mm), with 11% of those tested having LVDd greater than 70mm.

**PURPOSE:** The purpose of this investigation was to assess whether ultra-marathon runners have physiological cardiac hypertrophy to the magnitude and prevalence that has been previously reported.

**METHODS:** A total of 105 (26 female) ultra-marathon runners (Age =  $43.3 \pm 9.3$  years (range 24-76 years)) underwent M-mode echocardiography to assess LVDd, interventricular septal thickness (IVS) and posterior wall thickness (PWT). LV mass (LVM) was calculated as:  $0.8 (1.04(LVDd + IVS + PWT)^3 - LVDd^3) + 0.6$ . Body surface area (BSA) was estimated ( $71.84 (\text{height}^{0.725} * (\text{weight}^{0.425})) / 10000$ ), and LVM index (LVMI) was calculated as  $LVM / BSA^{1.5}$ . All participants were recruited from the Western States Endurance Run (160km), or the Comrades Ultra-Marathon (89km). Participants with known cardiovascular disease or hypertension (systolic  $>140$ mmHg, diastolic  $>90$ mmHg) were excluded from the analyses.

**RESULTS:** On average, the athletes ran  $92.1 \pm 32.1$  km/week and had trained for  $15.4 \pm 10.2$  yrs. The average resting heart rate was  $58 \pm 10$  beats/minute, while systolic and diastolic blood pressures were  $116 \pm 10$  and  $76 \pm 9$  mmHg respectively. Mean fractional shortening was  $40.2 \pm 6.1$  %, while LVDd was  $51.4 \pm 4.1$  mm (range: 42 to 61 mm). LVDd exceeded the upper normal limits ( $\geq$  55mm) in 27 (26%) athletes. Mean IVS was  $10.3 \pm 1.7$  mm (range: 6 to 14 mm) and mean PWT was  $9.4 \pm 1.6$  mm (range: 6 to 13 mm). Average LVM was  $192.5 \pm 42.2$  g (range: 105 to 320g), and LVMI was  $76.6 \pm 13.2$  g/m<sup>3</sup> (range: 45 to 114g/m<sup>3</sup>).

**CONCLUSIONS:** Our results suggest that although some (26%) ultra-marathon runners have evidence of eccentric hypertrophy, the frequency and magnitude of hypertrophy are not as great as previously reported. Importantly, only our highest LVDd was equivalent to the mean value reported previously in ultra-marathon runners.

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### 2348 Board #236 May 28 2:00 PM - 3:30 PM

#### Maintenance Of Total Body Water Despite Body Weight Loss During An Ultramarathon

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(No relationships reported)

**PURPOSE:** To determine if: 1) body weight loss equates to total body water loss during prolonged endurance exercise and 2) plasma sodium, osmolality and volume are maintained with ad libitum food and fluid intakes, despite significant ( $>2\%$ ) bodyweight loss from pre to post race.

**METHODS:** Ten athletes participating in an 80km mountain footrace consented to bodyweight (BW), venous blood and saliva measurement 2-days, immediately pre- and post-race. Changes (D) in body mass, plasma sodium and potassium concentration, osmolality and volume were determined. Changes in total body water (TBW) were quantified using deuterium oxide. Food and fluid were allowed ad libitum and quantified by researchers stationed at 13 checkpoints.

**RESULTS:** 8 subjects completed the 80km footrace with a mean finishing time (mean  $\pm$  SD) of  $691.4 \pm 51.8$  minutes (range: 583 - 769.2) and fluid intake of  $4.8 \pm 0.9$  L (range: 3.5 - 6.1). A significant decrease was noted between D in % BW loss versus D in % TBW loss immediately post-race minus 2-days pre-race ( $-3.5 \pm 1.4\%$  BW vs.  $-1.1 \pm 1.2\%$  TBW;  $p < 0.05$ ). Significant differences were noted between the D in % BW loss in both the post- minus immediately pre-race condition ( $-4.7 \pm 4.1\%$ ) and the post- minus 2-day pre-race condition ( $-3.5 \pm 1.4\%$ ) when compared with the pre- minus the 2-days pre-race condition ( $+1.5 \pm 3.1\%$ ;  $p < 0.05$ ). No significant differences were noted in the D in plasma sodium concentration or plasma volume when the three testing conditions were compared.

**CONCLUSIONS:** TBW, plasma sodium, plasma osmolality and plasma volume were maintained during an 80km mountain footrace despite significant (4-5%) BW loss. These preliminary data suggests that recommendations to replace 100% BW losses during prolonged endurance running may promote TBW dysregulation that is worthy of further, more robust and stringent investigation.

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**2349 Board #237 May 28 2:00 PM - 3:30 PM**

**Energy Intake And Expenditure During An Ultra Endurance Event - Race Across America**

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Energy Expenditure (EE) was measured with doubly labelled water (DLW) technique during heavy sustained exercise with an official finishing team in the Race Across America (RAAM). Energy Intake (EI) was also calculated to produce an energy deficit for the total race. EE has not previously been reported during the RAAM using the DLW technique which is the gold standard method for EE in free living humans, and used to validate other methods of EE.

**PURPOSE:** To determine the EE of athletes participating in the RAAM and to examine the energy intake throughout such a demanding ultra endurance event.

**METHODS:** A team of 4 cyclists (age: 38.25 ± 5.68 yr; height: 182.25 ± 8.18 cm; weight: 80.75 ± 6.60 kg) were used as consenting subjects, and completed the race in an intermittent fashion to maintain a high intensity and to encourage recovery between exercise bouts. To determine EE the DLW method was employed. Urine samples were collected prior to consumption of the DLW on the race morning, 2 hours post drink, then every 24 hours after and a final sample on completion of the race. All samples were analysed by isotope ratio mass spectrometry. EI was analysed using a dietary analysis package (Microdiet) following completion of food diaries by the support team.

**RESULTS:** The team completed the race in 6 days 10 hours and 51 minutes, finishing in third place in the 4 man team event. Total EE was found to be 44,941.75 kcals (ranging from 40,376 - 47,418 kcals) with an average daily EE 6420.25 kcals (ranging from 5768 - 6774 kcals). Total EI from all food and drink consumed was calculated at 29,505.5 kcals (ranging from 24,698 - 35,386 kcals) with an average daily EI of 4215.025 kcals (ranging from 3528.3 - 5055 kcals). This resulted in an energy deficit of 15,361.25 kcals (ranging from 11,878 - 18,237 kcals) with an average daily energy deficit of 2205.2 kcals (ranging from 1696.9 - 2605.3 kcals).

**CONCLUSIONS:** The high EE, three times that of a typical EI for males, highlights the need for correct and practical dietary strategies and challenges nutritionists to devise high energy diets that not only contain the correct macronutrient balance, but are also palatable to the cyclists, thus encouraging a high EI. The findings from this study can aid future cyclists, coaches and nutritionist participating in the RAAM and other ultra endurance events.

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**2350 Board #238 May 28 2:00 PM - 3:30 PM**

**Assessment Of Hydration And Electrolyte Values Following A 161-km Endurance Race**

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**PURPOSE:** Maintaining body water and blood electrolyte concentrations within a normal range is critical for athletes in ultra-endurance events. This study examined the relationships between body mass, total body water, and blood electrolyte values before and after a 161-km ultra-marathon run.

**METHODS:** Measurements were made on runners of the 2008 Rio Del Lago 161-km trail run, which included body height & mass, bioimpedance spectroscopy, and electrolyte concentrations. These measurements were made the day before the race on 72 of the 109 starters, and immediately post-race on the 44 participants who finished. Analyses were performed by t-test to compare pre- and post-race body mass, total body water (TBW), blood concentrations of sodium and potassium, hematocrit (Hct), and hemoglobin (Hgb).

**RESULTS:** Height and age of the study participants (mean±SD) were 188.9±8.6 cm and 53±8.2 years. Mean (±SD) pre-race values among all finishers for body mass (70.4±10.8 kg) and TBW (43.3±7.3 L) were not significantly different from those immediately after the race (68.1±10.6 kg and 42.9±7.7 L). Among finishers whose electrolytes were measured, there were significant differences before and after the race. Pre-race blood sodium (139±2.0 mmol/L, range 135-143 mmol/L, n=27) decreased significantly by the end of the race (135±4.9 mmol/L, range 123-148 mmol/L, p<0.001, n=40). Twenty one participants (53%) were clinically hyponatremic (sodium 145 mmol/L) at the end of the race. Potassium concentration increased significantly from pre- to post-race (4.9±0.4 mmol/L, range 3.9-5.7 mmol/L; 5.4±0.8 mmol/L, range 4.2-6.9 mmol/L, p<0.001). Similarly, pre-race measurements of Hct (47.8±5.1 PCV) and Hgb (16.2±1.7 g/dL) decreased (p=0.02) by the end of the race (45.4±4.6 PCV and 15.4±1.6).

**CONCLUSIONS:** Even though body mass and TBW were maintained during the race, electrolyte, Hct, and Hgb concentrations changed significantly. Changes in serum electrolyte, Hct and Hgb concentrations suggest additional research is needed to more fully understand and evaluate changes in these parameters during ultra-endurance events and the potential physiological effects.

Support was provided by the Western States Endurance Run and ImpediMed

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**2351 Board #239 May 28 2:00 PM - 3:30 PM**

**Historical Analysis Of The Western States 100-mile Endurance Run: 1974 Through 2007**

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**PURPOSE:** To summarize data on the Western States 100-Mile Endurance Run (WSER) since its inception in 1974, including the characteristics of participants, relationship of performance to age and sex, and changes over time in runner demographics and performance.

**METHODS:** Name, age, sex and finish time of each WSER finisher 1974-1985 and of all starters and finishers 1986-2007 were obtained from published race results. Name, age and sex discrepancies from year to year for repeat runners were reconciled through line-by-line examination of the data.

**RESULTS:** A total of 6462 finishes at the WSER were accounted for by 3459 individuals (84% men) from 1974 through 2007. The proportion of starters who were women increased from 10-12% in 1986-88 to 20-22% since 2001. Starters ranged in age from 18 to 75 years, and finishers ranged from 18 to 71 years. Mean (±SD) ages of participants were 44±9 years for men and 42±8 for women. The average age of men starting the race increased (p<0.001) from 41 in 1986 to 47 in 1999, then leveled off. Average age of women starters increased but remained about 3 years younger than men (p<0.001). The increase in average age of starters was accounted for by increasing (p<0.02) participation among women ≥40 years of age, increasing (p≤0.001) participation among men ≥50 years of age, and decreasing (p<0.0001) participation among men <50 years of age. Since 1974, ages of the top performers have increased (p≤0.002) for both sexes to the upper 30's. Finish times among men, when examined across different age groups and performance levels (top-5 or all finishers), showed no change between 1986 and 2007. However, the top-5 women finishers in the 30-39 and 40-49 year age groups have shown improvements (p<0.01) across this time period.

**CONCLUSIONS:** Participation in the WSER has increased among women and older athletes, and the ages of the fastest runners at the WSER have gradually risen to the extent

that the fastest runners at the WSER are now older than the fastest marathoners. In contrast to what has been observed for men, the performances among the top women have improved over the last two decades at the WSER.

*Supported by the Ultra-Endurance Exercise Research Foundation*

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**2352 Board #240 May 28 2:00 PM - 3:30 PM**  
**Impact Of Ambient Temperature On Performance In A 161-km Ultramarathon Run**

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**PURPOSE:** The effect of ambient temperature on performance in ultramarathon runs has not been previously examined. The present work makes such an analysis relative to a 161-km ultramarathon run over mountain trails.

**METHODS:** Race results for the Western States Endurance Run from 1986 through 2007 were compiled along with minimum, mean, and maximum local ambient temperatures on the day of each run. Two separate generalized linear mixed-effects regression models were computed to assess the degree to which (1) probability of finishing and (2) finish times of finishers were related to ambient temperature, while adjusting for sex, age, and starter's previous WSER experience. Coefficients were reported with respect to a temperature difference of 5°C. Only one of minimum, mean, and maximum temperature was used in models; for reporting, the single measure of temperature was chosen which provided the best fit.

**RESULTS:** Race day ambient temperatures ranged from 11 to 22°C (minimums), 14 to 30°C (means), and 16 to 38°C (maximums). Unadjusted finish rates ranged from 51% to 80%. Due to outliers in mean and maximum temperatures, minimum temperature was found to provide the best fit in regression. After adjustment for covariates, a temperature decrease of 5°C was found to be associated with a 34% increased chance ( $p=0.026$ ) of finishing for individuals who either had never started since 1986 or had finished every run they started, and with a 61% increased chance ( $p=0.036$ ) of finishing for those who had dropped out in the past. Among men who finished, a temperature decrease of 5°C was associated with a 24 minute decrease ( $p<0.01$ ) in average finish time. Women averaged 78 minutes slower than men but their finish time only decreased 7.4 minutes with a temperature decrease of 5°C (both  $p<0.01$ ).

**CONCLUSIONS:** Elevated temperatures during a 161-km trail ultramarathon run adversely affect finish rates and finish times, but affect finish times less strongly for women than for men.

*Supported by the Ultra-Endurance Exercise Research Foundation*

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**2353 Board #241 May 28 2:00 PM - 3:30 PM**  
**Analysis Of Factors Affecting The Probability Of Finishing The Western States 100-mile Endurance Run**

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**PURPOSE:** Determine factors associated with finishing the Western States 100-Mile Endurance Run (WSER).

**METHODS:** Name, age, sex and finish or drop-out information was obtained for each runner starting the WSER from 1986 through 2007. Generalized linear mixed-effects models were computed to assess the degree to which the probability of a starter finishing a race was related to starter's sex, age, previous WSER experience, and to ambient race day temperature. Separate relationships between age and probability of finishing were computed in the lower quartile (18-38 years), interquartile (38-50 years) and upper quartile (>50 years). WSER experience was categorized as never previously started, started in the past and finished each run started, started in the past and finished at least once and dropped out at least once, and started in the past and never finished.

**RESULTS:** There were a total of 8282 starts and 5276 finishes from 1986 through 2007. Yearly finish rates ranged from 51% to 80%. There was no effect of age across 18-38 years, but from 38-50 years an increase in age was associated with decreased probability of finishing and the association was stronger for >50 years (both  $p<0.001$ ). Specifically, men were 46% more likely to finish at age 38 than 50, and 6 times more likely to finish at age 50 than 72. Men and women 18-38 years of age had no difference in probability of finishing, but women's probability of finishing decreased more quickly than men's across ages 38-50 ( $p=0.01$ ). Specifically, 50 year old men were 70% more likely to finish than 50 year old women. Over age 50, the decrease was parallel for men and women. New starters since 1986, and those who had finished every race they started since 1986, were 28% more likely ( $p<0.001$ ) to finish than those who had ever dropped out of the race since 1986. Increased ambient temperature was associated with a decreased probability ( $p=0.026$ ) of finishing. Starters who had previously dropped out of the race were more likely ( $p=0.036$ ) to drop out in high temperatures than those who either had always finished or had never started since 1986.

**CONCLUSIONS:** Factors adversely associated with finishing the WSER include increasing age, being female >38 years of age, having previously dropped out of the race, and higher ambient temperatures.

*Supported by the Ultra-Endurance Exercise Research Foundation*

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**2354 Board #242 May 28 2:00 PM - 3:30 PM**  
**Historical Analysis Of Participation And Performance In 100-mile Ultramarathon Runs In North America: 1974-2008**

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(No relationships reported)

**PURPOSE:** To document changes in participation and performance in 100-mile (161-km) ultramarathon running competitions in North America from 1974 to 2008.

**METHODS:** Results were tabulated for all 161-km running races in North America between 1974 and 2008 from which results could be identified. Regression analyses were used to examine changes across time. ANOVA was used to compare the fastest finish times across age groups.

**RESULTS:** From 1974 through 2007, a total of 29,617 finishes were identified which were accounted for by 8969 different individuals (83% men). There was exponential growth in the total number of finishes as well as the number of different individuals finishing these races. The number of 161-km ultramarathon running races in North America has also risen exponentially since 1980, with there being 53 such events in 2008. The proportion of finishes accounted for by women has increased to the current level of nearly 20%. Finishers ranged in age from 15-75 years, and women were significantly ( $p<0.0001$ ) younger than men ( $41\pm 8$  vs.  $43\pm 9$  years). Mean ages generally increased ( $p<0.0001$ ) across years for both men and women, but dropped after 2004 among men so that ages in 2007 averaged 44 and 43 years, respectively. The general increase in average age of finishers was accounted for by proportional increases among those  $\geq 40$  years of age and decreases among those <40 years of age for men; and proportional increases among those in the 40-59 year age range and decreases among those <30 years of age for women. Overall finish rates have increased slightly ( $p<0.002$ ) over the last 30 years to approximately 60%. Runners in the 30-39 year age group achieved the fastest finish times. Over the last 30 years, the average age of winners has increased ( $p\leq 0.01$ ) for both sexes to approximately 38 years. On the whole, the fastest women were 22% slower than the fastest men, and this difference has not changed in the last 20 years.

**CONCLUSIONS:** Participation in 161-km running competitions in North America increased exponentially from the 1970's, and though participation among women grew, men have remained dominant in terms of quantity and speed. The age range of finishers was quite wide, and the average age of finishers and winners has increased to the mid-40's and upper-30's, respectively.

*Supported by the Ultra-Endurance Exercise Research Foundation*

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**2355 Board #243 May 28 2:00 PM - 3:30 PM**  
**Body Composition Characteristics Of Participants In A 161-km Trail Ultramarathon**

Alison C. Ganong<sup>1</sup>, Daniel K. Lebus<sup>2</sup>, Marta D. Van Loan, FACSM<sup>3</sup>, Gretchen A. Casazza<sup>1</sup>, Martin D. Hoffman, FACSM<sup>4</sup>. <sup>1</sup>University of California Davis Medical Center, Sacramento, CA. <sup>2</sup>University of California, Davis, Davis, CA. <sup>3</sup>USDA, ARS Western Human Nutrition Research Center, Davis, CA. <sup>4</sup>University of California Davis Medical Center and VA Northern California Health Care System, Sacramento, CA.  
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*(No relationships reported)*

**PURPOSE:** Previous work has demonstrated considerable variability in body mass index (BMI) among top finishers in a 161-km trail ultramarathon. The present study further examines anthropometric characteristics of runners participating in a 161-km trail ultramarathon and compares body composition with running performance.

**METHODS:** Height, weight, and percent body fat from bioimpedance spectroscopy measurements were made on 72 of 109 starters of the 2008 Rio Del Lago 161-km trail run. Correlation analyses were used to compare body characteristics with finish time, and ANOVA and effect sizes were used to compare characteristics of finishers with non-finishers.

**RESULTS:** Mean ( $\pm$ SD) BMI ( $\text{kg/m}^2$ ) was  $24.8 \pm 2.7$  (range 19.1-32.2) for the men and  $21.2 \pm 2.1$  (range 18.1-26.7) for the women. Among the five fastest participants in the study, BMI values were  $22.9 \pm 2.7$  (range 19.5-26.9) for men and  $20.3 \pm 2.0$  (range 18.1-22.9) for women. Percent body fat values for men and women were  $17 \pm 5$  (range 5-35) and  $21 \pm 6$  (range 10-29) among all participants, and  $11 \pm 3$  (range 6-14) and  $20 \pm 5$  (range 14-27) among the fastest five participants. Of the 72 athletes in the study, 45 (35 men, 10 women) finished the run. Among the men, there was a significant positive correlation ( $p=0.002$ ) between finish time and percent body fat. There was also a trend ( $p=0.06$ ) among the men towards a significant positive relationship between finish time and BMI. Of the 10 female finishers in the study, there was no significant relationship ( $p=0.5$ ) between finish time and BMI, but there was a trend ( $p=0.06$ ) towards a negative correlation between finish time and percent body fat. ANOVA revealed no difference in BMI and percent body fat values between finishers and non-finishers for either sex, however, effect sizes for percent body fat were moderate for men ( $d=0.52$ ; mean 19 vs. 24 for finishers vs. non-finishers) and large for women ( $d=0.85$ ; mean 16 vs. 19 for finishers vs. non-finishers).

**CONCLUSIONS:** Despite wide variations in BMI and percent body fat among the ultramarathon participants, the faster men tended to have lower BMI and percent body fat values than the slower men, and those who finished tended to have lower BMI and percent body fat values than non-finishers within both sexes.

*Support was provided by the Western States Endurance Run and ImpediMed*

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**E-24 Free Communication/Poster - Altitude and Hypoxia: Training and Performance**

MAY 29, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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**2356 Board #1 May 29 8:00 AM - 9:30 AM**  
**Self-selected Exercise Intensity Decreases But Perception Of Effort Remains Constant During A Cycle Time-trial At Altitude**

B A. Beidleman, S R. Muza, FACSM, C S. Fulco, E Lammi, J E. Staab, A Cymerman. *U.S. Army Research Institute of Environmental Medicine, Natick, MA.* (Sponsor: Stephen Muza, FACSM)

*(No relationships reported)*

Self-selected exercise intensity during a time-trial is regulated within the brain by peripheral sensory feedback (e.g., perception of effort) and the anticipated workload remaining (Abbiss, 2008).

**PURPOSE:** To determine whether a decrease in arterial oxygen saturation ( $\text{SaO}_2$ ) during an acute exposure to altitude affects self-selected exercise intensity and perception of effort during a cycle time trial.

**METHODS:** Twenty-six male lowlanders of similar age ( $22 \pm 1$  yr; mean  $\pm$  SE), weight ( $81 \pm 4$  kg), and sea-level (SL) peak oxygen uptake ( $47.6 \pm 1.9$  ml/kg/min) first completed a maximal effort 720 kJ cycle time-trial at SL and then again within 4 h of exposure to either 3000 m ( $n=6$ ), 3500 m ( $n=8$ ) or 4300 m ( $n=12$ ) altitude in a hypobaric chamber.  $\text{SaO}_2$ , heart rate (HR), and rating of perceived exertion (RPE) were measured every 5-min during the cycle time-trial and the respective overall means were calculated. The overall mean work rate and altitude-specific percent of maximum work rate ( $\% \text{WR}_{\text{max}}$ ) maintained during the time-trial were calculated for each altitude.

**RESULTS:** Time-trial performance (min) was impaired ( $p<0.05$ ) by  $\sim 32\%$  from SL values ( $73 \pm 5$ ) to 3000 m ( $97 \pm 10$ ), by  $\sim 38\%$  from SL to 3500 m ( $104 \pm 9$ ) and by  $\sim 65\%$  from SL to 4300 m ( $120 \pm 7$ ).  $\text{SaO}_2$  (%) was decreased ( $p<0.05$ ) from SL values ( $97 \pm 1$ ) at 3000 m ( $87 \pm 1$ ), 3500 m ( $83 \pm 1$ ) and 4300 m ( $74 \pm 1$ ). HR (beats/min) did not change from SL values ( $165 \pm 3$ ) at 3000 m ( $150 \pm 5$ ) or 3500 m ( $150 \pm 4$ ), but was decreased ( $p<0.05$ ) at 4300 m ( $148 \pm 3$ ).  $\% \text{WR}_{\text{max}}$  did not change from SL values ( $60 \pm 2\%$ ) at 3000 m ( $53 \pm 3\%$ ), but was decreased ( $p<0.05$ ) at 3500 m ( $50 \pm 3\%$ ) and 4300 m ( $46 \pm 3\%$ ). RPE did not change from SL values ( $14 \pm 1$ ) at any altitude. The decrease in  $\% \text{WR}_{\text{max}}$  was correlated ( $r=0.40$ ;  $p<0.05$ ) to the decrease in  $\text{SaO}_2$  with increasing altitude.

**CONCLUSION:** These results demonstrate that during an acute exposure to altitude, self-selected exercise intensity (e.g.,  $\% \text{WR}_{\text{max}}$ ) is decreased proportional to the decrease in  $\text{SaO}_2$  during a cycle time trial but perceived exertion is maintained around 14 (i.e., somewhat hard to hard) regardless of altitude. Funding provided by US Army MPMC ATO IV.MD2006.01. Authors' views not official US Army or DoD policy.

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**2357 Board #2 May 29 8:00 AM - 9:30 AM**  
**Maximal Oxygen Consumption Changes After Altitude Training: Role Of Ventilatory Acclimatization**

Daniel P. Wilhite, Abigail S. Laymon, James M. McKenzie, Elizabeth A. Lundgren, Robert F. Chapman. *Indiana University, Bloomington, IN.* (Sponsor: Timothy Mickleborough, FACSM)

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*(No relationships reported)*

With chronic altitude training, ventilatory acclimatization often results in an increase in maximal exercise ventilation. The added respiratory muscle work may contribute to the  $\text{VO}_2\text{max}$  increase seen in many elite endurance athletes after altitude training.

**PURPOSE:** To determine the contribution of respiratory muscle oxygen consumption to the change in  $\text{VO}_2\text{max}$  after altitude training.

**METHODS:** Seven elite endurance runners (6 M, 1 F;  $\text{VO}_2\text{max}$  M,  $70.6 \pm 4.5$  ml/kg/min,  $\text{VO}_2\text{max}$  F,  $64.7$  ml/kg/min) participated in a 28 day altitude training intervention in Flagstaff, Arizona, elevation 2150m, following a "live-high, train-low" training model.  $\text{VO}_2\text{max}$  and  $\text{VEmax}$  were measured 2-9 days prior to departure for altitude and 1-2



days after returning to sea level. Respiratory muscle  $\text{VO}_2$  ( $\text{VO}_{2\text{rm}}$ ) was estimated using the equations of Aaron et al (1992).

**RESULTS:**  $\text{VO}_{2\text{max}}$  increased from  $4.67 \pm 0.71$  L/min pre-altitude to  $4.86 \pm 0.81$  L/min post-altitude ( $p=0.016$ ).  $\text{VE}_{\text{max}}$  increased from  $169.7 \pm 23.5$  L/min pre-altitude to  $183.1 \pm 26.1$  L/min post-altitude ( $p=0.045$ ).  $\text{VO}_{2\text{rm}}$  increased from  $484 \pm 67$  mL/min during maximal exercise pre-altitude to  $522 \pm 64$  mL/min post-altitude.

**CONCLUSIONS:** Of the 210 mL/min increase in  $\text{VO}_{2\text{max}}$  with altitude training, an estimated 38 mL/min or 18.2% of the whole body increase in  $\text{VO}_{2\text{max}}$  came from the increased metabolic cost of ventilation. These results suggest that ventilatory acclimatization plays a role in maximal oxygen consumption improvements with altitude training. It is unknown if a) the added respiratory  $\text{VO}_2$  after altitude training effectively limits the potential magnitude of locomotor  $\text{VO}_{2\text{max}}$  increase, or b) if  $\text{VO}_{2\text{max}}$  would change over time at sea level as ventilatory acclimatization decays. These issues may be of importance to elite endurance athletes, regarding the timing of key competitions after an altitude training camp.

*Supported by the AAU/Bell-Updyke-Willett Kinesiology Research Fund, Indiana University School of HPER.*

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**2358      Board #3      May 29      8:00 AM - 9:30 AM**  
**Effect Of Altitude On Hiking Performance While Carrying A Weighted Backpack**

J E. Staab, B A. Beidleman, S R. Muza, FACSM, C S. Fulco, E Lammi, A Cymerman. *U.S. Army Research Institute of Environmental Medicine, Natick, MA.*

*(No relationships reported)*

Athletic performances lasting longer than ~1 hr can be impaired by as much as 30% to 70% at 3000 m to 4300 m from sea level (Fulco, 1998). However, the magnitude of impairment while hiking with a backpack at such altitudes has never been quantitated.

**PURPOSE:** To determine at altitude if the relative performance impairments while hiking with a weighted backpack are similar to those observed during athletic performances.

**METHODS:** Twenty-eight male lowlanders of similar age ( $22 \pm 1$  yr; mean  $\pm$  SE), weight ( $82 \pm 4$  kg), and SL peak oxygen uptake ( $47 \pm 1$  mL/kg/min) completed a 8-km, 5% grade maximal effort, simulated hike on a treadmill while carrying a 16-kg backpack at sea level (SL) and again after 24-h exposure to 3000 m ( $n=6$ ), 3500 m ( $n=8$ ) or 4300 m ( $n=14$ ) altitude in a hypobaric chamber. Heart rate (HR), arterial oxygen saturation ( $\text{SaO}_2$ ) and rating of perceived exertion (RPE) were measured every 5-min during the hike and the respective overall mean values were calculated.

**RESULTS:** Seven of the volunteers exposed to 4300 m could not complete the hike and their data were excluded. Hike performance (min) was impaired ( $p<0.05$ ) by ~13% from SL ( $81 \pm 2$ ) to 3000 m ( $92 \pm 3$ ), by ~19% from SL ( $74 \pm 3$ ) to 3500 m ( $88 \pm 3$ ) and by ~24% from SL ( $81 \pm 2$ ) to 4300 m ( $100 \pm 3$ ).  $\text{SaO}_2$  (%) was decreased ( $p<0.05$ ) from SL values ( $96 \pm 1$ ) at 3000 m ( $84 \pm 1$ ), 3500 m ( $80 \pm 1$ ), and 4300 m ( $72 \pm 1$ ). HR (beats/min) and RPE did not change from SL values ( $160 \pm 4$ ;  $13 \pm 1$ ) at either 3000 m ( $158 \pm 3$ ;  $14 \pm 1$ ), 3500 m ( $156 \pm 3$ ;  $14 \pm 1$ ), or 4300 m ( $153 \pm 3$ ;  $13 \pm 1$ ), respectively.

**CONCLUSION:** These results indicate that the performance impairments at altitude that occur when hiking with a weighted backpack are smaller than those that occur during athletic events. The most likely reason for this difference is a narrowed range of movement speed due to a change in body position imposed by carrying the weighted backpack. Funding provided by US Army MPMC ATO IV.MD2006.01. Authors' views not official US Army or DoD policy.

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**2359      Board #4      May 29      8:00 AM - 9:30 AM**  
**Running Economy Changes After Altitude Training: Role Of Ventilatory Acclimatization**

Elizabeth A. Lundgren, Daniel P. Wilhite, Abigail S. Laymon, James M. McKenzie, Robert F. Chapman. *Indiana University, Bloomington, IN.*

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*(No relationships reported)*

Several recent studies suggest that chronic altitude training may cause changes in submaximal oxygen uptake in elite endurance runners. Ventilatory acclimatization with altitude training may increase respiratory muscle work, confounding the measurement and interpretation of running economy.

**PURPOSE:** To determine if potential running economy changes after altitude training can be explained by changes in ventilatory factors.

**METHODS:** Six elite male distance runners ( $\text{VO}_{2\text{max}} 70.6 \pm 4.5$  mL/kg/min) completed a 28 day altitude training intervention in Flagstaff, Arizona, elevation 2150m, following a "live high - train low" training model. Running economy and expired ventilation (VE) were measured 2-9 days prior to departure to altitude and 1-2 days after return to sea level. Running economy was determined from  $\text{VO}_2$  measured in the final minute of 3 minute stages at 3 constant submaximal treadmill speeds of 291, 301, and 311 m/min. Respiratory muscle  $\text{VO}_2$  ( $\text{VO}_{2\text{rm}}$ ) was estimated using the equations of Aaron et al (1992).

**RESULTS:** Post-altitude  $\text{VO}_2$  was higher at each submaximal workload ( $\text{DVO}_2$  pre- to post-altitude range 2.3 - 3.2 mL/kg/min;  $p$  range 0.037 - 0.115). Post altitude VE was significantly higher at each submaximal workload ( $\text{DVE}$  pre- to post-altitude range 7.5 - 12.7 L/min;  $p$  range 0.016 - 0.021). Estimated  $\text{VO}_{2\text{rm}}$  accounted for 12.3 %, 11.0 %, and 14.2 % of the increase in whole body  $\text{VO}_2$  at each of 3 submaximal workloads after altitude training.

**CONCLUSIONS:** Submaximal  $\text{VO}_2$  increased in our elite athlete cohort after chronic altitude training. Although ventilation increased post-altitude, the estimated metabolic cost of ventilation explained 11.0 - 14.2% of the  $\text{VO}_2$  increase. The source of the remaining submaximal  $\text{VO}_2$  change after altitude training remains unknown.

*Supported by the AAU/Bell-Updyke-Willett Kinesiology Research Fund, Indiana University School of HPER.*

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**2360      Board #5      May 29      8:00 AM - 9:30 AM**  
**Running Economy Changes After Altitude Training: Role Of Running Mechanics**

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*(No relationships reported)*

The oxygen cost of running at submaximal workloads is influenced in large part by individual differences in running mechanics. Several recent studies suggest that chronic altitude training may cause changes in submaximal oxygen uptake in elite endurance runners. Whether any change in running economy after altitude training is due to altered running mechanics is undetermined.

**PURPOSE:** To determine if potential running economy changes after altitude training can be explained by changes in biomechanical factors.

**METHODS:** Six elite male distance runners ( $\text{VO}_{2\text{max}} 70.6 \pm 4.5$  mL/kg/min) completed a 28 day altitude training intervention in Flagstaff, Arizona, elevation 2150m, following a "live high - train low" training model. Running economy and gait parameters were measured 2-9 days prior to departure to altitude and 1-2 days after returning to sea level. Running economy was determined from  $\text{VO}_2$  measured in the final minute of 3 minute stages at 3 constant submaximal treadmill speeds of 291, 301, and 311 m/min. To measure variables related to running mechanics, subjects completed separate 30 second stages at constant treadmill speeds of 300, 315, 330, 345, and 360 m/min. Each running stage was separated by a period of standing rest. Wireless tri-axial 10g accelerometer devices, sampling at 1024 Hz, were securely attached to the laces of each shoe. Values of ground contact time, stride time, swing time, stride length, and stride frequency were determined from accelerometric output corresponding to foot strike and toe-off events obtained from a minimum of 25 consecutive steps.

**RESULTS:** Post-altitude  $\text{VO}_2$  was higher at each submaximal workload ( $\text{DVO}_2$  pre- to post-altitude range 2.3 - 3.2 mL/kg/min;  $p$  range 0.037 - 0.115;  $n = 6$ ). No significant differences were found in ground contact time, stride time, swing time, stride length or stride frequency at any speed after altitude training.

**CONCLUSIONS:** Changes in running economy in elite endurance runners after chronic altitude training are not due to altitude mediated changes in running mechanics.



**2361 Board #6 May 29 8:00 AM - 9:30 AM**  
**What Is The Effect Of Moderate Altitude (ma) On Olympic Running Performance: Perplexing Findings?**

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(No relationships reported)

Several approaches have been employed to ascertain the effect of MA, ~ 2,300 m, on running performance. A common method has been to compare a MA time to a sea level SL mark, such as winning times for the Mexico City Olympics (MCO) to SL marks such as the previous Olympiad. Another technique has been to measure run marks of a sample at SL and then at MA. The former method is limited due to the questionable validity of using an extreme, single measure as a representative effect, while the latter approach has, generally, been restricted to small samples and has been confined to distance events.

**PURPOSE:** To determine the effect of MA on times for events without hurdles, by comparing the best times during the MCO with the best SL marks for the same individuals and season.

**METHODS:** Run events, listed below, were analyzed to determine run times and the % difference, SL time - MCO time, (%D) for the first ~32 finishers/event (n= 297). Only 211 SL times could be validated for the MCO entries (26.4±5.1/event) or 70.5 % of the MCO sample. Additionally, %D scores were regressed over finish place and the slope (b) was tested for significance at p <0.05.

**RESULTS:** The mean MCO and SL times (in s) were as follows (in m):100=10.23/10.18; 200=20.59/ 20.67; 400=45.78/46.14; 800=108.10/ 107.10; 1,500=231.25/220.73; 5,000= 880.53/821.66; 10,000=1828.08/1719.66; marathon= 9296.11/8362.66. The mean %D from 100 m to the marathon were, respectively, -0.48; 0.40; 0.78; -0.93; -4.77; -7.17; -6.20; -11.24. Only the 100 and 200 m sprints were unaffected by MA. The regression analysis revealed that, with the exception of the 100 m, %D was related to finish position, as r ranged from -.43 to -.78 with b ranging from -0.04 to -0.31 %D. Only the b for the 100 m was not different from no slope, p=0.21.

**CONCLUSION:** The findings for the 100 and 200 m do not support single data point reports, as no differences (p > 0.05) were found for %D. However, the direction of the effect for the 400 m, 5, 10 km and marathon were in agreement, though the magnitude of the differences was considerably smaller compared to the this report. The 800 and 1500 m results yielded opposite effects, as the latter event displayed a smaller effect (1.5 vs -4.8 %). The major finding is that the order of finish is related to the %D, and informs as to why the size of the %D is smaller when MA winners are compared to SL winners.

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**2362 Board #7 May 29 8:00 AM - 9:30 AM**  
**Relationship Between Total Hemoglobin Mass And Aerobic Performance Of Sea Level Residents Exposed To 2210m**

Jeffrey L. Nelson<sup>1</sup>, Brandon K. Doan<sup>1</sup>, Ben Ryan<sup>2</sup>, Al Wile<sup>1</sup>, William C. Byrnes, FACSM<sup>2</sup>, Michael D. Brothers<sup>1</sup>. <sup>1</sup>*U.S. Air Force Academy Human Performance Lab, USAF Academy, CO.* <sup>2</sup>*University of Colorado, Boulder, CO.*  
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(No relationships reported)

It is reported that up to 70% of aerobic performance is related to O<sub>2</sub> carrying capacity as measured by total hemoglobin mass (THM). However, the relationship between THM and performance among sea level (SL) subjects following acute and chronic residence at moderate altitude (MA) has not been examined.

**PURPOSE:** To examine the relationship between THM and 1.5 mile run time acutely and after 6 and 10 weeks of chronic MA exposure among SL and MA subjects at the U.S. Air Force Academy (USAF). We hypothesized that a significant correlation would exist between THM and 1.5 mile run time acutely, that former SL subjects would display a significant increase in THM and improved run time chronically, and these changes would correlate significantly.

**METHODS:** 66 male and female freshman subjects (55 SL, 11 MA) aged 18.1 ± 0.3 years completed a 1.5 mile run 1 day after in-processing USAFA (2210m) as part of a standard fitness test. THM was measured within 72 hours of arrival utilizing the optimized CO re-breathing protocol. This 1.5 mile run and THM assessment was repeated following 6 and 10 weeks of chronic residence at USAFA.

**RESULTS:** Acutely, all hematological variables examined correlated significantly (p<0.01) with aerobic performance among SL subjects (R = -0.37 to -0.70), with THM predicting 49% of the variability observed. After 6 and 10 weeks at MA, cadets from SL displayed a 5% and 8.5% gain in THM, and 12.7% and 15.8% improvement in 1.5 mile run time, respectively, and all hematological variables again correlated significantly (p<0.05; R = -0.31 to -0.71). However, the change (D) in these blood values vs. D-run time among SL subjects after +6 weeks resulted in non-significant correlations, and only D-THM and D-erythrocyte volume correlated significantly at +10 weeks (R = -0.41, p<0.01). No significant correlations occurred among MA controls.

**CONCLUSIONS:** While strong correlations existed between blood values and run time, they explained less than half of the variability. Significant improvements in performance were seen chronically, yet blood adaptations accounted for only 16% of this variability. Other adaptations besides THM may be needed for improved aerobic performance and MA acclimatization. Disclaimer: the views expressed are the authors and do not reflect the official policy/position of the USAF, the DoD, or the US Government.

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**2363 Board #8 May 29 8:00 AM - 9:30 AM**  
**Effect Of Iron Supplementation On Hematological Adaptations To Moderate Altitude Among Former Sea Level Females**

Christina Minares<sup>1</sup>, Julia McGregor<sup>1</sup>, Chris Ruth<sup>1</sup>, Elizabeth Terry<sup>2</sup>, Jeffrey L. Nelson<sup>2</sup>, Brandon K. Doan<sup>2</sup>, Michael D. Brothers<sup>2</sup>. <sup>1</sup>*Air Force Research Labs, Brooks City-Base, TX.* <sup>2</sup>*US Air Force Academy Human Performance Lab, USAF Academy, CO.* (Sponsor: William C. Byrnes, FACSM)  
(No relationships reported)

Previous research at the U.S. Air Force Academy (USAF) has suggested that more than 37 weeks may be required for complete hematological acclimatization to moderate altitude (MA), but this lengthy time may have been confounded by insufficient iron stores and/or intake.

**PURPOSE:** To further elucidate the time requirement for hematological adaptations and the effect of iron supplementation, a double blind, placebo controlled study was designed. 18 female subjects' (9 iron, 9 placebo) total hemoglobin mass (THM), erythrocyte volume (EV), plasma volume (PV), and total blood volume (BV) were measured acutely and chronically at USAFA--a unique and well-controlled military installation--to quantify the long term hematological adaptations to MA (2210m). We hypothesized that SL females supplemented with iron would display significantly faster gains in THM and EV compared to the placebo controls.

**METHODS:** 18 incoming female freshman subjects were provided with either 100mg ferrous sulfate or placebo (corn starch) upon arrival at USAFA to be taken daily. THM was assessed within the first 72 hours of in-processing USAFA, and again after +6 and +10 weeks of chronic MA exposure utilizing the optimized CO re-breathing protocol. During this same assessment, a controlled, seated venipuncture was conducted and EV, PV, and total BV was calculated with this additional data.

**RESULTS:** Although both cohorts displayed a significant (p<0.001) increase (+11-12%) in THM and EV following 10 weeks of chronic MA, there were no significant differences in relative THM (9.3 ± 0.7 vs. 9.4 ± 0.7 g/kg) or EV (27.2 ± 1.4 vs. 27.5 ± 1.9 ml/kg) between cohorts.

**CONCLUSIONS:** Chronic exposure to 2210m resulted in significant increases in THM and EV, but daily supplementation for 10 weeks with 100mg ferrous sulfate failed to enhance hematological adaptation among this population of former SL residents.

*Disclaimer: the views expressed are those of the authors and do not reflect the official policy or position of the United States Air Force, the Department of Defense, or the US Government.*

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2364 Board #9 May 29 8:00 AM - 9:30 AM

**Hemoglobin Mass And Erythrocyte Volume Adaptations After 10 Weeks Of Altitude In Sea Level Females**

Julia McGregor<sup>1</sup>, Christina Minares<sup>1</sup>, Chris Ruth<sup>1</sup>, Andrea Pinchak<sup>1</sup>, Michael F. Zupan<sup>1</sup>, Jeffrey L. Nelson<sup>2</sup>, Michael D. Brothers<sup>2</sup>. <sup>1</sup>U.S. Air Force Research Labs, Brooks City-Base, TX. <sup>2</sup>U.S. Air Force Academy Human Performance Lab, USAF Academy, CO. (Sponsor: William C. Bymes, FACSM)

(No relationships reported)

Previous research from the U.S. Air Force Academy (USAF) has suggested that significant altitude-related hematological adaptations are required for former sea level (SL) males exposed to moderate altitude (MA), but more precise hematological measurements such as total hemoglobin mass (THM) have not occurred--especially among SL female subjects.

**PURPOSE:** To assess hematological adaptations to MA, THM, erythrocyte volume (EV), plasma volume (PV), and total blood volume (BV) were measured in SL females acutely and chronically at USAFA (2210m). We hypothesized that SL females would display significant gains in all hematological parameters over time.

**METHODS:** 18 SL female subjects' (age 18.3 ± 0.4 years) THM was assessed within the first 72 hours of in-processing USAFA, and after +6 and +10 weeks of chronic MA exposure utilizing the optimized CO re-breathing protocol. During these same assessments, a controlled, seated venipuncture was conducted and EV, PV, and total BV was calculated utilizing the THM data, hemoglobin concentration, and hematocrit. Relative THM values were compared to the average THM values measured among upper-class USAFA females that had resided at MA for 2+ years (n=20).

**RESULTS:** Former SL females had a significant (p<0.001) 12.5% increase in THM (1.1 ± 0.6 g/kg) and 10.8% increase in EV (2.7 ± 1.0 ml/kg) following 10 weeks of chronic MA versus acute values. However, neither BV (+1.9 ± 6.1 ml/kg; p=0.36) nor PV (-0.7 ± 5.3 ml/kg; p=0.86) changed significantly from acute values. SL subject's THM was significantly (p<0.01) lower acutely (-14.0%, or -1.4 g/kg) and following +6 weeks of MA exposure (-5.9%, or -0.6 g/kg; p<0.05) compared to MA controls, but was not significant at week 10.

**CONCLUSIONS:** Chronic exposure to 2210m combined with military training resulted in significant increases in THM and EV which required 10 weeks to reach the hematological values of long-term MA females. Disclaimer: the views expressed are those of the authors and do not reflect the official policy or position of the United States Air Force, the Department of Defense, or the US Government.

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2365 Board #10 May 29 8:00 AM - 9:30 AM

**Altitude-related Difference In Hemoglobin Mass And Blood Volumes Upon Acute Exposure To Moderate Altitude**

Michael D. Brothers<sup>1</sup>, Jeffrey L. Nelson<sup>1</sup>, Brandon K. Doan<sup>1</sup>, Matt Lorenz<sup>2</sup>, Michael F. Zupan<sup>3</sup>, William C. Bymes, FACSM<sup>4</sup>. <sup>1</sup>U.S. Air Force Academy Human Performance Lab, U.S. Air Force Academy, CO. <sup>2</sup>University of Colorado, Colorado Springs, CO. <sup>3</sup>Air Force Research Laboratory, Brooks City-Base, TX. <sup>4</sup>University of Colorado, Boulder, CO.

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(No relationships reported)

Research from the U.S. Air Force Academy (USAF) has suggested that significant altitude-related hematological differences exist between moderate altitude (MA) and sea level (SL) residents acutely exposed to MA (2210m), but these studies did not distinguish between differences due to variations in total hemoglobin mass (THM) versus plasma volume.

**PURPOSE:** To assess acute differences in THM plus erythrocyte (EV), plasma (PV), and total blood (BV) volumes between incoming SL (<300m) and MA (>1800m) male freshmen USAFA cadets. We hypothesized that MA subjects would have significantly more THM, EV, PV and BV.

**METHODS:** Within 72 hours of MA exposure, a resting seated venipuncture (Hb concentration & hematocrit) and the optimized CO re-breathing protocol (THM) were performed on 56 incoming male freshmen. EV, PV, and total BV were calculated utilizing THM data, hemoglobin concentration, and hematocrit.

**RESULTS:** Although there were no differences in hemoglobin concentration (14.82 ± 1.19 vs. 14.69 ± 1.22 g/dL), cadets from MA had significantly (p < 0.01) higher THM (12.01 ± 0.71 vs. 11.30 ± 0.97 g/kg; +6.3%), and significantly (p < 0.05) greater EV (35.25 ± 2.23 vs. 33.38 ± 2.78 ml/kg; +5.6%) and BV (89.69 ± 8.91 vs. 84.86 ± 6.85 ml/kg; +5.7%). For PV, the magnitude of the difference (5.8%) between MA (54.44 ± 7.87) and SL (51.47 ± 5.74 ml/kg) was similar and approached significance (p < 0.07).

**CONCLUSIONS:** Long-term (2+ years) residence at MA results in significant hematological acclimatization which increases nearly all hematological parameters compared to SL residents of similar fitness.

*This research was funded by a HQ Air Force SGR grant.*

*Disclaimer: the views expressed are those of the authors and do not reflect the official policy or position of the United States Air Force, the Department of Defense, or the US Government.*

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**E-25 Free Communication/Poster - Body Image and Eating Disorders**

MAY 29, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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2366 Board #11 May 29 9:00 AM - 10:30 AM

**Relation Between Measured And Ideal Weight, Body And Life Satisfaction, And Fitness Levels Of Adolescents**

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(No relationships reported)

The state of Texas enacted legislation requiring public schools to conduct comprehensive health-related physical fitness evaluations on students in grades 3-12 each year.

**PURPOSE:** To examine the relation between middle school students' measured weight, self-reported ideal weight, body satisfaction, life satisfaction, and achieving the "Healthy Fitness Zone" (HFZ) standards of the *FITNESSGRAM*® physical fitness testing program in Texas.

**METHODS:** Students are considered to be in the HFZ if they achieve health-related standards on each of six tests (aerobic capacity, abdominal strength, upper body strength, trunk extensor strength, flexibility, and body composition), with the standards adjusted for their age and gender. The PACER, curl-up, push-up, trunk-lift, sit and reach, and BMI were given. Students also completed self-report measures that assessed their psychosocial health. The difference between measured weight and self-reported ideal weight was computed for each participant. Of the 448 middle school students who participated in the study, 121 achieved the HFZ standards whereas 327 did not achieve the HFZ standards for all six tests.

**RESULTS:** A 2 (gender) by 2 (HFZ) MANOVA was conducted using their measured and ideal weight difference, body satisfaction, and general life satisfaction as dependent measures. Results revealed main effects for gender and HFZ. Girls had a greater difference between their measured and ideal weight than boys. They were also less likely to be

satisfied with their bodies than boys. Those who achieved the HFZ standard for all six tests had smaller differences between their measured and ideal weight than those who did not achieve the HFZ standard. In addition, those who achieved the HFZ standard were more likely to be satisfied with their body and life in general than those who did not achieve the HFZ standard.

**CONCLUSIONS:** Middle school students who were objectively judged to be physically fit were more satisfied with their weight, body, and life in general than those who were less fit. Recognizing that those who do not achieve the HFZ standards may be dissatisfied with their fitness performance and their weight, bodies, and possibly their life in general may help physical educators develop multifaceted strategies to improve both the physical and psychosocial health of students.

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**2367 Board #12 May 29 9:00 AM - 10:30 AM**  
**Body Mass Index And Perceptions Of Body Among Chinese University Students In Hong Kong.**

Robert SK NG<sup>1</sup>, Violette FP LIN<sup>2</sup>. <sup>1</sup>*The Hong Kong Polytechnic University, Hong Kong, China.* <sup>2</sup>*Food and Environment Hygiene Department, Hong Kong, China.*

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(No relationships reported)

**PURPOSE:** The prevalence of both obesity and eating disorders are on the rise worldwide, especially in the young. This study explored the relationship between different weight status as measured by body mass index (BMI) and the perception of body image and health among university students.

**METHODS:** Students were recruited from different universities in Hong Kong to fill in a Chinese self-administered questionnaire. Respondents had to match 9 men (and women) drawings of different sizes with words such as sickly, healthy, underweight, and obese. They also recorded their current and ideal body images. BMI was calculated using self-reported weight and height. Body image discrepancy (BID) was the difference between ideal and current body images selected from the 9-figure rating scale. Spearman's rho correlation analyses were conducted separately for men and women.

**RESULTS:** As the pilot of a large scale survey, 71 men (mean age 21.8±2.0 years) and 79 women (mean age 21.6±1.8 years) took part in the study. The mean BMIs were 21.7±3.5 and 19.7±2.7 kg/m<sup>2</sup> for men and women respectively. For men, 23.9% dissatisfied with their shapes, 28.2% wanted to be thinner whereas 33.8% wanted to be fatter. For women, 43.0% dissatisfied with their body shapes, 45.6% wanted to be thinner whereas 22.8% wanted to be fatter. BID was negatively correlated with BMI in men (r=-.578) and women (r=-.548). Most overweight men and women (BMI >23.0) and underweight men (BMI <18.5) did not describe the skinny figure as sickly, whereas most underweight women described the skinny figure as sickly. In the perception of "healthiest", overweight and underweight men perceived the fatter male figures as the healthiest; but slimmer female figures as the healthiest. Overweight and underweight women perceived the fatter female figures as the healthiest; but slimmer male figures as the healthiest.

**CONCLUSIONS:** The study indicates that an increase in BMI aggravates an increase in BID. Weight status influenced the gender perception of the healthiest figure. Overweight people tended to regard slim as healthy in opposite gender, but for the same gender fat is healthy. The study highlights a need for interventions to help young adults develop a healthy and realistic body image and healthy ways to manage their weight.

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**2368 Board #13 May 29 9:00 AM - 10:30 AM**  
**The Effects Of Healthy Lifestyle Intervention On Body Dissatisfaction And Weight Concerns In Minority Girls**

Norma Olvera<sup>1</sup>, Kendall McCarley<sup>2</sup>, Stephanie Kellam<sup>1</sup>, Jessica McLeod<sup>1</sup>, Jill A. Bush, FACSM<sup>3</sup>. <sup>1</sup>*University of Houston, Houston, TX.* <sup>2</sup>*University of Denver, Denver, CO.* <sup>3</sup>*University of Towson, Maryland, MD.*

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(No relationships reported)

**PURPOSE:** The primary aim of this study was to assess the effect of a family-based healthy lifestyle intervention titled BOUNCE on body dissatisfaction and weight concerns in overweight minority girls.

**METHODS:** Thirty-eight Hispanic and African American girls aged 8-14y (11.5±1.4y) and their mothers aged 26-39y (39.3+ 6.5y) participated as part of a pilot study of a healthy lifestyle intervention to promote physical activity and physical fitness. Most of the participating girls (85%) were categorized as being overweight (BMI >95%) and 15% were at risk for overweight (BMI >85<95). Similarly, most of mothers were categorized as being overweight (41%) or obese (53%). Girls completed body dissatisfaction and weight concerns measures at baseline and after a 4-week intervention.

**RESULTS:** The BOUNCE healthy lifestyle summer intervention had a significant decrease in girls' body dissatisfaction ( $p < .0005$ ) pre-post intervention, but no significant differences in weight concerns were observed pre and post-intervention.

**CONCLUSIONS:** This is one of the few studies to assess the effects of a healthy lifestyle intervention on body image and weight concerns in preadolescent Hispanic and African American girls. Body dissatisfaction was positively influenced by the intervention.

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**2369 Board #14 May 29 9:00 AM - 10:30 AM**  
**A Preliminary Survey Of College Cheerleaders For Symptoms Of Eating Disorders**

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(No relationships reported)

**INTRODUCTION:** While some may not consider cheerleading a sport, it still shares some of the same pressures as those sports that require a low body weight. An emphasis on maintaining a low body weight raises the potential for the occurrence of eating disorders among those participating in this activity.

**PURPOSE:** The purpose of this study was to use the Eating Disorders Inventory-2 (EDI-2) to evaluate the potential for eating disorders among college cheerleaders.

**METHODS:** Participants were 28 college cheerleaders from four universities. All participants were asked to fill out the Eating Disorder Inventory-Symptoms Checklist (EDI-SC) and the EDI-2 anonymously and return the packets to a sealed box. The questionnaires were then coded and analyzed to provide descriptive information regarding the participants and the subscales of the EDI-2. Descriptive statistics were used to characterize the potential for eating disorders among college cheerleaders. Independent t-tests were used to compare subjects with eating disorders to those without eating disorders.

**RESULTS:** The 28 college cheerleaders were all females with an average age of 19.5 yrs (± 1.6) and an average height and weight of 63.3 in (± 2.9) and 122 lbs (± 16.2), respectively. The mean for the highest weight (excluding pregnancy) was 127 lbs (± 17.6) and included a female who currently weighed 173 lbs with a height of 67 in. The means of all of the subscales fell within the normal ranges for college females with the exception of the "Maturity Fears" subscale. A mean value of 2.7 is considered appropriate for college females, while in the current study the "Maturity Fears" subscale indicated a mean value of 5.0. Individual profiles of the subscales were determined for each of the 28 participants. This led to the separation of seven of the original group of 28 cheerleaders into a subgroup with symptoms of disordered eating. The subscales of the high disordered eating group were significantly different ( $p < 0.05$ ) from the low disordered eating group with the exception of the Perfectionism and Maturity Fears subscales.

**CONCLUSIONS:** Twenty five percent of the cheerleaders sampled were identified as having an eating disorder. This finding suggests that cheerleaders may comprise a group that includes those with eating disorders.

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**2370 Board #15 May 29 9:00 AM - 10:30 AM**

## A Comparison Of Body Dissatisfaction And Obligatory Exercise Among Certified Fitness Instructors And Regular Exercisers

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(No relationships reported)

**INTRODUCTION:** Literature suggests that fitness professionals may feel additional pressure to meet societal expectations related to body image which may lead to greater risk of body dissatisfaction and obligatory exercise.

**PURPOSE:** The purpose of the present study was to compare body dissatisfaction (BD) and obligatory exercise (OE) among certified fitness instructors and regular exercisers. **SUBJECTS:** There were 68 total subjects who participated in the study, 48 (mean age: 20.8 + 2.3) of those subjects (42 female and 6 male) were from the general population of exercisers, and 20 (mean age: 25.8 + 3.9) were certified fitness professionals (18 female, 2 male) including group exercise instructors and personal trainers.

**METHODS:** All subjects completed a modified Body Dissatisfaction subscale of the EDI-2, the Obligatory Exercise Questionnaire, and the Body Contour Rating (BCR) scale in a private environment. Subjects also provided demographic data on exercise history, current exercise habits, and menstrual history.

**RESULTS:** No significant difference ( $p>0.05$ ) was found in body dissatisfaction between the general exercisers (mean BD= 28.4) and the certified professionals (mean BD= 29.5). No significant difference ( $p>0.05$ ) was found in obligatory exercise between the general exercisers (mean OE= 27.5) and the certified professionals (mean OE= 28.7). The BCR scale revealed similar physique misperceptions between the general exercisers (less than 25% were satisfied with current figure) and certified fitness professionals (less than 12% were satisfied with current figure).

**CONCLUSION:** Although previous literature has suggested that fitness professionals may be at greater risk of body image and excessive exercise, the present study demonstrated that the certified fitness professional were less satisfied with their physique and preferred to have physiques that were not realistic.

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### 2371 Board #16 May 29 9:00 AM - 10:30 AM Alexithymia Is Related To Disordered Eating, Exercise Dependence, And Depression In Young Adults

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Alexithymia is a psychological construct that describes one's inability to distinguish between physical feelings and emotions, and one's inability to express their emotions. The prevalence of alexithymia is generally higher in eating disorder and depression patients than in controls. Alexithymia has not been studied in people with exercise dependence.

**PURPOSE:** The aims of this study were to examine the association between alexithymia and exercise dependence, disordered eating, and depression; and to see if exercise dependence is more prevalent in people with alexithymia than not.

**METHODS:** Subjects were men and women between 18-40 y. Each subject completed the following diagnostic tools: TAS-20 (Alexithymia), EDI (Eating Disorder Inventory), EDS (Exercise Dependence Scale), and the BDI (Beck Depression Inventory).

**RESULTS:** Alexithymia is positively related ( $p<0.0001$ ) to disordered eating ( $r=0.61$ ), depression ( $r=0.59$ ), and exercise dependence ( $r=0.41$ ). 93% of those with alexithymia are depressed, while 100% of those with exercise dependence are depressed. 40% of those with exercise dependence are alexithymic. Eating Disorder Inventory ( $p<0.001$ ), Beck Depression Inventory ( $p<0.003$ ), and Exercise Dependence Scale ( $p<0.03$ ) scores are higher in those with alexithymia than without. The prevalence of alexithymia (18%) is higher in the sample than eating disorders (5%,  $p<0.003$ ), less than the prevalence of depression (58%,  $p<0.001$ ), and the same as that of exercise dependence (6%). Exercise dependence is higher ( $p<0.01$ ) in those with alexithymia (14%) than those without (5%). Exercise dependence is higher ( $p<0.004$ ) in those with depression (28%) than those without (3%).

**CONCLUSION:** Alexithymia, exercise dependence and eating disorders are significantly related. A person's inability to identify and express his/her emotions may pre-dispose him/her to an eating or exercise disorder.

*Supported by the Department of Exercise Science at George Washington University*

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### 2372 Board #17 May 29 9:00 AM - 10:30 AM Body Image Perceptions Among Female Weight Lifters

Karen M. Skemp-Arlt, Richard P. Mikat, FACSM. *University Wisconsin La Crosse, La Crosse, WI.*  
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Muscle Dysmorphia (MD) has been recognized as a disorder associated with body dissatisfaction and is especially prevalent among the exercising/athletic population, however, little is known about MD among female weight lifters.

**PURPOSE:** The purpose of the study was to measure body image perceptions particularly comparing the levels of MD among competitive and non-competitive female weight lifters.

**METHODS:** The Muscle Dysmorphia Inventory (MDI) was used to assess body image perceptions and the characteristics of muscle dysmorphia among the groups. This 27-item self-report survey has been validated in previous research and was designed for the assessment of behavioral and psychological characteristics associated with MD. The MDI contains 6 subscales and each subscale uses a 6-point Likert scale ranging from "never" (=1) to "always" (=6). Higher subscale scores represent a greater association with MD characteristics. Participants included 15 competitive and 15 non-competitive female weight lifters (mean age = 22). Data collection was done using a combination of paper and web-based surveys. MANOVA was used to measure differences between groups in all subscales.

**RESULTS:** Results indicated significant differences between competitive and noncompetitive weightlifters on the diet and exercise subscales ( $p<.01$ )\*.

MDI Subscales	Competitive (Mean Total $\pm$ SD)	Noncompetitive (Mean Total $\pm$ SD)	MANOVA p-values
Dietary Behavior	19.17 $\pm$ 5.90	11.47 $\pm$ 3.98	0.000*
Supplement Use	8.07 $\pm$ 5.68	5.47 $\pm$ 2.29	0.111
Physique Protection	10.13 $\pm$ 2.88	11.20 $\pm$ 6.25	0.553
Exercise Dependence	16.47 $\pm$ 3.54	12.40 $\pm$ 2.26	0.001*
Body size/symmetry	10.67 $\pm$ 3.83	9.33 $\pm$ 4.70	0.402
Pharmacology Use	3.00 $\pm$ 0.00	3.73 $\pm$ 2.58	0.280

**CONCLUSIONS:** Results of this study indicate that competitive female weight lifters exhibit greater behavioral characteristics associated with MD than do their non-competitive counterparts and suggest they may be at risk for this disorder. Awareness of the behavioral signs associated with MD by coaches, trainers, and health professionals is important for communication and intervention purposes.

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**2373 Board #18 May 29 9:00 AM - 10:30 AM**  
**Body Image Perceptions Related To Muscle Dysmorphia Among Competitive And Non-competitive Male Weight Lifters**  
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(No relationships reported)

Muscle Dysmorphia (MD) is a psychological disorder associated with body dissatisfaction. The current literature shows a prevalence of MD among competitive male weight lifters, however, little is known about MD among non-competitive male weight lifters.

**PURPOSE:** The purpose of this study was to measure and compare body image perceptions related to MD among competitive and non-competitive male weight lifters.

**METHODS:** The Muscle Dysmorphia Inventory (MDI) was used to assess body image perceptions and the characteristics of muscle dysmorphia among men in both competitive and non-competitive groups. Each subscale score of the MDI was calculated by summing all item scores within the subscale. Higher scores were associated with greater risk for MD. Participants included 38 competitive and 38 non-competitive male weight lifters (mean age = 24). MANOVA was used to measure differences between groups in all subscales.

**RESULTS:** Both competitive and non-competitive male weightlifters exhibited relatively high MDI subscale scores and no significant differences in MDI subscale scores were found between groups ( $\alpha = 0.05$ , see table below).

MDI Subscales	Maximum Possible Score	Competitive (Total Mean $\pm$ SD)	Noncompetitive (Total Mean $\pm$ SD)	MANOVA p-values
Dietary Behavior	30	18.74 $\pm$ 5.17	17.47 $\pm$ 5.77	0.318
Supplement Use	24	13.55 $\pm$ 4.48	12.95 $\pm$ 5.68	0.607
Physique Protection	36	12.55 $\pm$ 4.71	13.03 $\pm$ 4.35	0.650
Exercise Dependence	24	17.34 $\pm$ 3.50	15.61 $\pm$ 4.50	0.064
Body size/symmetry	30	18.79 $\pm$ 5.92	17.16 $\pm$ 6.59	0.260
Pharmacology Use	18	3.26 $\pm$ 0.83	3.45 $\pm$ 1.11	0.414

**CONCLUSION:** All weightlifters in this study had similarly high MDI subscale scores which place them at risk for MD. Additionally, no apparent differences in MDI subscale scores between competitive and non-competitive male weightlifters were found indicating that both groups have similar MD risks. These findings should encourage coaches, trainers, and fitness and health professionals to become aware of the behavioral signs associated with MD and to look for these signs in all male weight lifters under their supervision.

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**2374 Board #19 May 29 9:00 AM - 10:30 AM**  
**Affective Responses To Dexa Images And Body Composition Analysis**  
Mark D. Faries, Cathrine S. Boroff, Matthew Stults-Kolehmainen. *University of Texas-Austin, Austin, TX.* (Sponsor: John Bartholomew, FACSM)  
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(No relationships reported)

Dual-energy X-ray absorptiometry (DEXA) has become a widely used method for estimation of body composition, including bone mineral density, muscle mass and fat mass. In addition to body composition results, DEXA also provides users with full body two-dimensional images; one of their skeleton and one of their soft tissue. It is unknown what affective responses incur upon finding out one's own body composition, along with seeing these images of self.

**PURPOSE:** To examine the affective responses to viewing DEXA images after body composition analysis, and whether or not body fat percentage (BF%) moderates such responses.

**METHODS:** 111 participants (female,  $n = 73$ ; male,  $n = 38$ ;  $21.09 \pm 3.56$  yrs) were randomly assigned to either a control (NO IMAGE,  $n = 55$ ) or experimental group (IMAGE,  $n = 56$ ). Both groups completed a demographic questionnaire and the Positive Affect Negative Affect Scale (PANAS) prior to the DEXA scan. Participants then completed a DEXA scan, and were told their measured total body fat percentage along with norms (women 21-32%, men 8-19%). At this point, the IMAGE group was allowed to view their own produced DEXA images, while the NO IMAGE group was kept from seeing their images. Immediately following the DEXA scan, all participants completed a post-PANAS. Changes in positive affect (PA) and negative affect (NA) were separately investigated using 3-way repeated measures ANOVA (condition, gender & BF%).

**RESULTS:** There was a main effect of time on PA, decreasing from  $3.18 \pm .78$  to  $2.83 \pm .87$  ( $p < 0.01$ ), as well as both genders and BF% categories (in norm-desired range vs. above range) decreasing significantly ( $p < 0.01$ ). No within-subjects interaction effects were found. For NA, there were no main effects of time, condition or gender, although a significant interaction effect with BF% was found. There was a significant increase in NA for those whose BF% was greater than the desired range ( $1.47 \pm .54$  to  $1.58 \pm .62$ ,  $p < 0.05$ ), while there was a non-significant effect of time on NA for those who BF% was in the desired range ( $1.58 \pm .57$  to  $1.51 \pm .68$ ,  $p > 0.05$ ).

**CONCLUSIONS:** It appears that finding out one's own BF% may not be as benign as thought, with decreases in PA overall, in both genders and BF% categories, while NA increases in overweight individuals. Viewing DEXA images do not differentially influence affective responses.

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**2375 Board #20 May 29 9:00 AM - 10:30 AM**  
**Male Athletes, Fitness Media, And Post-exercise Psychological Affect**  
Ann Wertz Garvin, Adam Crowley, Robert Schilt, Sean Dill. *University of Wisconsin Whitewater, Whitewater, WI.*  
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Fitness magazines with images of the lean muscular body type characteristic of athletes, dominate the reading materials provided at exercise facilities. Preliminary research suggests that exposure to this type of image may have negative psychological consequences related to increased anxiety and reduced mood in women and non athlete males.

**PURPOSE:** The purpose of this investigation was to quantify the effects of fitness media exposure on the psychological affect of male athletes; athletes whose BMI and physical aesthetics are in alignment with the idealized fitness images in popular press.

**METHODS:** Male athletes ( $N=95$ ) were recruited, counterbalanced and randomly assigned to conditions within a Solomon-multi-group design. Participants were provided with either a Men's Health and Fitness (fitness images), a National Geographic (no fitness images) or no-magazine control condition. All athletes engaged in 30-min of cycle ergometry at a self-selected intensity. State anxiety (STAI) and mood state (POMS) were measured in half the cases before exercise, and in all cases within 3-min following



exercise. This design allows for speculation regarding pre-test sensitization and expectancy, as well as, group differences in the post exercise condition. Data were analyzed with a series of repeated measures ANOVAs and dependent t-tests on post-test scores.

**SUMMARY OF RESULTS:** Collapsed across conditions (viewing a fitness magazine, non fitness magazine or no magazine control) state anxiety and global mood state were associated with significant improvements ( $P < .001$ ) from pre- to post- exercise. Viewing popular media with or without fitness images did not appear to impact the dependent variables measured when compared to controls. While this trend was recorded in the subscales of the POMS (depression and tension) it appears that pre-test sensitization may have effected post-test outcomes in these specific variables.

**CONCLUSIONS:** Results indicate that athletes experience similar positive psychological benefit from acute exercise as has been previously documented in exercise literature. From this investigation, it appears viewing popular magazines with or without idealized fitness images has little effect on post-exercise psychological affect when compared to controls in the non-clinical athletic male sample.

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**2376 Board #21 May 29 9:00 AM - 10:30 AM**  
**Eating Disorder Knowledge In Collegiate Auxiliary Administrators And Instructors**

Toni M. Torres-McGehee<sup>1</sup>, James Matt Green, FACSM<sup>2</sup>, Deidre Leaver-Dunn<sup>3</sup>, James D. Leeper<sup>3</sup>, Phillip A. Bishop, FACSM<sup>3</sup>, Mark Richardson<sup>3</sup>.

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(No relationships reported)

**PURPOSE:** Assess collegiate band administrators and auxiliary unit instructors regarding eating disorders: (a) knowledge, (b) educational program attendance, and (c) confidence scores of knowledge responses.

**METHODS:** An online questionnaire was distributed to NCAA Division I, II, and III university band administrators ( $n = 175$ ) and instructors ( $n = 150$ ) of auxiliary units (majorettes, dance line, color guard). Response rates were: administrators (34.9%,  $n = 61$ ), instructors (29.3%,  $n = 44$ ), total response rate (32.3%,  $n = 105$ ). An eating disorder questionnaire assessed [attendance at educational programs] about eating disorders, knowledge, and confidence levels of responses across five domains of etiology, identifying signs/symptoms, management/ treatment, risk factors, and prevention and education. The survey included 30 true-false questions each followed by a 4-point Likert-type scale assessing respondents' personal confidence levels for each answer.

**RESULTS:** Percentages for those administrators and instructions who reported ever attending a session were: administrators (13.1%), instructors (40.9%), overall (24.8%). Overall, instructors' knowledge score ( $71.9\% \pm 9.5\%$ ) was significantly ( $p = 0.03$ ) better than administrators ( $67.9\% \pm 9.3\%$ ). Individual domain scores were not significantly different between groups, but instructors demonstrated higher confidence levels (2.6 vs. 3.2,  $p \leq 0.01$ ) for correct responses in the identification of signs/symptoms, management/treatment (2.7 vs. 3.1,  $p = 0.04$ ), and risk factor (2.6 vs. 3.2,  $p = 0.02$ ) domains. Confidence levels in etiology and prevention and education were not significantly different.

**CONCLUSIONS:** While instructors demonstrated greater eating disorder knowledge (vs. administrators), scores were low in both groups. Because knowledge scores were lower in the group with a lower attendance record, educational intervention may offer a viable avenue for improving knowledge. Results emphasized the need for improving educational levels of administrators and auxiliary unit instructors on eating disorder knowledge.

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**E-26 Free Communication/Poster - Cardiac Rehabilitation**

MAY 29, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**2377 Board #22 Abstract Withdrawn**

**2378 Board #23 May 29 8:00 AM - 9:30 AM**  
**Early Participation in Cardiac Rehabilitation Exercise Programming Further Improves Aerobic Capacity Post Myocardial Infarction**

Tyler G. Threlfall<sup>1</sup>, Trina Hauer<sup>1</sup>, Dr. Ross Arena, FACSM<sup>2</sup>, Karen Parker<sup>3</sup>, Debra Lundberg<sup>3</sup>, Dr. David Goodhart<sup>3</sup>, Dr. Mouhieddin Traboulsi<sup>3</sup>, Dr. Sandeep Aggarwal<sup>1</sup>. <sup>1</sup>Cardiac Wellness Institute of Calgary, Calgary, AB, Canada. <sup>2</sup>Virginia Commonwealth University, Richmond, VA. <sup>3</sup>Calgary Health Region, Calgary, AB, Canada.

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(No relationships reported)

Aerobic capacity is an important outcome of exercise based cardiac rehabilitation (CR) programs as it is a strong predictor of cardiac related death. Following a myocardial infarction (MI), engaging in aerobic exercise CR programming improves aerobic capacity, however, optimal timing of this programming remains controversial.

**PURPOSE:** To determine if there are differences in aerobic capacity between subjects who engage in early compared to usual timing of aerobic exercise CR programming post MI.

**METHODS:** One hundred and one patients diagnosed with a low risk (CADILLAC score 0-2) ST elevation MI participated in this analysis. Fifty three subjects (91% male, age:  $56.1 \pm 9.1$  years) were allocated to the Early Exercise arm, while forty eight subjects (81% male, age:  $56.9 \pm 10.5$  years), identified retrospectively and matched for Early Exercise criterion, served as the Usual Care comparison group. All subjects participated in a 12 week outpatient CR aerobic exercise program and underwent maximal exercise treadmill stress testing using BRUCE protocol, at baseline and at completion of their program.

**RESULTS:** The following results are reported Early Exercise versus Usual Care group throughout. The time between MI event and baseline exercise testing was significantly shorter in the Early Exercise group ( $11.7 \pm 14.6$  vs.  $61.5 \pm 33.3$  days,  $p < 0.001$ ). Baseline peak metabolic equivalent (MET) level was not significantly different ( $8.3 \pm 1.8$  vs.  $7.8 \pm 1.8$  METs,  $p = 0.25$ ) between groups. While both groups experienced a significant improvement in post CR peak MET level ( $p < 0.001$ ) the mean change was significantly greater in the Early Exercise group ( $1.4 \pm 0.98$  vs.  $0.76 \pm 1.1$  METs,  $p < 0.005$ ).

**CONCLUSION:** The results of the present investigation are consistent with the vast body of previous literature demonstrating CR leads to a significant improvement in aerobic capacity. However, the mean improvement in aerobic capacity was significantly greater in the Early Exercise group compared to subjects entering Usual Care outpatient CR according to a more traditional initiation of exercise time-line. Hypotheses for this outcome include: 1) Less sedentary lifestyle-induced deconditioning following hospital discharge in the Early Exercise group and 2) Early cardiac follow-up care post MI leading to improved exercise compliance.

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**2379 Board #24 May 29 8:00 AM - 9:30 AM**  
**Comprehensive Cardiac Rehabilitation: What Benefits Are Maintained At Repeated Residential Cardiac Rehabilitation After 16 Months?**

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Helmut Sinzinger<sup>6</sup>, Peter Schmid<sup>1</sup>. <sup>1</sup>Center for Cardiovascular Rehabilitation, Bad Schallerbach, Austria. <sup>2</sup>University of Salzburg, Hallein/Rif, Austria. <sup>3</sup>Texas A&M University, College Station, TX. <sup>4</sup>University of Texas Southwestern Medical Center, Dallas, TX. <sup>5</sup>General Hospital Braunau, Braunau, Austria. <sup>6</sup>ATHOS, Institute for Diagnosis and Treatment of Atherosclerosis and Lipid Disorders, Vienna, Austria.  
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Cardiac rehabilitation and secondary prevention (CR) services have become recognized as a significant component in the continuum of care for persons with cardiovascular disease (CVD), undergone cardiac surgery or suffer from heart failure. The role of CR services in the comprehensive secondary prevention of CVD events is well documented and has been promoted by various health care organizations and position statements.

**PURPOSE:** We investigated the 16-months effect of CR in cardiac patients readmitted to CR.

**METHODS:** 408 patients (60±10 years) underwent cycle ergometry, blood sampling, and fasting glucose tests at the beginning, the end of 21±2 days of the exercise program and at readmission after 488±116 days. Maximal oxygen uptake (VO<sub>2</sub>max) was estimated from the maximal watts (W) achieved. The CR program consisted of cycling for 17±4 min 6.0 x wk and daily walking for 45 min at 60-70% of the maximal individual heart rate (HR<sub>max</sub>).

**RESULTS:** Blood cholesterol, LDL-C, TRIGs, and the body mass index (BMI) fell significantly during CR, -12%, -17%, -19 %, and -2%, respectively. Resting blood pressure, maximal performance, VO<sub>2</sub>max and the HR recovery in 1 minute improved significantly (P<0.001). Fasting glucose was unchanged. After readmission BMI, lipids (blood cholesterol, LDL-C, TRIGs) and resting blood pressure as traditional cardiovascular risk factors were increased significantly, +5%, +22%, +28%, +32%, +4%, respectively, although medication was unchanged. Exercise performance was comparable to discharge and was not significantly different.

**CONCLUSION:** During CR exercise performance and cardiovascular risk factors improved. However, readmission revealed an increase in BMI, lipids and resting blood pressure although physical fitness remained unchanged in comparison to discharge. Thus, lifestyle modification as a part of secondary prevention in CVD was changed in terms of exercise behaviors, but lifestyle trends are still a cause for concern in cardiac patients, as is the lack of any improvement in blood-pressure management, and the fact that most CHD patients are still not achieving the cholesterol goal of less than 200 mg/dl. Whether reinforcement of CR sessions or other strategies to enhance long-term adherence to lifestyle changes could attenuate the observed attrition in benefits needs further study.

**2380 Board #25 May 29 8:00 AM - 9:30 AM**  
**Accuracy Of Ambulatory Heart Rate Monitoring During Exercise In Patients With Coronary Artery Disease.**

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Accuracy of Ambulatory Heart Rate Monitoring During Exercise in Cardiac Patients With and Without Arrhythmias

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Although the accuracy of ambulatory heart rate (HR) monitoring has been reported in healthy populations, few data are available in patients with coronary disease.

**PURPOSE:** The accuracy of contemporary HR monitors was evaluated during prescribed exercise in phase 2/3 coronary patients (n=17) with and without a history of bundle branch block (n=3), atrial fibrillation (n=3), and atrial/ventricular arrhythmias (n=6), using simultaneous ECG-telemetry monitoring as the criteria measure. Mean ± SD age, body mass index, and estimated cardiorespiratory fitness was 57.8 ± 9.5 years, 26.0 ± 3.6 kg/m<sup>2</sup>, and 10.3 ± 2.3 metabolic equivalents.

**METHODS:** Our protocol assessed exercise HRs at 60-80% HR<sub>max</sub> using an elliptical trainer and a stationary cycle ergometer equipped with sensor (gripping) HR monitors versus ambulatory monitoring (Polar®). Patients performed a 5-min warm-up, and 5-7 min on a sensor HR equipped elliptical trainer and stationary cycle ergometer, in randomized order, while ECG-telemetry monitored.

**RESULTS:** A comparison of HR responses obtained from the 2 different exercise devices versus simultaneous ambulatory and ECG-telemetry is shown below.

Exercise Device	Sensor HR	Ambulatory HR	ECG-Telemetry HR
Cycle ergometer	113.5 ± 15.2	113.9 ± 5.0	113.6 ± 15.1
Elliptical trainer	119.7 ± 11.9	119.8 ± 13.2	121.5 ± 11.8

All of the paired differences were examined using paired t-tests. None were significantly different.

**CONCLUSIONS:** Contemporary ambulatory monitors and exercise equipment provide accurate measures of HR during exercise in coronary patients with and without conduction anomalies and/or atrial and ventricular arrhythmias.

**2381 Board #26 May 29 8:00 AM - 9:30 AM**  
**Evaluation Of A Simple Intervention To Increase Self-efficacy For Independent Exercise In Cardiac Rehabilitation Participants**

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While benefits of exercise after a cardiac event are well documented, participation in and adherence to cardiac rehabilitation (CR) programs is often low.

**PURPOSE:** To test the effectiveness of a self-efficacy coaching intervention (SCI): a simple theory-based behavioral intervention to increase self-efficacy for independent exercise as well as independent exercise behavior in CR patients. It was hypothesized that persons receiving the SCI treatment (T) would have higher levels of self-efficacy for exercise and greater participation in independent exercise than those in an attention control (C) group.

**METHODS:** People referred to a hospital-based CR program by their physician were invited to participate in the study (N = 65). Participants were assigned to either T or C groups which were randomly designated by class time. The SCI was administered every two weeks by CR staff as a supplement to standard CR care. Patients in the T group received coaching about independent exercise, patients in the C group received coaching matched for time and technique but covering information about healthy eating. Self-efficacy for independent exercise was assessed at the beginning and end of the supervised CR program with an Exercise Self-Efficacy (ESE) scale and a Barriers Self-Efficacy (BARSE) scale. Participation in independent exercise was determined by self-report with activity logs. Outcome differences between and within T and C groups were analyzed through one-way ANOVA.

**RESULTS:** Differences between groups were not statistically significant (p > .10) for any outcome variable. Significant within groups changes (p < .05) were seen for BARSE change in the T group, and for independent exercise change in both groups. Analysis of covariance suggested an independent effect of gender on change in ESE and BARSE scores, and an independent effect of previous exercise on exercise change.

**CONCLUSIONS:** This study adds to the limited body of knowledge about theory-based interventions in CR programs and takes an important step in translating self-efficacy theory into a simple, practical application that will promote maintenance of lifestyle changes in this population. Further study is needed to see if the changes translate into maintenance of independent exercise behavior after completion of a formal CR program.

**2382 Board #27 May 29 8:00 AM - 9:30 AM****Utilizing A 12-minute Walk Test To Assess Progress In A Cardiac Rehabilitation Population**

Suresh Koneswaran<sup>1</sup>, Debra Boardley<sup>2</sup>, Dalynn T. Badenhop, FACSM<sup>1</sup>, Angela Burkett<sup>1</sup>, Abby Steigerwalt<sup>1</sup>. <sup>1</sup>University of Toledo Medical Center, Toledo, OH. <sup>2</sup>University of Toledo, Toledo, OH.

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(No relationships reported)

Measuring a patient's ability to walk for a distance over a specific time period is a simple and cost-effective means of assessing functional improvement in cardiac patients.

**PURPOSE:** To determine the significance of the 12-minute walk test (12MWT) in a population of cardiac rehabilitation patients, with specific regards to improvement in distance walked.

**METHODS:** Data were collected from 586 patients (402 men, 184 women) who completed a 12MWT prior to and upon completion of a phase II cardiac rehabilitation program. Age, gender, and primary diagnosis in 4 categories were used to examine 12-minute distance walked (12MWD), measured in feet, using repeated measures ANOVA with Tukey's post hoc test when group differences were significant.

**RESULTS:** Men (3105 + 695) walked further than women (2610 + 701) in the pre-program 12MWT ( $p < .001$ ). Both men and women improved walk distance in the post 12MWT ( $p < .001$ ) but there was not a significant difference between men and women ( $p = .052$ ). Considering age groups, all groups increased distance walked from pre to post ( $p < .001$ ). Post 12MWD in those < 45 years of age (3829 + 958) and those 45-60 (3686 + 958) did not differ significantly ( $p = .89$ ). Patients < 45 years old increased significantly more (603) than patients > 75 years old (311) ( $p < .001$ ). There were no significant differences between diagnoses in mean distance walked prior to cardiac rehabilitation. By diagnosis category (Coronary Artery Bypass Graft Surgery, Myocardial Infarction, Stable Angina, and Other), all groups improved over time ( $p < .001$ ). However, after cardiac rehabilitation, there was a significant change in distance walked between myocardial infarction patients (489) and stable angina patients (315), myocardial infarction patients improving more ( $p = .013$ ).

**CONCLUSIONS:** Upon completion of a cardiac rehabilitation program, all patients regardless of gender, age, and diagnosis significantly improved their 12MWD. This test may be particularly useful to small medical centers and outpatient clinics that desire to evaluate improvement in functional capacity, but do not have access to conventional treadmill tests.

**2383 Board #28 May 29 8:00 AM - 9:30 AM****Aerobic Exercise Training Affects Vascular Endothelial And Cardiac Diastolic Functions In Coronary Artery Disease**

Levent Soyer, Sadi Sanli Kurdak, Mesut Demir, Kerem Tuncay Ozgunen, Medih Celiktas, Cigdem Zeren, Ozlem Ayse Ornek, Esmeray Acarturk, Mehmet Kanadası. *Cukurova University Medical Faculty, Adana, Turkey.*

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(No relationships reported)

Endothelial dysfunction is an early manifestation of coronary artery disease (CAD). The heart, as a specialized form of vessel, has an endothelial system which is forming the composition of endocardium. Therefore, endothelial dysfunction may impair the diastolic functions of the heart. The beneficial effect of aerobic exercise on endothelium may also improve the diastolic functions.

**PURPOSE:** The aim of this study was to investigate the effect of aerobic exercise training on vascular endothelial and cardiac diastolic functions.

	Pre Exercise	Post Exercise
Plasma Homocystein (umol/L)	11.86 ± 1.29	14.53 ± 0.93*
Microalbuminuria (mg/L)	14.90 ± 3.04	10.3 ± 3.78*
Flow Mediated Dilatation (%)	10.38 ± 3.61	12.97 ± 3.38*
<b>Mitral Flow</b>		
E (m/s) ± Early diastolic flow	0.627 ± 0.046	0.671 ± 0.040
A (m/s) ± Atrial systolic flow	0.769 ± 0.050	0.695 ± 0.053*
EDT (ms) ± Deceleration time of E	213.83 ± 12.41	180.37 ± 12.16
E/A	0.865 ± 0.102	1.009 ± 0.144
<b>Mitral Annular Velocities</b>		
E' (m/s) ± Early diastolic velocity	0.181 ± 0.009	0.161 ± 0.001*
A' (m/s) ± Atrial systolic velocity	0.279 ± 0.030	0.171 ± 0.008*
E' (m/s) ± Ventricular systolic velocity	0.143 ± 0.008	0.131 ± 0.007
E/E'	3.512 ± 0.255	4.242 ± 0.299*

**METHODS:** Eleven patients (8 males and 3 females, mean age 57±2) with stable CAD were included to the study. Blood and urine samples were taken to calculate plasma homocystein (PH) and instant microalbuminuria levels, respectively. Doppler echocardiographic measurements and the amount of brachial flow mediated dilatation (FMD) were achieved. Patients were trained for four weeks with moderate intensity treadmill exercise, regarding the 50% of peak oxygen uptake. All laboratory and echocardiographic examinations were repeated after the training protocol. Paired sample t-test was used to evaluate the level of significance, and p values < 0.05 were accepted as significant.

**RESULTS:** Transmittal peak velocities evaluated by pulsed wave Doppler, tissue Doppler velocities, FMD and laboratory results are summarized in table.

Table \* = indicates the significant difference ( $p < 0.05$ )

**CONCLUSIONS:** Moderate intensity level of exercise improved both endothelial and diastolic functions in patients with CAD. Regular exercise may be an important tool in the CAD treatment protocol. Wide range studies might be helpful to explain the relation of both entities.

**E-27 Free Communication/Poster - Cardio Disease/Rehabilitation**

MAY 29, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

**2384 Board #29 May 29 8:00 AM - 9:30 AM****A Short-term Exercise Intervention Reduced Total Matrix Metalloproteinase-9 In Patients With Metabolic Syndrome**

Ignacio Rosety<sup>1</sup>, Miguel A. Rosety<sup>2</sup>, Manuel Rosety<sup>1</sup>, Francisco J. Ordóñez<sup>1</sup>, Ramon Alvero<sup>3</sup>, Gabriel Fornieles-Gonzalez<sup>1</sup>, Manuel Rosety-Rodriguez<sup>1</sup>. <sup>1</sup>University of Cadiz, Cadiz, Spain. <sup>2</sup>European University of Madrid, Madrid, Spain. <sup>3</sup>University of Malaga, Malaga, Spain.

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(No relationships reported)

Oxidative stress, endothelial cell activation, inflammation and plaque stability are now recognized as important contributors to explain the incidence of atherosclerosis in metabolic syndrome. In this respect it is suggested matrix metalloproteinase (MMP-9) independently predict early risk of cardiovascular disease. Fortunately, recent studies have reported regular exercise may reduce proinflammatory status in patients with metabolic syndrome. On the contrary little attention has been paid regarding plaque destabilization.

**PURPOSE:** For the reasons already mentioned this study was designed to determine the influence of exercise on serum levels of total matrix metalloproteinase-9 (MMP-9) in adult women with metabolic syndrome

**METHODS:** Sixty adult women with metabolic syndrome according to the criteria reported by the National Cholesterol Education Program Adult Treatment Panel III volunteered for this study. Forty-five were randomly included in experimental group to perform a 12-week aerobic training program, 3 days/week, consisting of warm up (10-min), main part (20-35-min [increasing 5 minutes each 3 weeks]) at a work intensity of 60-75% of peak heart rate (increasing 5% each 3 weeks) and cool-down (10min). Control group included 15 age, sex and BMI-matched women with metabolic syndrome that will not perform any program. Written informed consent was obtained. Further our protocol was approved by an institutional ethic committee. Serum total MMP-9 concentration was measured by ELISA, using a commercially available kit (R&D Systems) twice: 72-hours before starting the program (pre-test) and after its ending (post-test).

**RESULTS:** When compared to baseline serum total MMP-9 concentration was decreased significantly after our 12-week protocol ( $886.3 \pm 15.1$  vs  $609.7 \pm 13.2$  ng/ml;  $p < 0.05$ ). No changes were reported in controls.

**CONCLUSIONS:** A 12-week training program decreased serum total MMP-9 concentration in adult women with metabolic syndrome. Further studies on this topic are required.

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**2385 Board #30 May 29 8:00 AM - 9:30 AM**  
**A 12-week Aerobic Training Program Increased Adiponectin Levels In Male Adults With Metabolic Syndrome**

Gabriel Fornieles-Gonzalez<sup>1</sup>, Ignacio Rosety<sup>1</sup>, Francisco J. Ordonez<sup>1</sup>, Miguel A. Rosety<sup>2</sup>, Ramon Alvero<sup>3</sup>, Manuel Rosety<sup>1</sup>, Manuel Rosety-Rodriguez<sup>1</sup>.  
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The clustering of multiple coronary artery disease (CAD) risk factors in the same individual, commonly referred to as the metabolic syndrome is extremely prevalent in westernized societies. Accordingly the examination of the effect of modifying environmental influences (e.g. exercise) is warranted. In this respect, increasing attention has been paid to plasma proteins that originate from adipose tissue, especially adiponectin, which exhibits potent anti-inflammatory and anti-atherosclerotic effects.

**PURPOSE:** The present study was designed to determine the influence of regular exercise on plasmatic adiponectin levels in young male adults with metabolic syndrome.

**METHODS:** Sixty adult men with metabolic syndrome according to the criteria reported by the National Cholesterol Education Program Adult Treatment Panel III volunteered for this study. Forty-five were randomly included in experimental group to perform a 12-week aerobic training program, 3 days/week, consisting of warm up (10-min), main part (20-35-min [increasing 5 minutes each 3 weeks]) at a work intensity of 60-75% of peak heart rate (increasing 5% each 3 weeks) and cool-down (10-min). Control group included 15 age, sex and BMI-matched men with metabolic syndrome that will not perform any program. Written informed consent was obtained. Further our protocol was approved by an institutional ethic committee. Plasma adiponectin was assessed using a commercially available radioimmunoassay kit (HADP-61HK) 72-hours before starting the program (pre-test) and 72-hours after its ending (post-test).

**RESULTS:** When compared to baseline IL-6 levels were decreased significantly after being exercised ( $6.3 \pm 1.2$  vs  $8.0 \pm 1.4$  pg/ml;  $p < 0.05$ ). On the contrary no changes were reported in controls

**CONCLUSIONS:** It may be concluded regular exercise may increase plasmatic adiponectin levels in young male adults with metabolic syndrome. Further studies on this topic are still required.

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**2386 Board #31 May 29 8:00 AM - 9:30 AM**  
**Plasmatic E-selectin Levels Were Decreased In Young Women With Metabolic Syndrome After Being Exercised**

Manuel Rosety-Rodriguez<sup>1</sup>, Ignacio Rosety<sup>1</sup>, Gabriel Fornieles<sup>1</sup>, Isabel M. Macias-Amat<sup>1</sup>, Antonio Diaz<sup>1</sup>, Ramon Alvero<sup>2</sup>, Ahmed Sbihi<sup>3</sup>, Miguel Angel Rosety<sup>4</sup>, Francisco J. Ordonez<sup>1</sup>. <sup>1</sup>University of Cadiz, Cadiz, Spain. <sup>2</sup>University of Malaga, Malaga, Spain. <sup>3</sup>University of Rabat, Rabat, Morocco. <sup>4</sup>European University of Madrid, Madrid, Spain.  
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It is widely accepted P-selectin is a cell-surface adhesion molecule involved in leukocyte rolling and attachment that has been studied in various inflammatory and pro-thrombotic disorders. In fact P-selectin is increased in patients with early atherosclerosis or those with manifest atherosclerotic disease. Fortunately regular exercise may reduce circulating levels of cardiovascular inflammatory markers in patients with metabolic syndrome.

**PURPOSE:** Accordingly this study was designed to determine the influence of exercise on soluble plasmatic P-selectin levels in women with metabolic syndrome.

**METHODS:** Sixty adult women with metabolic syndrome according to the criteria reported by the National Cholesterol Education Program Adult Treatment Panel III volunteered for this study. Forty-five were randomly included in experimental group to perform a 12-week aerobic training program, 3 days/week, consisting of warm up (10-min), main part (20-35-min [increasing 5 minutes each 3 weeks]) at a work intensity of 60-75% of peak heart rate (increasing 5% each 3 weeks) and cool-down (10-min). Control group included 15 age, sex and BMI-matched women with metabolic syndrome that will not perform any program. Written informed consent was obtained. Further our protocol was approved by an institutional ethic committee. Circulating levels of soluble P-Selectin were measured with an enzyme-linked immunosorbent assay (ELISA) using monoclonal antibodies (Parameter, R&D Systems) twice: 72-hours before starting the program (pre-test) and after its ending (post-test).

**RESULTS:** When compared to baseline soluble P-Selectin concentration was not decreased significantly after our 12-week protocol based on exercise ( $131.6 \pm 8.1$  vs  $126.8 \pm 7.7$  ng/ml;  $p > 0.05$ ). On the contrary, no changes were reported in controls.

**CONCLUSION:** A 12-week aerobic training program did not change significantly circulating levels of soluble plasmatic P-Selectin in women with metabolic syndrome. Further studies on this topic are required.

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**2387 Board #32 May 29 8:00 AM - 9:30 AM**  
**Exercise With Arb Improved Metabolic Syndrome Risk Factors And Exercise-induced Cardio-renal Disorganization In Oletf Rats**

Yuka Nagashima, Daisuke Shindo, Masato Suzuki. *The Jikei University School of Medicine, Tokyo, Japan.*  
(No relationships reported)

**PURPOSE:** Exercise is one of the treatments for hypertension. However, our previous study showed no antihypertensive effects of exercise in Otsuka Long-Evans Tokushima Fatty (OLETF) rats. Exercise activates sympathetic nervous activity and renin-angiotensin-aldosterone system, which may lead to cardio-renal disorganization, via elevated blood pressure (BP) or direct actions of angiotensin II (Ang II). This study investigated the effects of combination treatment with exercise and Ang II receptor blocker (ARB) on metabolic syndrome (MS) risk factors and morphological findings of the heart and kidney in OLETF rats.

**METHODS:** Male OLETF rats were assigned to exercise (Ex, n = 7), ARB (ARB, n = 8), exercise with ARB (Ex & ARB, n = 8), and sedentary control (Sed, n = 9) groups. Exercise was performed by using a rotatory wheel. ARB, telmisartan (10 mg/kg/day), was blended in a powdered feed. Body weight, BP, and urinary albumin excretion were measured during the treatment. Oral glucose tolerance test was performed before and after the treatment. After the treatment, the heart, kidney, skeletal muscles, visceral fat, and subcutaneous fat were removed and weighed. Interstitial myocardial fibrotic area (IMFA) of the heart and glomerular area (GA) and mesangial area (MA) of the kidney were measured using an imaging analyzer.

**RESULTS:** In both the Ex and Ex & ARB groups, body weight and visceral fat weight (g/kg) were reduced, skeletal muscle weight (g/kg) was increased, and the glucose,



HbA1c, TC, TG, and LDL-C levels were improved significantly compared with those of the Sed group. However, BP of the Ex group was significantly higher than that of the Ex & ARB and ARB groups. The heart weight (g/kg) and urinary albumin excretion in the Ex group were significantly higher than those of the Sed group, while the Ex & ARB group showed a non-significant increase in these variables. In addition, BP correlated significantly with heart weight, IMFA, kidney weight, and MA.

**CONCLUSION:** The single treatment with exercise didn't have antihypertensive effects, while it improved MS risk factors such as visceral fat, glucose intolerance, and dyslipidemia. On the other hand, the combination treatment with exercise and ARB could lower elevated BP, improved MS risk factors, and inhibited exercise-induced cardiac hypertrophy and albuminuria in OLETF rats.

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**2388 Board #33 May 29 8:00 AM - 9:30 AM**  
**Relationship Between Regional Adiposity And Risk For Cardiovascular Disease In College Aged Students**

Laura Swan, David Q. Thomas, FACSM, Karen K. Dennis, Ashley Reum, Lindsay Gallovitch. *Illinois State University, Normal, IL.*  
(No relationships reported)

Studies stress the importance of body fat distribution when determining risk for cardiovascular and metabolic diseases, often citing adiposity in the trunk as a main indicator for these health problems. However, risk factors in college aged individuals have not been thoroughly investigated.

**PURPOSE:** To determine the relationship between regional adiposity and risk for cardiovascular disease in college aged students.

**METHODS:** Fifty male and female students (mean age 20.4 years, SD  $\pm 1.19$ ) participated in the study. Institutional Review Board approval was obtained. After each subject completed an informed consent, medical health history, and a cardiac risk evaluation worksheet, physical measurements (height and weight for calculation of BMI, waist and hip circumference for calculation of WHR, as well as both peripheral and truncal skinfolds) were obtained. Each subject also underwent air displacement plethysmography (ADP) testing for assessment of body fat percentage.

**RESULTS:** Descriptive statistics (means and standard deviations) were calculated for all data and Pearson Product-Moment Correlations were used to determine the relationship between regional adiposity and cardiac risk. The entire sample showed a significant correlation between waist circumference ( $r = 0.34$ ) and BMI ( $r = 0.34$ ) with cardiac risk. Men showed a significant correlation between peripheral skinfolds ( $r = 0.47$ ), body fat percentage ( $r = 0.49$ ), and cardiac risk, while women did not show any significant relationships.

**CONCLUSIONS:** There appears to be a significant relationship between cardiac risk and body composition in this population. The strongest relationships were found for the male subjects. No relationship was found between truncal skinfolds and cardiac risk. This may be due to the low relative risk in subjects of this age group. Future research is necessary to explore why body composition was not related to cardiac risk in female subjects and to determine at what age truncal adiposity becomes related to cardiac risk.

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**2389 Board #34 May 29 8:00 AM - 9:30 AM**  
**Obstructive Sleep Apnea Alters Exercise Blood Pressure Responses in Normal Weight Men**

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In adult obstructive sleep apnea (OSA), severity of the disorder generally increases in proportion to the degree of obesity. OSA severity is also correlated to the increase in resting blood pressure and the onset of hypertension. Apneas caused by upper airway collapse lead to repetitive sympathetic activations, arousals, and fragmented sleep. These 'events' appear fundamental to the mechanisms by which OSA independently contributes to development of hypertension (Nieto *et al.* JAMA, 2000). Exaggerated blood pressure during exercise has been shown in some studies to predict future development of hypertension; recent studies have demonstrated exercise responses are altered in the presence of OSA. Since OSA is generally associated with overweight or obese individuals, little is known about exercise blood pressure responses in normal-weight subjects.

**PURPOSE:** To determine whether mild OSA alters exercise systolic and diastolic blood pressure responses in normal-weight young men.

**METHODS:** Eight normal-weight men with mild OSA [apnea-hypnea index (AHI: Mean  $\pm$  SD) =  $8.0 \pm 2.8$  events/hr; body mass index (BMI) =  $21.8 \pm 1.5$  kg/m<sup>2</sup>; age =  $22.1 \pm 2.9$  years] and seventeen control men without OSA (AHI =  $1.9 \pm 1.1$  events/hr; BMI =  $22.4 \pm 1.6$  kg/m<sup>2</sup>; age =  $21.1 \pm 2.1$  years) completed a maximal graded cycle ergometer exercise test (GXT). During the GXT, blood pressure (BP), heart rate (HR), rating of perceived exertion (RPE), respiratory exchange ratio (RER), and oxygen consumption (VO<sub>2</sub>pk) were measured throughout.

**RESULTS:** Age, BMI, resting HR and BP, mean arterial pressure (MAP) were not different between men with and without OSA. During exercise in the OSA group, mean systolic BP was 5 to 11% lower ( $p \leq 0.05$ ) at all intensities, whereas diastolic BP in the OSA group was lower only at submaximal intensities ( $p \leq 0.05$ ). At peak exercise, maximal endpoints for HR, RPE, RER, and VO<sub>2</sub>pk were not different between the groups.

**CONCLUSION:** Normal weight OSA subjects have a unique response to GXT, characterized by blunted BP responses, which are different than the exaggerated BP responses previously reported for overweight adults with OSA. This unexpected result requires further research to understand the mechanistic differences in OSA in the absence of obesity.

*Parts of the research were Supported by a grant from ResMed Corporation, San Diego, CA.*

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**2390 Board #35 May 29 8:00 AM - 9:30 AM**  
**Cross Tolerance Effect Of Endurance Training Against In Vitro Cardiac Mitochondrial Dysfunction In Diabetes**

Antonio Ascensao<sup>1</sup>, Jose A. Lumini<sup>1</sup>, Paulo J. Oliveira<sup>2</sup>, Cláudia V. Pereira<sup>2</sup>, José Magalhães<sup>1</sup>. <sup>1</sup>Faculty of Sport, University of Porto, Porto, Portugal. <sup>2</sup>Centre for Neurosciences and Cell Biology, University of Coimbra, Coimbra, Portugal. (Sponsor: FCT grants SFRH/BPD/4225/2007; SFRH/BD/30906/2006, FACSM)  
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Cardiac dysfunction characterizing diabetes has been associated with mitochondrial impairments. On the other hand, endurance training (ET) provides protection against cardiac mitochondrionopathies.

**PURPOSE:** To analyze the effects of ET on cardiac mitochondrial dysfunction caused by streptozotocin (STZ) treatment, particularly on the susceptibility to mitochondrial permeability transition pore (mPTP) opening.

**METHODS:** Twenty four adult male Wistar rats were randomly divided into sedentary (Sed), sedentary STZ (single dose, 50 mg/kg, i.p.), ET (14 wk treadmill running, 60 min/day, 25m/min) and ET+STZ (TSTZ). After STZ injection (18 wk), isolated heart mitochondria were used for in vitro oxygen consumption and transmembrane potential (D $\Psi$ ) assessment using malate-pyruvate (MP) and succinate plus rotenone (SR). Cyclosporin A (CyA)-sensitive mitochondrial osmotic swelling and Ca<sup>2+</sup> fluxes were also measured to study mPTP opening susceptibility.

**RESULTS:** In sedentary groups, STZ treatment resulted in decreased state 3 ( $165.6 \pm 6.8$  vs  $136.7 \pm 5.7$  natomO/min/mg;  $p < 0.05$ ), respiratory control ratio ( $9.9 \pm 0.4$  vs  $4.9 \pm 0.3$ ;  $p < 0.05$ ), CCCP-induced uncoupled respiration ( $394.4 \pm 7.1$  vs  $277.8 \pm 6.3$  natomO/min/mg;  $p < 0.05$ ), oligomycin-inhibited respiration ( $115.8 \pm 6.6$  vs  $74.9 \pm 7.8$  natomO/min/mg;  $p < 0.05$ ) and increased state 4 ( $16.7 \pm 0.6$  vs  $27.3 \pm 2.5$  natomO/min/mg;  $p < 0.05$ ), D $\Psi$  with endogenous substrates ( $185.9 \pm 2.9$  vs  $194.9 \pm 1.4$  mV;  $p < 0.05$ ) and lag phase ( $70.0 \pm 2.1$  vs  $112.0 \pm 2.1$  s;  $p < 0.05$ ) (MP). It decreased both state 3 ( $394.3 \pm 7.1$  vs  $276.7 \pm 7.9$ ;  $p < 0.05$ ) and state 4 ( $117.0 \pm 4.0$  vs  $75.4 \pm 3.9$ ;  $p < 0.05$ ) with SR. STZ treatment decreased CyA-sensitive Ca<sup>2+</sup> uptake ( $250.8 \pm 4.8$  vs  $220.8 \pm 1.4$  nmol/mg;  $p < 0.05$ ) and release ( $64.8 \pm 7.0$  vs  $47.9 \pm 3.4$ ;  $p < 0.05$ ), despite the increased swelling amplitude ( $3.5 \text{E}6 \pm 1.9 \text{E}5$  vs  $4.1 \text{E}6 \pm 3.7 \text{E}4$  AU;  $p < 0.05$ ) in sedentary groups. The respiratory and D $\Psi$  parameters impaired by STZ treatment were reverted by ET (STZ vs TSTZ). ET increased



mitochondrial Ca<sup>2+</sup> uptake (220,8±1.4 vs 273,1±3.7; p<0,05) and decreased Ca<sup>2+</sup> release (47,9±3.4 vs 30,1±2.1; p<0,05) in diabetic animals.

**CONCLUSION:** ET reverted the impaired heart mitochondrial respiratory function caused by STZ and decreased the susceptibility to mtPTP opening.

FCT grants SFRH/BPD/4225/2007; SFRH/BD/30906/2006.

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**2391 Board #36 May 29 8:00 AM - 9:30 AM**

**Effects Of Exercise Training On Arterial Stiffness And Vasoactive Hormonal Levels Of Normotensive Young Women At High Familial Risk Of Hypertension**

Emmanuel G. Ciolac, Edimar A. Bocchi, Luiz A. Bortolotto, Júlia M. Greve, Guilherme V. Guimarães. *University of São Paulo, Medical School, Sao Paulo, Brazil.*

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(No relationships reported)

**BACKGROUND:** Offspring of essential hypertensive parents (OHT) are at high risk of future hypertension and subsequent cardiovascular diseases. Whether alterations on arterial stiffness and vasoactive hormonal levels precede the increase in blood pressure (BP) is not well established. Moreover, there is little information about the effects of exercise training (ET) in OHT.

**PURPOSE:** To evaluate arterial stiffness and vasoactive hormonal levels in normotensive women OHT, as well as the effects of ET on these variables.

**METHODS:** First, we studied 44 healthy sedentary young women aged 19 to 30 years: 15 had two hypertensive parents (OHT<sub>2</sub>), 17 had one hypertensive parent (OHT<sub>1</sub>), and 12 had no hypertensive parents (ONT). Ambulatory BP monitoring (ABPM), arterial stiffness (carotid-femoral pulse wave velocity [PWV]), and nor-epinephrine (NE) and epinephrine (EPI) levels at rest, immediately after (exercise) and ten minutes after (recovery) a graded exercise test were evaluated. Second, the OHT women were randomly assigned to ET (OHT<sub>ex</sub>; 40 minutes walking or running at 70% of VO<sub>2PEAK</sub> three times-a-week) or control (OHT<sub>con</sub>) group, and had their ABPM, PWV, NE and EPI levels analyzed after 16 weeks of follow-up.

**RESULTS:** ABPM was not different between groups at baseline. However, PWV was 7.2% and 11.7% higher in OHT<sub>2</sub> than OHT<sub>1</sub> and ONT, respectively (p ≤ 0.01). Rest, exercise and recovery NE were 37.9% to 47.9% higher in OHT<sub>2</sub> than ONT (p ≤ 0.003), while rest and recovery NE were 36% and 26.5% higher in OHT<sub>1</sub> than ONT (p ≤ 0.047). Exercise EPI were also higher in OHT<sub>2</sub> than ONT (p ≤ 0.047), and recovery EPI were higher in OHT<sub>2</sub> than OHT<sub>1</sub> and ONT (p ≤ 0.01), respectively. On the other hand, ET reduced PWV (p = 0.01) and basal NE (p = 0.003) in OHT<sub>ex</sub> to levels similar to those of ONT. OHT<sub>ex</sub> also showed tendency toward reduction (p = 0.06) in exercise NE after exercise training. PWV, NE and EPI did not change in OHT<sub>con</sub> after follow-up.

**CONCLUSIONS:** Arterial stiffness and vasoactive hormonal levels were increased in normotensive women offspring of hypertensive parents, but were reduced by exercise training to levels similar to those of women without familial history of hypertension. These results suggest that exercise training may have a potential role in the management of an inherited hypertensive disorder.

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**2392 Board #37 May 29 8:00 AM - 9:30 AM**

**Decreasing Superoxide Within The Nucleus Tractus Solitarius Partially Corrects Skeletal Muscle Mechanoreflex Overactivity In Hypertension**

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(No relationships reported)

In hypertension, the blood pressure (BP) response to exercise is abnormally elevated. We have previously demonstrated that overactivity of the skeletal muscle mechanoreflex (MMR) plays a significant role in generating this exaggerated BP response to exercise. Yet the mechanisms underlying MMR overactivity remain unknown. Sensory information elicited by activation of the MMR is processed within the nucleus tractus solitarius (NTS) of the medulla oblongata. In normotensive rats, nitric oxide (NO) within the NTS is known to buffer MMR function. Recent evidence suggests the production of reactive oxygen species in the NTS, specifically superoxide (a NO scavenger), is increased in hypertension. Therefore, augmentations in superoxide production could reduce the NO available for biological activity. This may reduce the buffering capacity of NO in hypertension resulting in MMR overactivity.

**PURPOSE:** To determine the effects of endogenously produced superoxide on MMR activity in male normotensive Wistar-Kyoto (WKY; n=4) and Spontaneously Hypertensive (SHR; n=5) rats.

**METHODS:** The MMR was selectively activated by passively stretching hindlimb skeletal muscle before and after the microdialysis of the superoxide dismutase mimetic, tempol (30 μM) in the NTS. Superoxide dismutase is the endogenous enzyme responsible for the breakdown of superoxide.

**RESULTS:** Activation of the MMR by stretch resulted in significantly larger increases in mean BP in SHR (58±5 mmHg) than WKY (22±3 mmHg). In both groups, dialysis of tempol reduced the BP response to stretch. Interestingly, the magnitude of the tempol-induced decrease in BP in response to MMR activation was larger in SHR (-24±6 mmHg) compared to WKY (-7±4 mmHg). Despite this larger effect, the stretch-induced augmentation in BP in SHR treated with tempol was greater than the BP increase elicited by stretch in untreated WKY.

**CONCLUSIONS:** The results demonstrate that endogenously produced superoxide modulates MMR activity in both WKY and SHR animals. Further, the findings suggest that decreasing superoxide within the NTS can partially correct the exaggerated BP response to activation of the MMR in SHR. As such, the data are consistent with the concept that increases in superoxide production within the NTS contribute to MMR dysfunction in hypertension.

Supported by HL-088422

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**2393 Board #38 May 29 8:00 AM - 9:30 AM**

**Phase I Cardiac Rehabilitation, Physical Activity Levels And Exercise Capacity In Coronary Artery Disease Patients**

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(No relationships reported)

Previous studies have determined the amount of physical activity (PA) in patients with coronary artery disease (CAD) enrolled in phase II/III cardiac rehabilitation programs (CRP). However, it must be highlighted that the number of patients that reach the phase II/III of CRP is smaller than the potential candidates, since a minority of eligible patients actually enrol CRP. In this sense, the information given in phase I in-hospital CRP is paramount to the adoption of an active lifestyle. Additionally, a positive relationship between daily PA and exercise capacity is established in healthy adults. To date, no studies exist in CAD patients, where direct measurements of VO<sub>2</sub> and accelerometers have been used to study the relationship between exercise capacity and daily PA.

**PURPOSE:** To analyze the habitual PA levels of CAD patients after a phase I CRP and its relation to exercise capacity.

**METHODS:** Forty-three consecutive, sedentary, patients (36 male; age: 54.5 ± 11.1 yrs; weight: 79.6 ± 15.6 kg; height: 168 ± 8.0 cm; BMI: 28.2 ± 4.9 kg/m<sup>2</sup>) with recent history of first myocardial infarction (65% percutaneous coronary intervention) were recruited. Assessment included cardiopulmonary graded exercise testing and PA measured

objectively during seven consecutive days by accelerometry. During hospitalization patients received counseling concerning the deleterious effects of cardiovascular risk factors on health and strategies for their management. All the assessment procedures were conducted six weeks after hospital discharge (none of the patients was enrolled in a phase II CRP at that time).

**RESULTS:** The average daily amount of light, moderate, and vigorous PA was, respectively,  $595.8 \pm 114.6$  min,  $38.7 \pm 29.7$  min, and  $0.73 \pm 2.3$  min. The number of 10-minute bouts of moderate-intensity PA was  $0.75 \pm 0.90$ . Mean peak oxygen uptake was  $31.9 \pm 7.4$  mL/min/kg and exercise time averaged  $9.26 \pm 2.23$  min. Only PA of moderate-intensity was significantly related to peak oxygen uptake ( $r = 0.348$ ,  $p = 0.02$ ) and exercise time ( $r = 0.359$ ,  $p = 0.01$ ).

**CONCLUSIONS:** The information provided in a phase I CRP led patients to perform enough moderate-intensity PA to meet health-related recommendations. Importantly, exercise capacity was only related to PA of moderate-intensity. Thus, emphasis should be given to the improvement of moderate intensity PA.

**2394 Board #39 May 29 8:00 AM - 9:30 AM**

**Effects Of Training On Blood NT-proBNP In Cardiac Patients Classified According To Ejection Fraction**

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(No relationships reported)

Blood N-terminal pro-brain natriuretic peptide (NT-proBNP), a known marker for heart failure, is released from ventricles in response to stretch of cardiomyocytes.

**PURPOSE:** Cardiac patients (68 women, 296 men, aged  $63 \pm 11$  yr) were categorized by echo-derived ejection fraction (EF) into 4 groups (EF >55%, 45 - 55%, 30 - 44%, <30%), then studied for changes in NT-proBNP and training effects before and after  $25 \pm 4$  days of residential cardiac rehabilitation.

**METHODS:** Exercise training consisted of 6 x wk cycle ergometry for 14 - 22 min (mean  $17 \pm 4$  min), and daily walking for 45 min at 60 - 70% maximal heart rate (HRmax). Nutrition, diet, and pharmacologic prescriptions were initiated when indicated.

**RESULTS:** see table.

EF (%)	Rehab Status	NT-proBNP (pg.mL <sup>-1</sup> )	VO2max (mL.min <sup>-1</sup> )	Rest HR (bpm)
>55%	Before	726±996	1870±557	73±14
	After	470±569*	2083±567*	66±13*
45-55%	Before	796±768	1815±549	73±13
	After	573±511*	2059±585*	69±11*
30-44%	Before	1607±1882	1872±523	75±14
	After	1278±1140*	1984±517*	73±13
<30%	Before	2761±2098	1651±503	80±16
	After	1574±1138*	1930±569*	74±15*

Table . \* indicates  $p < 0.05$  for difference from before cardiac rehab

In addition to changes with training, NT-proBNP was significantly greater before rehab training in patients with EF <30% and EF 30-44% than those with higher EF. This remained true after training in spite of significant NT-proBNP reductions in all EF groups.

**CONCLUSIONS:** These significant findings in only 25 days suggest a relatively powerful effect of short-term exercise training to improve myocardial function in cardiac patients regardless of initial EF, and to at least partially ameliorate the symptoms of ventricular systolic and diastolic insufficiency.

Partial support: Sydney and J.L. Huffines Institute for Sports Medicine and Human Performance

**2395 Board #40 May 29 8:00 AM - 9:30 AM**

**The Impact Of Exercise Training On Oxidative Stress In Spinal Cord-injured Individuals**

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Spinal cord-injured (SCI) individuals have a high prevalence of morbidity and mortality due to cardiovascular diseases, which is unlikely explained by traditional CVD risk factors. Recent studies suggest that an imbalance in (anti)oxidative status is associated with an increased cardiovascular risk. However, little is known about the (anti)oxidative balance in SCI.

**PURPOSE:** To compare baseline levels of oxidative stress and antioxidative capacity in SCI individuals and able-bodied (AB) subjects, and to assess acute and long-term effects of functional electrical stimulation (FES) exercise on oxidative stress and antioxidative capacity in SCI individuals.

**METHODS:** Venous blood was taken from SCI ( $n=9$ ;  $41 \pm 9$  years) and age-matched AB subjects ( $n=9$ ;  $42 \pm 10$  years) to examine oxidative stress through malondialdehyde (MDA) levels, while superoxide dismutase (SOD) and glutathione peroxidase (GPx) enzyme levels represented anti-oxidative capacity. Subsequently, SCI subjects performed an 8 week FES exercise training period. Blood was taken after the first and last FES exercise session to examine the acute effect of FES exercise. Baseline blood samples before the last FES exercise session were used to assess the chronic effect of FES exercise.

**RESULTS:** Baseline levels of MDA, SOD and GPx were not different between SCI and AB subjects. Both, a single bout of FES exercise and 8 weeks of FES exercise training, had no effect on MDA, SOD and GPx levels.

**CONCLUSIONS:** The preserved (anti)oxidative status in SCI suggests that the increased prevalence for CVD in SCI is unlikely explained by (anti)oxidative imbalance. In contrast with previous studies in AB, we found no changes in (anti)oxidative status after acute and long-term FES exercise in SCI. Possibly, the stimulus induced by FES exercise is insufficient to change (anti)oxidative status in SCI individuals.

**2396 Board #41 May 29 8:00 AM - 9:30 AM**

**No Acute Exercise Effect On Inflammatory And Oxidative Stress Markers In Lean And Obese Children.**

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(No relationships reported)

Elevated biomarkers of inflammation and oxidative stress are associated with increased relative risk of cardiovascular disease in adults. The impact of obesity, diet, and acute exercise on these markers in young children are unknown.

**PURPOSE:** To determine the effect of obesity and/or acute exercise (EX) on fasting and post-meal inflammatory and oxidative stress markers in pre- and early-pubertal children.

**METHODS:** We studied the effects of a high-fat test meal on inflammatory markers (CRP, IL-6, TNF $\alpha$ ) and oxidized LDL (ox-LDL) in 23 children (Tanner 1-3, 10 $\pm$ 2yrs, 11 lean/12 obese, 11M/12F) during 2 separate study days of rest (RST) or EX (random order) each preceded by 3 days of diet/exercise control. The afternoon prior to the study day (5pm) subjects rode a cycle ergometer (25 min @ 65% max HR) or rested for the same time period. The following morning (7:30am) a milkshake test meal (50% fat, 20% protein and 30% carbohydrate) was consumed. Subjects remained resting during the study day. Blood was drawn before and after the EX bout, and before and 3 times after the test meal (6 samples EX, 5 samples RST). Main effects of group, condition, and group x condition were tested by repeated measures ANOVA; alpha set at  $p < 0.05$ .

**RESULTS:** As expected, obese were heavier ( $p < 0.0001$ ) with higher fat mass ( $p < 0.0001$ ) than lean. Fasting CRP ( $1.12 \pm 0.84$  vs  $0.13 \pm 0.11$  mg/L,  $p < 0.01$ ), IL-6 ( $97 \pm 81$  vs  $40 \pm 39$  pg/ml,  $p < 0.05$ ) and ox-LDL ( $54 \pm 12$  vs  $40 \pm 12$  U/L,  $p < 0.05$ ) were greater in obese than lean, but fasting or post-meal TNF $\alpha$  did not differ by group. EX had no effect on pre- or post-meal levels of these biomarkers, nor did the test meal change concentrations from fasted values.

**CONCLUSIONS:** Obese had greater fasting CRP, IL-6 and ox-LDL than lean children. Neither EX nor a high-fat meal changed these markers in lean or obese children. The lack of change in these markers in response to the meal suggests that acute consumption of high dietary fat does not increase these markers above levels seen due to obesity alone, and that increased levels of inflammation and oxidative stress are related to chronic obesity. These data have important chronic health implications for children with elevated adiposity, and suggest that long-term behavior modification strategies are necessary for reversal of this detrimental condition.

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## E-28 Free Communication/Poster - Dietary Analysis

MAY 29, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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**2397 Board #42 May 29 8:00 AM - 9:30 AM**  
**Dairy Intake And Cardiorespiratory Fitness Influence C-reactive Protein Levels In Young, Healthy, Non-obese Individuals**  
Mary P. Miles, FACSM<sup>1</sup>, Brinley Geiger<sup>2</sup>, Katherine Bodenber<sup>2</sup>, Eileen Spellman<sup>2</sup>, Laura Duceman<sup>2</sup>, Theodore Ferran<sup>2</sup>, Eric S. Rawson, FACSM<sup>2</sup>.  
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Research is needed to clarify the meaning of CRP concentrations in healthy, younger, non-obese individuals.

**PURPOSE:** To determine whether anthropometric characteristics, physical activity, cardiorespiratory fitness, diet, and variables related to metabolic syndrome (e.g. blood lipids, glucose, insulin, inflammation markers) differ across CRP tertile groups in healthy, young, non-obese adults.

**METHODS:** This was a cross-sectional study in which 42 non-obese men and women (18-27 y) were assessed using a VO<sub>2</sub>max test for cardiorespiratory fitness, bio-impedance analysis (BC-418 8 contact electrode) for total and regional body composition, ActiGraph accelerometry for 7 days physical activity assessment, a 110 item Block 2005 Food Frequency Questionnaire (FFQ) for dietary intake patterns, two fasting blood draws for analysis of CRP, blood lipids, interleukin-6 (IL-6), soluble tumor necrosis factor receptor-1 (sTNFR1), glucose, insulin, and homeostatic model assessment (HOMA) for estimation of insulin resistance and beta-cell function.

**RESULTS:** CRP concentrations ranged from 0.150-0.304, 0.324-1.115, and 1.127-11.836 mg·dl<sup>-1</sup> for Low, Average, and High CRP tertiles, respectively. The groups had similar proportions of men and women, anthropometric characteristics, blood lipids, IL-6, sTNFR1, physical activity, and HOMA variables (even though blood glucose was higher in the Low compared to High group). VO<sub>2</sub>max was higher in the Average compared to the High CRP group. Similarly, estimates from the FFQ were indicative of a higher quality diet, primarily in the form of increased dairy consumption, in the Average ( $2.7 \pm 1.5$  servings/day) compared to the High CRP ( $1.2 \pm 0.4$  servings/day) groups. Consistent with the higher intake of dairy was a higher ( $P < 0.05$ ) intake of calcium, retinol, Vitamins A and D, and a lower overall glycemic index in the Average compared to High CRP group.

**CONCLUSIONS:** Higher dairy consumption and cardiorespiratory fitness were the variables differentiating young, healthy non-obese individuals between Average and High CRP tertiles. Anti-inflammatory effects of increased dairy consumption have been identified in previous research.

Supported by grants from the Bloomsburg University Foundation and the Pacific Mountain Affiliate of the American Heart Association.

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**2398 Board #43 May 29 8:00 AM - 9:30 AM**  
**Carbohydrate And Protein Intake Before, During, And After Exercise: Are Active Women Following Current Recommendations?**  
Lynn A. Cialdella-Kam, Katherine Lewis, Melinda M. Manore, FACSM, Lanae M. Joubert. *Oregon State University, Corvallis, OR.*  
(No relationships reported)

Optimal intakes of Carbohydrate (CHO) and Protein (PRO) prior, during, and after exercise can yield improved exercise performance, recovery from exercise, and adaptations to training. Recommendations for active individuals have been developed based on research examining the relationship between dietary intake and exercise. To our knowledge, only one study has examined whether active women follow these recommendations.

**PURPOSE:** To determine if CHO and PRO intake in active women before, during, and after exercise meet current recommendations.

**METHODS:** Secondary analysis data analysis was performed on young, aerobically trained women ( $n=17$ , age =  $26 \pm 4$ y,  $>420$  min·wk<sup>-1</sup> of exercise), who participated in a study examining the relationship between physical activity (PA) and blood homocysteine levels. PA was assessed using 7-d PA records. CHO and PRO intake were assessed using 7-d weighed food records. Unpaired t-tests ( $\alpha=0.05$ ) were used to determine if mean CHO and PRO intakes (g·kg<sup>-1</sup> or total g·d<sup>-1</sup>), timing (min before/after exercise), and frequency (number of meals after exercise) were different from recommendations.

**RESULTS:** It is recommended that active individuals consume 150-300g of CHO in the 2-4h prior to exercise and 60g·h<sup>-1</sup> of CHO during exercise bouts  $>1$ h. Results showed that 74% of the time women consumed a pre-exercise meal before exercise. When food was consumed prior to exercise, the mean CHO intake was 74g, which is less than current recommendations ( $p < 0.0001$ ). The mean duration of the exercise bouts was 70 min, with 38% lasting  $>1$ h. Only 19% of the women who exercised  $>1$ h consumed CHO during exercise (mean CHO intake = 51g). Post-exercise recommendations for active individuals are to consume 1.0-1.2 g·kg<sup>-1</sup>·h<sup>-1</sup> of CHO and 0.3-0.4 g·kg<sup>-1</sup>·h<sup>-1</sup> of PRO every 30-60 min after exercise for 5h. 91% of the time, the women consumed at least one meal after exercise (1.6 post-exercise meals). However, the first meal was not consumed until 81 min after completion of exercise. The mean CHO intake was also below recommendations (0.45 g·kg<sup>-1</sup>·h<sup>-1</sup> of CHO,  $p=0.0009$ ) but PRO intake was not significantly lower (0.14 g·kg<sup>-1</sup>·h<sup>-1</sup> of PRO,  $p=0.21$ ).

**CONCLUSION:** Although recommendations for CHO and PRO intake before, during, and after exercise have been published, the active women in this study did not adhere to current

**2399 Board #44 May 29 8:00 AM - 9:30 AM**

**Nutrition Status And Diets Of Children In Calanga, A Rural Locality In Mozambique**

Carole A. Conn, FACSM<sup>1</sup>, Antonio Prista<sup>2</sup>, Carina Ismael<sup>3</sup>, Leonardo Nhantumbo<sup>2</sup>, Silvio Saranga<sup>2</sup>, Jose Maia<sup>4</sup>, Gaston Beunen<sup>5</sup>. <sup>1</sup>University of New Mexico, Albuquerque, NM. <sup>2</sup>Universidade Pedagógica, Maputo, Mozambique. <sup>3</sup>Helen Keller International, Maputo, Mozambique. <sup>4</sup>University of Porto, Porto, Portugal. <sup>5</sup>KU Leuven, Leuven, Belgium.

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Mozambique is a southeastern African nation in the beginning stages of major socioeconomic changes which will result in changes in infrastructure and in diet and exercise patterns that will alter the disease profile of the nation from predominantly infectious diseases and nutrition-related health problems associated with poverty, such as stunting, to nutrition-related chronic diseases and health problems that arise as abject poverty abates, such as obesity and diabetes. It is of interest to determine to what extent the better economic climate in Mozambique during the last decade may have altered the foods available to rural children of Calanga and/or affected their nutrition status.

**PURPOSE:** To describe the quality of foods consumed by rural children in Mozambique in relation to their nutrition status.

**METHODS:** A descriptive, cross-sectional study of children in a rural farming region on the southeast coast of Mozambique lacking adequate access to roads, electricity, health services, sanitation and water was completed. Dietary information for 271 children was evaluated using the Mozambican Diet Assessment Tool (MDAT). Children, ages 5 to 18 y, were measured for height and weight to calculate nutrition status according to international norms.

**RESULTS:** Data demonstrated a high prevalence of stunting: more than one-fourth of both boys and girls. Only 4 children were classified as overweight. Food records showed that 49% of diets were of low or very low quality as estimated by the MDAT index. Children classified as wasted with low weight-for-height, were more likely to have reported diets of low or very low quality ( $p=0.05$ ). Diet quality improved if the child had consumed lunch at school.

**CONCLUSIONS:** Low quality diets may be a major factor underlying the poor nutrition status of the children of Calanga.

Supported by funds from the World Bank Quick Impact Fund through the Higher Education -I Project of the Ministry of Science and Technology.

**2400 Board #45 May 29 8:00 AM - 9:30 AM**

**Determination Of The Glycemic Index Of Selected Chinese Traditional Foods Using Different Glucose Analyzers**

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(No relationships reported)

**PURPOSE:** To determine the glycemic index (GI) of 4 Chinese traditional foods and compare the agreement between portable glucose monitoring system (PoG) and the YSI glucose analyzer in determining the GI of the test foods.

**METHODS:** Thirteen healthy adults (8 males and 5 females, age:  $26.0 \pm 1.3$  y, BMI:  $21.5 \pm 0.6$  kg·m<sup>-2</sup>) volunteered to participate the experiment. All subjects were required to refrain from alcohol consumption and vigorous physical activities 24h before test. After 10-14h overnight fast, the subjects consumed either reference (50g anhydrous glucose) or test foods containing 50g of available carbohydrate. The food included baked barbecued pork puff (BBPP), fried rice in Yangzhou-style (FRYS), fried fritter (FF), and "Mai-lai" cake (MLC). The finger-prick blood samples were collected immediately before, 15, 30, 45, 60, 90, and 120min after food consumption, and were analyzed with portable glucometer (Glucometer Elite, Bayer Diagnostics, Japan) and YSI glucose analyzer (YSI 1500, USA). The GI was calculated by expressing the incremental area under the blood glucose response curve (IAUC) for each test food as a percentage of each subject's average IAUC for the glucose.

**RESULTS:** The mean glucose concentrations measured by PoG were higher than that measured by YSI ( $5.58 \pm 0.05$  vs.  $5.39 \pm 0.05$  mmol·L<sup>-1</sup>,  $P<0.01$ ). However, there were no differences in average IAUC ( $136.3 \pm 8.3$  vs.  $135.8 \pm 7.7$  mmol·min·L<sup>-1</sup>) and GI ( $62.7 \pm 4.6$  vs.  $68.8 \pm 4.6$ ) between PoG and YSI. There were no differences in the mean within-subject CV for the 13 subjects between IAUC<sub>YSI</sub> and IAUC<sub>PoG</sub> ( $47.3 \pm 6.5$  vs.  $47.9 \pm 3.2$  %), GI<sub>YSI</sub> and GI<sub>PoG</sub> ( $47.9 \pm 7.4$  vs.  $52.8 \pm 3.1$  %). Bland-Altman plots showed that the 95% limits of agreement for IAUC was -74.6 to 73.6 mmol·min·L<sup>-1</sup>, and for GI values was -45 to 57. No differences were observed in the mean GI values of the 4 food items determined by YSI and PoG (BBPP:  $57 \pm 7$  vs.  $54 \pm 8$ ; FRYS:  $79 \pm 7$  vs.  $73 \pm 9$ ; FF:  $74 \pm 9$  vs.  $69 \pm 11$ ; MLC:  $66 \pm 12$  vs.  $54 \pm 9$ ).

**CONCLUSIONS:** The PoG and YSI glucose analyzer produced similar results in determining the GI of 4 Chinese traditional foods.

**2401 Board #46 May 29 8:00 AM - 9:30 AM**

**Assessment Of Dietary Intake In Elite Ethiopian Distance Runners**

Lukas Y. Beis<sup>1</sup>, Lena Willkomm<sup>1</sup>, Ramzy Ross<sup>1</sup>, Zeru Bekele<sup>2</sup>, Bezabhe Wolde<sup>2</sup>, Yannis P. Pitsiladis<sup>1</sup>. <sup>1</sup>University of Glasgow, Glasgow, United Kingdom. <sup>2</sup>Addis Ababa University, Addis Ababa, Ethiopia.

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(No relationships reported)

Explanations for the astonishing success of Kenyan and Ethiopian distance runners include unique dietary intake. Previous studies found the diet of elite Kenyan endurance runners met most recommendations for endurance athletes for macronutrient intake but not for fluid intake (e.g. Onywera et al. Int J Sports Nutr 14: 709-719, 2004).

**PURPOSE:** The aim of the present study was to assess the food and macronutrient intake of elite Ethiopian long-distance runners during a period of intense training at altitude and prior to major competition.

**METHODS:** The dietary intake of 10 (8 male, 2 female) highly-trained Ethiopian long distance runners, living and training at high altitude (~2400 m above sea level) was assessed during a 7 day period of intense training prior to competition using the standard weighed intake method. Training was also assessed using an activity/training diary.

**RESULTS:** Body mass was well maintained over the assessment period (pre:  $56.7 \pm 4.3$  kg vs. post:  $56.6 \pm 4.2$  kg,  $P = 0.54$ ; mean  $\pm$  standard deviation). The diet comprised of  $3194 \pm 329$  kcal and was high in carbohydrate ( $64.3 \pm 2.4\%$ ,  $545 \pm 49$  g,  $9.7 \pm 0.9$  g/kg); fat and protein intake was  $23.3 \pm 2.1\%$  ( $83 \pm 14$  g) and  $12.4 \pm 0.6\%$  ( $99 \pm 13$  g,  $1.8 \pm 0.2$  g/kg), respectively. The diet consisted mainly of vegetable sources (~88%) with the remaining small contribution from meat sources. Fluid intake comprised mainly of water ( $1751 \pm 583$  ml,  $0.54 \pm 0.15$  ml/kcal), while no fluids were consumed before or during training with only modest amounts following training.

**CONCLUSION:** As previously found in elite Kenyan endurance runners, elite Ethiopian runners met dietary recommendations for endurance athletes for macronutrient intake but not for fluid intake.

**2402 Board #47 May 29 8:00 AM - 9:30 AM**

**Dietary Intake And Metabolic Markers In Athletes With Spinal Cord Injury Compared With Sedentary Non-disabled**

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(No relationships reported)



Although well studied in many populations, data on dietary habits of people with spinal cord injury (SCI), especially athletes, and the relation to metabolic markers compared to the able-bodied (AB) population is lacking.

**PURPOSE:** To assess nutrient intake and associations between metabolic markers in SCI athletes compared with sedentary AB controls.

**METHODS:** Paraplegic athletes (n = 14, 7 women; duration of injury 16.5±5.7 yrs, injury level T5-L5) were compared with 16 sedentary, age- and BMI-matched AB (8 women) controls. Fasting lipids, insulin (INS) and glucose (GLU) were assessed via 2-h oral glucose challenge with area under the curve (AUC) and HOMA calculated. Dietary intake was obtained from 3-day food diaries. Body composition was assessed with DXA.

**RESULTS:** Metabolic markers and nutrient intakes did not differ between SCI and AB. Trunk fat mass was lower in SCI than in AB (5.7±1.6kg, 7.7±2.0kg; p<0.01). In SCI, dietary fat intake (% of energy) was related (all p<0.05) to INS-AUC (r=0.58), total cholesterol (r=0.59), LDL (r=0.96) and HDL (r=0.56). Fiber intake was related to fasting INS (r=0.75) and HOMA (r=0.72). After controlling for trunk fat, % dietary fat remained related to LDL (r=0.56) and fiber remained related to fasting INS (r=0.86) and HOMA (r=0.83). In AB, daily energy intake was related to fasting GLU (r=0.50). Protein intake (% of energy) was related to GLU-AUC (r=0.63), INS-AUC (r=0.62), and HDL (r=0.49). Carbohydrate intake (grams) was related to fasting GLU (r=0.56), and GLU-AUC (r=0.46). Fiber was related to HOMA (r=0.49); and saturated fat to HOMA (r=0.51). After controlling for trunk fat in AB, energy intake remained associated with fasting GLU (r=0.48), % protein intake with GLU- and INS-AUC (r=0.59, 0.56), and carbohydrate intake (grams) with fasting GLU (r=0.58).

**CONCLUSIONS:** Despite greatly differing physical activity levels, dietary intake was similar in SCI athletes and sedentary AB controls; however, associations between nutrients and metabolic markers differed between SCI and AB such that dietary fat intake appears to negatively and fiber favorably impact SCI compared to AB. Conversely, protein and carbohydrate intake had greater implications for AB metabolic profiles. Trunk fat mass appeared to explain most correlations between markers and nutrients in SCI, but not in AB.

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**2403      Board #48      May 29      8:00 AM - 9:30 AM**  
**Nutritional Strategies Of Ncaa Division Iii Female Volleyball Players: Pre-season V. In-season**

Lana Brand, Whitney Sparby, Kelley Holmes, Lindsey Quale, Mark Blegen, FACSM. *College of St. Catherine, St. Paul, MN.*  
(No relationships reported)

Appropriate nutritional strategies play an important role in the success of all athletes. By consuming adequate and appropriate amounts of kilocalories (kcal), macronutrients, and micronutrients, athletes placing themselves in a position to positively influence body composition, glycogen storage, and recovery. However, due to varying demands placed on today's collegiate athletes, athletes may not be engaging in proper nutritional strategies throughout the year.

**PURPOSE:** The purpose of this study was to determine if there was a difference between pre-season and in-season nutrition among NCAA Division III female volleyball players.

**METHODS:** Ten (N = 10) NCAA Division III female volleyball players participated in this study. Subjects recorded their diets for three days (both pre-season and in-season) after receiving instruction from certified personnel. The three day diet records were analyzed for kcal, macronutrient, and micronutrient consumption.

**RESULTS:** Dependent samples t-tests identified no significant differences (p <0.05) between pre-season and in-season nutrition in terms of kcals consumed (2231 ± 1097 vs. 2275 ± 445 kcal), carbohydrates (286 ± 45 vs. 319 ± 88 grams), fat (61 ± 23 vs. 71 ± 15 grams), or protein (72 ± 23 vs. 74 ± 15 grams). Also, there were no significant differences identified among micronutrients.

**CONCLUSION:** The results of this study show that nutritional strategies among NCAA Division III female volleyball players do not differ when comparing pre-season to in-season. These results indicate that the various physiological demands placed on these athletes do not alter nutritional strategy.

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**2404      Board #49      May 29      8:00 AM - 9:30 AM**  
**Pre-season Nutritional Status Of Ncaa Division Iii Female Volleyball Players**

Whitney Sparby, Lana Brand, Kelley Holmes, Lindsey Quale, Mark Blegen, FACSM. *College of St. Catherine, St. Paul, MN.*  
(No relationships reported)

Proper consumption of macro- and micronutrients, along with adequate amounts of energy (kilocalories) are essential for athletic performance. Pre-season training, typically time intensive and physiologically demanding further emphasize the need for proper nutritional strategies.

**PURPOSE:** The purpose of this study was to investigate the pre-season macro- and micro-nutrient consumption patterns of NCAA Division III female volleyball players who attend an all female institution.

**METHODS:** Ten (N=10) NCAA Division III female volleyball players participated in this study. Subjects completed a three day diet record after receiving instructions from certified personnel.

**RESULTS:** Energy intake (kcal) fell within the recommended values for athletes (2443.2 ± 966.8 kcal). Vitamin C intake (106.8 ± 66 mg) represented 142% of Recommended Daily Intake (RDI), while vitamin E (7.9 ± 4 mg) and potassium (2.6 ± 0.971 g) represented 52% and 57% of RDI, respectively. Sodium intake was 222% of RDI (3323.3 ± 1229 mg).

**CONCLUSION:** The nutritional status of NCAA Division III female volleyball players in this study demonstrates both over- and under-consumption of micronutrients. Left unabated these consumption patterns could possibly lead to dietary induced deficiencies thus impacting performance.

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**2405      Board #50      May 29      8:00 AM - 9:30 AM**  
**Pre-season Nutritional Status Of Ncaa Division Iii Female Swimmers**

Kelley Holmes, Lindsey Quale, Lana Brand, Whitney Sparby, Mark Blegen, FACSM. *College of St. Catherine, St. Paul, MN.*  
(No relationships reported)

Adequate amounts of kilocalories (kcal), macronutrients, and micronutrients in the diet are important for athletic success. However, the demands of schoolwork and outside activities may cause stress and could lead athletes to consume an insufficient amount of both kcals and nutrients. If an athlete does not consume the appropriate amount of both kcals and nutrients it may negatively impact their athletic performance.

**PURPOSE:** This study was designed to determine if NCAA Division III female swimmers were adequately meeting the Daily Recommended Intakes (DRI) Guidelines.

**METHODS:** Fifteen (N=15) female NCAA Division III swimmers completed three day diet records. The records were analyzed for kcal, macronutrient, and micronutrient consumption.

**RESULTS:** Total energy intake was 2346.6 ± 425.8 kcal, representing 92% of the DRI. Carbohydrate consumption was 316.8 ± 43.2 g, representing 110% of the current DRI. Similarly, the consumption for protein was 94.2 ± 28.0 g (144% of DRI) while fat consumption was 78.4 ± 28.7 g (135% of DRI). Vitamin D consumption was 4.54 ± 3.18 µg and vitamin E consumption was 6.20 ± 3.61 mg, representing 91% and 41% of the DRI, respectively.

**CONCLUSION:** The results of this study show that NCAA Division III female swimmers are deficient in specific micronutrients while consuming too much fat and protein. These dietary practices, followed habitually, could lead to decrements in performance. Appropriate nutritional strategies should be incorporated in pre-season training to maximize swimming performance.

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**2406      Board #51      May 29      8:00 AM - 9:30 AM**  
**The Relationship Between Reported Dietary Intake And Time Spent In Sedentary Behaviors.**



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(No relationships reported)

The protective effects of regular physical activity on the human body have been well-documented. Unfortunately, our society has moved toward a more sedentary lifestyle. Physical inactivity (time spent sitting, watching television, working at the computer, and playing computer games) and physical activity may both be independently associated with obesity and chronic disease. Poor dietary choices could exacerbate the deleterious effects that are already associated with physical inactivity. Previous research has typically utilized self-reported measures of sedentary behaviors (SED).

**PURPOSE:** To examine the relationship between dietary intake and time spent in SED in normal weight (n=25), overweight (n=22), and obese (n=27) women between the ages of 25 and 40 y. This study design quantified SED by the use of accelerometers.

**METHODS:** Seventy-two young women (age 32±5 y; BMI 28.1±6.6 kg/m<sup>2</sup>) completed 7-day weighed food records (The Food Processor SQL). Participants wore an accelerometer (Kenz Lifecorder) for seven days and kept a log noting time to bed and time awake. Time (minutes/day) spent in four activity levels (inactive, light, moderate, vigorous) was determined. Sleep time (minutes) was subtracted from the inactive category. SED was defined as inactive - sleep time. Descriptive statistics and partial correlations were computed using SPSS version 15.

**RESULTS:** Participants reported consuming 2045±486 kcal/d, 52±6 % energy from carbohydrate, 20±6 % energy from sugar, 34±5 % energy from fat, and 11±2 % energy from saturated fat. Participants (n=72) spent an average of 635±105 minutes in sedentary behaviors per day. Participants of normal weight, overweight, and obese weight categories spent an average of 615±82, 630±137, and 659±95 respectively in sedentary behaviors. Controlling for age, positive partial correlations were found between 7-day average SED (minutes/day) and folate density (mcg DFE/1000 kcal) (P<0.01), and SED and iron density (mg/1000 kcal) (P<0.05). No other relationships between SED and dietary intake were observed in this study.

**CONCLUSION:** Time spent in SED was only associated with iron density and folate density. Thus, an increased time spent in SED was not associated with poor dietary choices.

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## 2407 Board #52 May 29 8:00 AM - 9:30 AM

### Dietary Intake And Energy Expenditure In Spanish Road Cyclist During Competition And Training

Raul Bescos<sup>1</sup>, Piero Galilea<sup>2</sup>, Bonet Jessica<sup>1</sup>, Jordi Porta<sup>1</sup>. <sup>1</sup>INEFC, University of Barcelona, Barcelona, Spain. <sup>2</sup>High Performance Centre, Sant Cugat, Spain.

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(No relationships reported)

**PURPOSE:** To assess the dietary intake and energy expenditure during training and competition in cycling

**METHODS:** 11 male high level road cyclists (mean ± SD; age: 24.2 ± 2.9 years; BMI: 21.8 ± 1.0 kg·m<sup>-2</sup>) performed at the beginning of season a progressive laboratory test, after 5-min warm-up at 100W, initial stage started at 130W and workload was increased by 30 W every 3 min until exhaustion. All subjects after received detailed instructions registered three days dietary record during competition with various stages and training period. In addition, cyclists reported mean heart rate (HR) and time duration of training and competition. Nutrient composition were analyzed using the software Regal®. Energy Expenditure (EE) was obtained with the exponential equations relationship between HR and oxygen consumption (VO<sub>2</sub>). The total VO<sub>2</sub> was then recalculated to kcal based on the assumption that for each litre of oxygen uptake, about 5 kcal was produced. The basal metabolic rate (BMR) in litres (O<sub>2</sub>/min) was calculated by multiplying the weight of the person in kg by 0.0035. Student *t* test was used to compare energy and nutrient intake during training and competition period.

**RESULTS:** Significant differences were found in energy, carbohydrate, iron, thiamin and niacin intake between training and competition period (table 1).

**CONCLUSIONS:** Inadequate eating behaviour was showed during training and competition. Also, insufficient replenishment of glycogen stores can affect dramatically in performance of the cyclist mainly during competition.

Note: Mean ± SD; EE: Energy Expenditure; EI: Energy Intake; * P<0.05		
	Training	Competition
Energy (kcal-day-1)	3279 ± 759	4024 ± 482 *
Carbohydrate (kcal-day-1)	375 ± 86	520 ± 102 *
Protein (g-day-1)	174 ± 41	198 ± 27
Lipids (g-day-1)	116 ± 40	131 ± 20
Iron (mg-day-1)	17.7 ± 6.9	20.4 ± 7.5 *
Thiamin (mg-day-1)	2.1 ± 0.8	2.9 ± 1.3 *
Niacin (g-day-1)	40.2 ± 19.8	53 ± 19.6 *
Total EE (included BMR) (kcal-day-1)	4619 ± 831	4869 ± 668
Differences between EI vs EE	71%	83%

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## E-29 Free Communication/Poster - Endocrinology

MAY 29, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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## 2408 Board #53 May 29 9:00 AM - 10:30 AM

### No Relationship Between Youth's Physical Activity And Changes In Insulin, Leptin, Cortisol And Growth Hormone

Kristin S. Ondrak, Robert G. McMurray, FACSM, A.C. Hackney, FACSM, Joanne S. Harrell. *University of North Carolina at Chapel Hill, Chapel Hill, NC.*

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(No relationships reported)

**PURPOSE:** The interrelationships among changes in habitual physical activity (PA) and changes in insulin, leptin, cortisol and growth hormone (GH) are complex, particularly in youth, and studies have not considered the influence of change in weight status on these relationships. This investigation determined the association between changes in these hormones and PA over two years in youth who were normal weight and became overweight, were overweight and normalized their weight, or simply maintained their weight status.

**METHODS:** Data were collected from 120 youth at baseline (mean age 9.8 years) and two years later. Participants were selected from a larger cohort to represent the following: normal weight ( $>5^{\text{th}}$  and  $<85^{\text{th}}$  BMI percentile) or overweight ( $\geq 85^{\text{th}}$  BMI percentile) at both time points, normal weight that became overweight and overweight that became normal weight. Fasting, morning plasma leptin, cortisol, GH and insulin were measured via radioimmunoassay. Habitual physical activity (PA) was assessed via questionnaire. Partial correlations and multiple regression analyses were used to determine the relationship between changes in insulin and changes in leptin, cortisol, GH, PA and BMI percentile, while controlling for race and sex. Additionally, correlations were computed between change in PA and changes in leptin, cortisol and GH.

**RESULTS:** Change in insulin was related to change in BMI percentile ( $r=0.25$ ,  $p<0.05$ ) and change in leptin ( $r=0.29$ ,  $p<0.05$ ), but was not related to changes in cortisol ( $r=-0.08$ ) or GH ( $r=0.16$ ) ( $p>0.05$ ). Likewise, change in PA over the two year period was not related to changes in any of the hormones ( $p>0.05$ ). Multiple regression analyses revealed that change in leptin accounted for 9% of the variance in insulin change, while change in BMI percentile accounted for 4% of the variance ( $p<0.05$ ); no other variables were significant.

**CONCLUSIONS:** In this sample of youth, changes in or maintenance of weight status over a two year period appears to only impact the association between hormonal changes in insulin and leptin. Thus, weight status has a stronger association with the insulin-leptin relationship than does habitual physical activity.

*Supported by NINR #NR01-1837.*

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**2409 Board #54 May 29 9:00 AM - 10:30 AM**

**Hormonal Markers And Physical Performance During A Peak-taper Cycle In Elite Track And Field Athletes.**

Arnold G. Nelson, FACSM<sup>1</sup>, Jason B. Winchester<sup>2</sup>, Laura K. Stewart<sup>1</sup>, Michael H. Stone<sup>3</sup>. <sup>1</sup>LSU, Baton Rouge, LA. <sup>2</sup>George Mason University, Manassas, VA. <sup>3</sup>East Tennessee State University, Johnson City, TN.

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(No relationships reported)

**PURPOSE:** To investigate the relationship between physical performance and testosterone and cortisol following short term alterations in training volume and intensity.

**METHODS:** Five male qualifiers for the 2006 NCAA D-I national track and field meet took part. At study start, they had just finished a peaking training phase prior to competition in a NCAA regional meet. Peaking involved a 2 week elevation in training volume/intensity, followed by 1 week reduction in training volume/intensity prior to the regional and national meets. Testing occurred immediately prior to beginning the peaking phase (pre), to the onset of the taper cycle (mid), and to leaving for the national meet (post). For each athlete, all tests were performed at the same time of day, on the same day of the week, and with a minimum of 48 h prior rest. The performances tested were broad jump (BJ) and mid-thigh pull. Testosterone (T) and cortisol (C) were determined from saliva samples. Samples were analyzed in duplicate via ELISA.

**RESULTS:** Free T (nmol/L) went unchanged throughout the study (pre=  $9.7 \pm 1.5$ , mid=  $9.6 \pm 1.2$ , post=  $10.8 \pm 1.6$ , mean  $\pm$  std. dev). On the other hand, free C (nmol/L) rose significantly ( $p<0.05$ ) at mid, but returned to pre levels at post (pre=  $18.5 \pm 3.7$ , mid=  $22.2 \pm 3.7$ , post=  $15.8 \pm 2.3$ ). T/C ratio was also increased at mid but returned to pre at post (pre=  $.5 \pm .3$ , mid=  $.4 \pm .1$ , post=  $.7 \pm .2$ ). Additionally, significant correlations were observed between T and BJ, peak force (PF), and rate of force development (RFD) for pre ( $r=.54$ ,  $.42$ ,  $.59$ ), mid ( $r=.44$ ,  $.62$ ,  $.57$ ), and with BJ and RFD during post ( $r=.56$ ,  $.53$ ). Significant negative correlations were observed between C and BJ and RFD during pre ( $r=-.44$ ,  $-.47$ ), and with RFD during mid ( $r=-.51$ ), and post ( $r=-.50$ ). Significant correlations were observed between T/C and BJ and RFD during pre ( $r=.64$ ,  $.68$ ), with PF during mid ( $r=.64$ ), and with BJ, PF, and RFD during post ( $r=.68$ ,  $.71$ ,  $.74$ ).

**CONCLUSIONS:** Athletes increasing training volume for 2 weeks showed a significant increase in [C]. When training volume was tapered, [C] decreased accordingly. However, [T] showed no significant alterations to either the sudden increase in the training or the tapering and cessation of training. In addition, T, C, and T/C shared significant relationships with the physical performance indicators of BJ, PF, and RFD.

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**2410 Board #55 May 29 9:00 AM - 10:30 AM**

**Testosterone to Cortisol Ratio Shows Strong Relationship With Adaptation to a Strength and Power Training Regimen in American-style Collegiate Football Players**

Jason B. Winchester<sup>1</sup>, Arnold G. Nelson, FACSM<sup>2</sup>, Laura K. Stewart<sup>2</sup>, Michael H. Stone<sup>3</sup>. <sup>1</sup>George Mason University, Manassas, VA. <sup>2</sup>Louisiana State University, Baton Rouge, LA. <sup>3</sup>East Tennessee State University, Johnson City, TN.

(No relationships reported)

**PURPOSE:** Previous research has demonstrated strong correlation between hormonal markers and physical performance. The purpose of this study was to examine the relationship that hormonal markers shared with performance measures and to establish whether or not alterations in performance were reflected through shifts in hormone profile.

**METHODS:** Twenty-two freshman collegiate American-style football players were recruited this study (Age =  $18.41 \pm 0.73$  years; Mass =  $107.60 \pm 22.97$  kg; and Height =  $188.31 \pm 6.71$  cm). Ten collegiate males were recruited as an experimental control (Age =  $19.01 \pm 0.81$  years; Mass =  $91.45 \pm 17.12$  kg; and Height =  $168.94 \pm 7.12$  cm). Performance testing included peak isometric force (PF), rate of force development (RFD), broad jump (BJ), and vertical jump (VJ). Hormone values included free testosterone (T), cortisol (C), and testosterone to cortisol ratio (T/C), measured via enzyme-linked immune assay. Following initial testing, treatment group subjects participated in seven weeks of strength and power training. Control group subjects were instructed not to participate in strength or power training during the course of the study. Statistical analysis was performed using a Pearson product-moment correlation and reliability was determined via interclass correlation (ICC). A paired t-test was used to compare pre-post means between the performance variables of PF and RFD within groups. An additional paired t-test was performed examining pre-post means of the BJ and VJ tests. A final paired t-test was performed to compare the pre-post means of the hormonal markers T, C, and T/C. The level of significance was set at  $p<0.05$ , and was adjusted to cover for multiple comparisons using a Bonferroni adjustment.

**RESULTS:** Significant correlations were observed between pre T/C and percent improvements in performance variables pre-post (BJ =  $3.8\%$   $r=0.59$ , PF =  $16.8\%$   $r=0.62$ , RFD =  $20.1\%$   $r=0.67$ , VJ =  $4.1\%$   $r=0.64$ ).

**CONCLUSIONS:** The results of this study suggest that the hormonal markers T, C, and T/C share significant correlation with indices of strength and power performance and that these relationships are sensitive to alterations in strength and power performance capabilities. Practitioners wishing to monitor training and adaptation may wish to consider the use of such hormonal markers in their participants.

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**2411 Board #56 May 29 9:00 AM - 10:30 AM**

**Acute Regulation Of Igf-1 By Differential Binding Protein Expression, Inhibition, And Proteolysis**

Gordon Fisher, Byron Foster, David D. Pascoe, FACSM. Auburn University, Auburn, AL.

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(No relationships reported)

**INTRODUCTION:** Strong evidence supports the roles of Insulin Growth Factor Binding Proteins (IGFBPs) in regulating Insulin Growth Factor 1 (IGF-1) bioavailability and individual regulation dynamics. A large percentage of circulating IGF-1 is bound in a ternary complex consisting of IGF-1, IGFBP-3, and hepatically-produced acid labile subunit. IGF-1 bound in binary complexes with IGFBP-1, -2, -4, -5, and -6 constitute an additional 4% of circulating IGF-1, the remainder is 'free' IGF-1. This free fraction of IGF-1 is able to bind to type 1 IGF receptor and elicit biological effects. Exercise (EX) combined with proper post-EX nutrition elicits metabolic signals that would serve to maximize bioavailability of free, dissociable IGF-1.

**PURPOSE:** This study investigated differential contributions of IGFBPs on bioavailability of IGF-1 and the individual regulation of each of these binding proteins in exercising humans.

**METHODS:** Eight recreationally-active college-aged males completed three identical high-intensity interval training protocols followed by each of three randomly ordered post-EX nutritional protocols: 1) non-caloric placebo; 2) carbohydrate-only (0.85 g/kg lbw); and 3) essential amino acid/carbohydrate (0.35 g/kg and 0.5 g/kg lbw). Blood samples were obtained pre-EX, immediately post-EX, 10 min intervals for 80 min post-EX, and 20 min intervals until 160 min post-EX. Blood samples were analyzed for growth hormone, free IGF-1, insulin, hematocrit, hemoglobin, plasma amino acid concentrations, and matrix metalloproteinase (MMP) activity. Analytes were compared relative to baseline and across conditions using repeated measures ANOVA. Total area under the curve was calculated for insulin and analyzed using one-way ANOVAs with repeated measures on condition. *A priori* significance level was  $p < 0.05$ .

**RESULTS:** Significant post-EX increases in free IGF-1 concentrations were observed only for essential amino acid/ carbohydrate group. Additionally, significant increases in post-EX MMP activity were observed in all groups.

**CONCLUSION:** Results indicate that post-EX macronutrient ratio is a determinant of free concentrations of IGF-1 and high-intensity EX results in increased MMP activity.

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**2412 Board #57 May 29 9:00 AM - 10:30 AM**  
**Plasma Free Testosterone, Regional Fat Mass And Plasma Leptin Concentration In Men**

Teresa Fuentes, Amelia Guadalupe-Grau, Hugo Olmedillas, Safira Delgado-Guerra, Jesús Gustavo Ponze-González, David Morales-Álamo, Lorena Rodríguez-García, Borja Guerra, José Antonio López-Calbet, Cecilia Dorado. *University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain.*

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(No relationships reported)

There is an inverse correlation between serum leptin and testosterone levels in men which could be explained by either an effect of testosterone on leptin secretion or by an indirect effect of testosterone in fat mass.

**PURPOSE:** To determine if the association between serum free testosterone and leptin concentrations is independent of fat mass and its regional distribution in men.

**METHODS:** Two hundred and fifty-nine healthy and physically active men, aged  $29.1 \pm 7.4$  years and with a percentage of body fat of  $19.5 \pm 7.3\%$  participated in this investigation. Fasting serum concentrations of leptin and free testosterone were assessed with ELISA and body composition with DEXA.

**RESULTS:** The percentage of body fat mass was associated with leptin (spearman  $r = -0.87$ ,  $P < 0.001$ ), free testosterone ( $r = -0.31$ ,  $P < 0.001$ ), and free testosterone with leptin ( $r = 0.24$ ;  $P < 0.01$ ). In addition, the percentage of fat accumulated in the trunk region was correlated with serum leptin ( $r = 0.70$ ,  $P < 0.001$ ) and free testosterone ( $r = -0.29$ ;  $P < 0.001$ ). However, when controlling for the percentage of body fat, there was no relationship between free testosterone and leptin.

**CONCLUSIONS:** Circulating levels of leptin and free testosterone are inversely associated and this relationship can be explained by the fat-reducing effects of serum free testosterone.

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**2413 Board #58 May 29 9:00 AM - 10:30 AM**  
**Serum Myostatin And IGF-I Status In Cancer Patients With And Without Cachexia**

Jeremy Baker, Michael Bembien, FACSM, Penny Hopkins, Vanessa Sherk, Debra Bembien, FACSM. *University of Oklahoma, Norman, OK.*

(No relationships reported)

Cancer cachexia is a syndrome involving weight loss, anorexia, loss of skeletal muscle, and body fat which results in lowered quality of life and survival rate for cancer patients.

**PURPOSE:** The purpose of this study was to examine serum myostatin and IGF-I levels in patients with cancer cachexia to determine if these hormones are involved in cancer associated weight loss.

**METHODS:** Subjects were divided into three groups: healthy age-matched controls (CON;  $n = 11$ ); weight stable cancer patients (NWL;  $n = 10$ ) and cancer patients (WL;  $n = 10$ ) who had lost at least 10% of their pre-diagnosis normal weight. Serum was analyzed via a western blot protocol for myostatin protein and by IRMA for IGF-I concentrations. Body composition was assessed using a multi-compartment model using DXA (mineral), Bod Pod (body density) and bio-impedance spectrum (BIS) analyzer (body water).

**RESULTS:** Physical characteristics were not significantly different between groups. WL had a weight loss of 20.46 kg from their pre-cancer normal weights. Body composition variables were not significantly different between groups except that intra-cellular water was significantly lower ( $p < 0.01$ ) in WL than in C. Myostatin and IGF-I levels were not significantly different ( $p > 0.05$ ) between the groups (Table 1). Myostatin was positively related to METs per week ( $r = 0.697$ ,  $p = 0.03$ ) in WL, which may be the result of myostatin production being stimulated by glucocorticoid release at higher levels of activity. IGF-I did show a positive correlation to the percentage of weight change from normal weight in WL ( $r = 0.71$ ,  $p = 0.02$ ).

**CONCLUSION:** Our findings suggest that there are mechanisms other than myostatin involved in cancer cachexia.

Table 1. Myostatin (Myo) and IGF-I Levels (Mean  $\pm$  SE)

Variable	NWL (n=10)	WL (n=10)	CON (n=11)
Myo (ng/ml)	$2.75 \pm 0.36$	$2.61 \pm 0.70$	$3.23 \pm 0.74$
IGF-I (ng/ml)	$216.1 \pm 29.9$	$259.4 \pm 34.7$	$185.1 \pm 19.7$

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**2414 Board #59 May 29 9:00 AM - 10:30 AM**  
**Effects Of rhGH On Selected Markers Of Altered Health Status In Trained Sportsmen**

Richard J. Godfrey, FACSM<sup>1</sup>, Anthony Blazevich<sup>2</sup>, Mariann Rand-Weaver<sup>1</sup>, Cristiana Velloso<sup>3</sup>, Pierre Bouloux<sup>3</sup>, Stephen Harridge<sup>3</sup>, Geoffrey Goldspink<sup>3</sup>. <sup>1</sup>Brunel University, London, United Kingdom. <sup>2</sup>Edith Cowan University, Perth, Australia. <sup>3</sup>University College London, London, United Kingdom.

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(No relationships reported)

Recombinant human growth hormone (rhGH) is used illicitly by some athletes as a means of improving sports performance. Exogenous administration of growth hormone is believed by athletes to reduce body fat and increase muscle mass. There are health risks associated with exogenous administration of rhGH. These include risk of diabetes, joint pain, skeletal changes and hepatomegaly. Some evidence also suggests a link between exogenous rhGH and changes in insulin sensitivity and cardiovascular risk.

**PURPOSE:** The aim of this work was to examine selected measures of the healthy *mileu* that may be altered in favour of pathology as a consequence of the illicit use of rhGH in sport. Accordingly, the analytes, leptin, adiponectin and IL-6 are examined as indices of potential pathologic change.

**METHODS:** Following the provision of written informed consent fourteen male undergraduates entered the study (Mean  $\pm$  sd; age  $22.5 \pm 2.3$  years, weight  $93.6 \pm 5.9$  kg). Each had a minimum of three years resistance training experience and, upon entry to the study, were regularly participating in a minimum of two resistance training sessions per week. A six week standardised, supervised, resistance training program comprising three sessions per week was implemented. Participants were tested on two occasions: T1

following 4 weeks of training and T2 following two further weeks of training plus either rhGH 0.1 IU/kg/day or placebo administration. The testing sessions involved the use of an acute high resistance exercise test of 4-8 sets of 10 repetitions leg-press at 80% of maximal voluntary contraction with 90 seconds rest between sets. This took place at the same time in the morning for each participant, in the fasted state and following insertion of a cannula in a radial vein. Blood samples were taken at rest, and at 5 and 60 minutes post exercise.

**RESULTS:** In the experimental group there was a large (300-fold,  $p < 0.001$ ) increase in exercise induced IGF-1 secretion compared with the control group. Hence administration of rhGH was demonstrated to have physiological efficacy. Despite this, there was no difference in either leptin, adiponectin or IL-6 when comparing experimental and control groups.

**CONCLUSION:** Any negative health-related changes in insulin sensitivity and cardiovascular risk are not mediated by leptin, adiponectin or IL-6.

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**2415      Board #60      May 29      9:00 AM - 10:30 AM**  
**Insulin-like Growth Factor 1 And Insulin-like Growth Factor Binding Proteins 1 And 3 During A Competitive College Cross-country Season**

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(No relationships reported)

The effect of exercise training on the IGF system remains equivocal. Some research indicates a negative effect of exercise training on the IGF system, while others report a positive effect.

**PURPOSE:** To determine the effects of 10wks of training in male (XCM) and female (XCF) collegiate cross-country runners on insulin-like growth factor-I (IGF-I), IGF binding protein 1 (IGFBP-1) & IGFBP-3.

**METHODS:** 8 male & 18 female collegiate runners & 9 male (CONM) & 10 female (CONF) active controls volunteered to participate in the 10wk study. Blood samples were obtained at baseline, 5 & 10 weeks. IGF-I, IGFBP-1, & IGFBP-3 were determined by ELISA. Diet records were obtained from all subjects for the 3d prior to blood collection.

**RESULTS:** Weekly running distance remained relatively constant through the 10wks (males: baseline,  $92 \pm 29$  km; 5wk,  $95 \pm 24$  km; 10wk,  $82 \pm 16$  km; females: baseline,  $69 \pm 16$  km; 5wk,  $77 \pm 13$  km; 10wk,  $68 \pm 11$  km). Energy intake at baseline was higher in runners (Males,  $3465 \pm 1370$  kcals, females  $2128 \pm 722$  kcals) than controls (males,  $2350 \pm 650$  kcals; females,  $1808 \pm 404$  kcals) due to higher carbohydrate (runners: males,  $479 \pm 204$  g; females,  $304 \pm 117$  g; controls males,  $275 \pm 85$  g; females,  $256 \pm 61$  g) & protein intake in runners (runners: males,  $125 \pm 30$  g; females,  $83 \pm 34$  g; controls: males,  $100 \pm 45$  g; females,  $77 \pm 25$  g). Energy, carbohydrate & protein consumption remained constant for the duration of the study for all groups. Baseline IGF-I (XCF,  $296 \pm 86$ ; XCM,  $335 \pm 87$ ; CONF,  $342 \pm 38$ ; CONM,  $342 \pm 61$  ng/mL) was not different among the groups & did not change over time. Baseline IGFBP-3 (XCF,  $2124 \pm 204$ ; XCM,  $1762 \pm 79$ ; CONF,  $1827 \pm 119$ ; CONM,  $1751 \pm 100$  ng/mL) was not different among the groups and did not change over time. Baseline IGFBP-1 was different among groups (XCF,  $52 \pm 22$ ; XCM,  $38 \pm 13$ ; CONF,  $40 \pm 7$ ; CONM,  $30 \pm 16$  ng/mL). IGFBP-1 was lower ( $P < 0.05$ ) at 5wk (XCF,  $33 \pm 22$ ; XCM,  $25 \pm 11$  ng/mL) & 10wk (XCF,  $32 \pm 14$ ; XCM,  $22 \pm 11$  ng/mL) compared to baseline in male & female runners. There was no change in IGFBP-1 in controls at 5wk (CONF,  $42 \pm 22$ ; CONM,  $24 \pm 14$  ng/mL) or 10wk (CONF,  $49 \pm 19$ ; CONM,  $27 \pm 22$  ng/mL).

**CONCLUSIONS:** A 10wk season of cross-country running had little effect on IGF-I and IGFBP-3. The decline in IGFBP-1 is unlikely related to negative energy or protein balance; as the runners remained weight stable. The change in IGFBP-1 requires further investigation.

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**2416      Board #61      May 29      9:00 AM - 10:30 AM**  
**The Effects Of Mouthpiece Use During Endurance Exercise On Lactate And Cortisol Levels**

Dena P. Garner, Erica McDivitt. *The Citadel, Charleston, SC.*  
(No relationships reported)

Protective mouthpieces have been used in a variety of sports to decrease the risk of orofacial injury. However, there is limited research on the physiological effects of mouthpiece use during exercise.

**PURPOSE:** To investigate the possible effect on lactate and cortisol levels when wearing and not wearing a mouthpiece, the wEdge (Bite-Tech Corp).

**METHODS:** Subjects ( $n=24$ ), age 18-24, ran at 75 -85% of their maximal heart rate for 30 minutes on 2 separate trials, being randomly assigned the use of the mouthpiece on 1 of the 2 trials. Lactate levels were assessed before, 15 and 30 minutes during, and post 10 minutes exercise. Subjects provided a passive drool sample before and after each exercise bout to assess salivary cortisol levels.

**RESULTS:** Lactate data indicated a significant difference between wearing and not wearing the mouthpiece at 30 minutes exercise ( $p$ -value = 0.024). Mean lactate levels at 30 minutes with the mouthpiece was 4.01 mmol/L versus 4.92 mmol/L without the mouthpiece. Mean cortisol levels showed no significant difference between wearing and not wearing the mouthpiece ( $p$ -value= 0.111). However, there was a trend towards lower mean cortisol levels with use of the mouthpiece (0.1484 ug/dL) versus no mouthpiece (0.2201 ug/dL).

**CONCLUSION:** This study suggests that use of a mouthpiece may reduce lactate and cortisol increases and thereby improve exercise performance.

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**2417      Board #62      May 29      9:00 AM - 10:30 AM**  
**Association Of Exercise-induced Salivary Cortisol To Exertional Perception And Affect**

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(No relationships reported)

**PURPOSE:** To examine the relation between cortisol levels and both exertional perceptions and exercise induced changes in affect during a bout of exercise.

**METHODS:** 13 males and 20 females (mean age  $30.5 \pm 1.2$  yrs) participated in this investigation. Salivary cortisol was measured at baseline (C1), 5 minutes after a submaximal (C2) and maximal (C3) treadmill protocols, and 30 minutes following the maximal treadmill test (C4). Affect was measured using the Total Mood Disturbance score (TMD) calculated from the Profile of Mood States (POMS) at baseline (TMD1), 5 min post submaximal test (TMD 2), 5 min post maximal test (TMD 3), and 30 minutes post maximal test (TMD 4). Ratings of perceived exertion (RPE) were assessed with the OMNI Walk/Run Scale during treadmill exercise for legs (RPE-L), chest and breathing (RPE-C), and overall body (RPE-O). Partial correlations were used to examine the association among cortisol values, affect, and RPE.

**RESULTS:** For males, there was a positive correlation between the D in TMD 1 to TMD 3 and the D in C1 to C3 ( $r=0.62$ ,  $p < 0.05$ ) and the D in C1 to C4 ( $r=.77$ ,  $p < 0.01$ ). For females, positive correlations were found between the D in C1 to C4 and RPE-L ( $r=0.53$ ,  $p < 0.05$ ), RPE-C ( $r=0.58$ ,  $p < 0.01$ ), and RPE-O ( $r=0.56$ ,  $p < 0.05$ ).

**CONCLUSION:** Findings suggest that increased post exercise cortisol levels are associated with a negative mood shift following a maximal treadmill test in males and higher perceived exertion during a maximal treadmill test in females. Examining the physiological and psychological responses to exercise may assist with the development of improved strategies to increase exercise adoption and adherence.

*Supported by NICHD (HD35607) and NCI (R01CA109895)*

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**2418      Board #63      May 29      9:00 AM - 10:30 AM**



## A Meta-analysis Of Biomarkers Associated With The Overtraining Syndrome

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(No relationships reported)

Overtraining (OT) syndrome has been investigated extensively with little agreement as to reliable markers for detection. A meta-analytic review is a procedure designed to compile studies in an area with hopes of reaching a consensus view.

**PURPOSE:** The purpose of this meta-analysis was to provide summary quantitative findings of biomarkers (i.e., blood) associated with the overtraining syndrome.

**METHODS:** A meta-analytic research design was utilized to investigate selected studies allowing for a coding process to record data. Thirteen studies met inclusion/exclusion criteria. Biomarkers included samples taken with subjects in normal (N) condition and during OT. These biomarkers were the following: glutamine (um), glutamate (um), cortisol (nmol<sup>-1</sup>), IL-6 (nm), testosterone (mg\*dL<sup>-1</sup>), total cholesterol (mg\*dL<sup>-1</sup>), glucose (mg\*dL<sup>-1</sup>), leptin (ng\*mL<sup>-1</sup>), hematocrit (%), hemoglobin (g\*L<sup>-1</sup>), norepinephrine (pg\*mL<sup>-1</sup>), epinephrine (pg/ml), creatine kinase (u\*L<sup>-1</sup>). To determine magnitude of difference between N and OT, the effect size calculation of  $M_2 - M_1 / SD_1$  was used where  $M_2$  is the mean of the OT sample,  $M_1$  was the mean of the N sample and  $SD_1$  is the standard deviation of the N sample.

**RESULTS:** Combined sample size (N) was 238 subjects with the mean time in OT of 6.6 (weeks). The following are mean (SD) of combined subject demographics: height (cm) 175.4 (2.4); weight (kg) 71.7 (2.6); body fat (%) 11.8 (0.9); age (y) 23.5 (2.03);  $VO_{2max}$  (ml\*kg<sup>-1</sup>\*min<sup>-1</sup>) 55.4 (0.8). Mean (SD) biomarker changes from N to OT were the following: Glutamine -56.3 (-2); glutamate 49.7 (2); cortisol -89.7 (-12.2); IL 6 -0.52 (0.12); testosterone -88.9 (-30); cholesterol 4.6 (-1.6); glucose -13.3 (1.9); leptin 0.15 (-0.11); hematocrit -0.83 (-0.4); hemoglobin -20; norepinephrine 36 (-4.1); epinephrine -2.2 (-3.5); creatine kinase 29.2 (8.5). Effect size calculations for the above biomarkers were considered large for the following: glutamine (-4.02), glutamate (8), cortisol, (-1.4), IL 6 (-5.2), glucose (-1.1).

**CONCLUSION:** From this analysis, the noted biomarker changes and direction of change (+, -) indicates considerable immune-suppression and increased stress with athletes experiencing the OT syndrome.

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2419 Board #64 May 29 9:00 AM - 10:30 AM

### Determining If *N. Micropus* Is A Viable Animal Model For The Study Of Type 2 Diabetes

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(No relationships reported)

**PURPOSE:** The purpose of this study was to determine if wild caught *N. micropus* would exhibit signs of type of type 2 diabetes when fed a high fat, high carbohydrate diet.

**METHODS:** Twenty *N. micropus* were captured from several field locations and brought into the lab. Initial blood samples of blood glucose, bone mineral density (BMD) and body fat percentage (%BF) were collected. The animals were fed a modified western high fat, high CHO diet. Beginning in the seventh week, the animals began exhibiting signs of distress, including increased fluid intake, loss of appetite, and polyuria. Upon death, a second blood glucose, BMD and %BF were collected along with tissue samples of the livers, pancreata, and kidneys. A repeated measures analysis of variance was run to determine differences between pre and post data.

**RESULTS:** The repeated measures analysis of variance revealed significant differences between pre-test and post-test glucose levels ( $F = 71.77$ ,  $p < 0.05$ ) and %BF ( $F = 10.1$ ,  $p < 0.05$ ). There were no significant differences between the experimental pre-test and the field control blood glucose values ( $t = 0.332$ ,  $p > 0.05$ ) or %BF ( $t = 1.08$ ,  $p > 0.05$ ). The livers of the experimental animals contained a statistically significant greater number of lipid droplets compared to the livers of the field control animals ( $F = 5.05$ ,  $p < 0.05$ ). The glomerular space of the kidneys in the experimental animals was significantly smaller than the space in the field control animals ( $F = 7.71$ ,  $p < 0.05$ ). H & E staining of pancreata from the experimental animals showed disruption of the lobular groups, a loss of the secretory and centroacinar cells due to lipid infiltration, and no islets could be identified.

**CONCLUSIONS:** Results of our study show that when *N. micropus* is placed on a high fat, high CHO diet, they rapidly develop symptoms of type 2 diabetes similar to those observed in humans. They have hyperglycemia, develop fatty deposits in the liver similar to non-alcoholic liver disease and the glomerulus swells resulting kidney damage. The pancreata shows a disruption of the lobular groups, a loss of the secretory and centroacinar cells due to lipid infiltration, and the destruction of the Islet of Langerhans. These results suggest that *N. micropus* can be developed in to a useful small animal model for the study of type 2 diabetes.

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2420 Board #65 May 29 9:00 AM - 10:30 AM

### Menstrual Cycle Disruptions In Female Soldiers During Military Training: Impact Of Body Weight And Composition

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(Sponsor: Dr. Andrew Young, FACSM)

(No relationships reported)

Menstrual cycle disruptions (MCDs) have been reported in populations experiencing increased physical activity and may be associated with poor health outcomes. The prevalence and etiology of MCDs have not been studied in enlisted female Soldiers during military training.

**PURPOSE:** In this study we investigated the prevalence of MCDs during military basic combat training (BCT), and the relationship between altered menstrual function and changes in body weight (BW) and composition. We hypothesized that female Soldiers who lost weight during BCT may develop MCDs.

**METHODS:** Survey questions regarding menstrual cycling were administered to 163 Soldier volunteers ([mean  $\pm$  SD] age = 21  $\pm$  4 yrs) immediately before and following the 9-wk BCT course. At both timepoints, measured BW was used to calculate body mass index (BMI), and skinfold thickness was used to calculate body fat percentage.

**RESULTS:** Following the 9-wk BCT course, 73.6% of volunteers reported that they had stopped menstruating regularly since arriving at BCT. Pre-BCT BW was lower ( $p < 0.05$ ) in individuals that reported MCDs (61.5  $\pm$  8.8 kg) as compared to those who did not (ND, 64.8  $\pm$  8.9 kg). The ND group had a greater ( $p < 0.05$ ) BCT-induced change in BW (-1.4  $\pm$  3.3 kg) than the MCD group (0.2  $\pm$  3.4 kg). Likewise, the ND group demonstrated a greater ( $p < 0.05$ ) BCT-induced change in BMI (-0.54  $\pm$  1.2 kg\*m<sup>-2</sup>) than the MCD group (0.06  $\pm$  1.3 kg\*m<sup>-2</sup>). There was no difference in body fat percentage between the MCD and ND groups at either timepoint.

**CONCLUSION:** Menstrual cycle disruptions are prevalent in female Soldiers following BCT. Starting BW, but not body fat percentage, appears to be associated with MCDs during the training period. Contrary to our hypothesis, volunteers reporting MCDs did not lose weight, suggesting that weight loss per se does not appear to affect menstrual function during BCT. Future studies should determine the impact of MCDs on Soldier health and performance during military training.

Research Supported by USAMRMC.

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2421 Board #66 May 29 9:00 AM - 10:30 AM

### Estrogen And Exercise Effects On The Recovery Of Atrophic Skeletal Muscle

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(No relationships reported)



Estrogen deficient women do not show as much improvement with rehabilitation as men. Several studies have indicated that the recovery of atrophic skeletal muscle does not occur or is delayed in female rats that are estrogen (E2) deficient. There is also evidence that E2 is anabolic, stimulating protein synthesis. The PURPOSE of this study was to determine extent of recovery of atrophic skeletal muscle in E2 deficient rats that were allowed to spontaneously cage recover from induced atrophy or exercised during recovery.

**METHODS:** 55 female rats age 5 mos were randomly placed into 4 groups:

1) control, 2) Hindlimb unweighted (HLU), 3) cage ambulation recovery and 4) exercise. Initially, all rats were ovariectomized and allowed to recover pre-surgery weight (~3 wks). 38 rats were HLU for 4 weeks to induced muscle atrophy; 13 were sacrificed at the end of HLU. Remaining animals were exercised daily for 14 days (rehabilitation activity and ladder climbing with resistance) after HLU or cage recovered for 14 days.

**RESULTS:** HLU resulted in significant atrophy in soleus, plantaris, gastrocnemius, tibialis anterior and Quads. Unexpectedly, ambulation recovery rats showed a strong trend toward return of muscle mass compared to control values whereas exercise rats did not. Means  $\pm$  sem of 2 locomotor muscles are presented. (Plantaris: Con: 396mg $\pm$ 10, HLU: 294 $\pm$ 5, Recov: 363 $\pm$ 9, Exercise: 306 $\pm$ 9; Gastroc: Con 1850 $\pm$ 40, HLU 1353 $\pm$ 45, Recov 1661 $\pm$ 37, Exercise 1371 $\pm$ 43). Recovery of muscle force lagged behind the recovery of mass in the exercise and cage ambulation groups as follows: (Plantaris Po: Con 312g $\pm$ 10, HLU 256 $\pm$ 21, Recov 292 $\pm$ 20, Exerc 226 $\pm$ 14; Lateral Gastroc: Con 407 $\pm$ 13, HLU 335 $\pm$ 29, Recov 332 $\pm$ 15, Exerc 309 $\pm$ 20). Cross-sectional area (CSA) data reflect the same trend as muscle mass with recovery rats showing an increase in CSA toward baseline and exercise rats failing to increase fiber size. Central nuclei were present in muscles from exercise rats, suggesting damage.

**CONCLUSIONS:** Exercise may be detrimental in an E2 deficient organism. Results may explain why E2 deficient women do not show as robust an increase in mass and strength with exercise as men.

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## **E-30 Free Communication/Poster - Heat Stress: Thermoregulation and Other Responses**

MAY 29, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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### **2422 Board #67 May 29 8:00 AM - 9:30 AM**

#### **Hypothalamic-pituitary-adrenal Axis And The Sympathetic-adrenomedullary System Responses During Heat Acclimation In Sedentary Males**

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(No relationships reported)

Previous research suggests that the release of HPA and SAS stress hormones are functionally linked to the increase in core temperature during exercise and heat stress exposure. Yet, heat acclimation is known to increase tolerance time and the core temperature tolerated during uncompensable heat stress (UHS), and reduce physiological strain. It would be of interest, therefore, to know whether the HPA and SAS hormone response following heat acclimation is reduced at any given level of thermal strain.

**PURPOSE:** To examine the HPA and SAS stress hormone responses in sedentary males during 9 days of exposure to UHS.

**METHODS:** Nine sedentary males (Mean $\pm$ SE:  $\text{VO}_{2\text{peak}}$  = 51.7 $\pm$ 1.9 mL $\cdot$ kgLBM $^{-1}\cdot$ min $^{-1}$ , 17 $\pm$ 2% fat) walked to exhaustion (EXH) on 9 days (over 2 consecutive weeks) on a treadmill (4.5 km $\cdot$ h $^{-1}$ , 2% incline) in 40°C and 30% R.H., wearing combat clothing and a protective hooded overgarment. At rest (PRE; prior to heat) and at a  $T_{re}$  of 38, 38.5, 39°C, and EXH venous blood samples were obtained. COR, GH, and ACTH were determined by chemiluminescence and NE and E by gas chromatography/mass spectrometry.

**RESULTS:** Although  $T_{re}$  EXH was not different from Day 1 (38.8 $\pm$ 0.1°C) to 9 (39.1 $\pm$ 0.1°C), time to EXH increased from 95 $\pm$ 8 to 145 $\pm$ 13 min. Significant increases were observed from PRE to EXH for COR (357.0 $\pm$ 8.5 to 491.3 $\pm$ 18.8 nmol $\cdot$ L $^{-1}$ ), ACTH (4.7 $\pm$ 0.2 to 21.7 $\pm$ 1.9 pmol $\cdot$ L $^{-1}$ ), NE (1.9 $\pm$ 0.0 to 4.7 $\pm$ 0.0 nmol $\cdot$ L $^{-1}$ ), and E (208.4 $\pm$ 3.5 to 547.5 $\pm$ 18.9 pmol $\cdot$ L $^{-1}$ ) that were unaffected by heat acclimation. No differences also were observed between Day 1 and 9 from Pre to 39°C for COR, ACTH, NE, and E ( $p \leq 0.1$ ). However, GH EXH on Day 1 (9.9 $\pm$ 1.7 mIU $\cdot$ mL $^{-1}$ ) was significantly greater than Days 5, 6, and 9 (6.5 $\pm$ 0.9, 6.4 $\pm$ 0.9, and 7.7 $\pm$ 0.2 mIU $\cdot$ mL $^{-1}$ , respectively).

**CONCLUSION:** Nine days of exertional heat acclimation improved the GH stress response, yet COR, ACTH, NE, and E remained temperature driven. Funded by a DRDC Technology Investment Fund.

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### **2423 Board #68 May 29 8:00 AM - 9:30 AM**

#### **The Relationship Between Plasma Volume Changes Following Heat Acclimation And Thermotolerance During Uncompensable Heat Stress In Sedentary Males**

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(No relationships reported)

Sedentary individuals can not tolerate the same increase in rectal temperature ( $T_{re}$ ) during uncompensable heat stress (UHS) compared with endurance trained subjects, partially due to intestinal ischemia and endotoxin leakage that occurs with the redistribution of splanchnic blood flow. Heat acclimation (HA) may be an adaptive strategy for these individuals to increase plasma volume and delay endotoxin leakage, thus increasing thermotolerance during UHS.

**PURPOSE:** The purpose was to examine the relationship between plasma volume (PV) changes and thermotolerance during UHS following 9 days of HA in sedentary males.

**METHODS:** Seven sedentary males (mean $\pm$ SD: 28 $\pm$ 7 y, 75.3 $\pm$ 8.0 kg,  $\text{VO}_{2\text{peak}}$  = 42 $\pm$ 6 mL $\cdot$ kg $^{-1}\cdot$ min $^{-1}$ ) walked to exhaustion on a treadmill (4.5 km $\cdot$ h $^{-1}$ , 2% grade) in 40°C and 30% R.H. wearing combat clothing and a protective hooded overgarment on 9 days (over 2 consecutive weeks). PV was determined prior to beginning HA using Indocyanine Green<sup>TM</sup> and resting hematocrit and hemoglobin values measured on subsequent days were used to calculate the change in PV.

**RESULTS:** PV increased significantly over the 9 days from 49.6 $\pm$ 9.0 to 53.3 $\pm$ 10.3 mL $\cdot$ kg $^{-1}$ . The change in  $T_{re}$  from beginning to end of the UHS also increased significantly over the 9 days from 1.94 $\pm$ 0.38 to 2.37 $\pm$ 0.3°C owing to both a significant reduction in resting  $T_{re}$  from 36.83 $\pm$ 0.32 to 36.59 $\pm$ 0.26°C and a non-significant increase ( $p < 0.08$ ) in  $T_{re}$  at exhaustion (38.76 $\pm$ 0.4 to 38.95 $\pm$ 0.31°C). Total heat storage increased significantly from 6.7 $\pm$ 1.3 to 8.0 $\pm$ 1.2 kJ $\cdot$ kg $^{-1}$ . However, PV changes were not related to changes in heat storage or the changes in initial or final core temperatures during UHS.

**CONCLUSION:** Although 9 days of HA induced an expansion of PV in these sedentary males, these changes were not directly related to the increase in heat storage that occurred. Funded by a Defence R&D Canada Technology Investment Fund and the US Navy Office of Naval Research.

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### **2424 Board #69 May 29 8:00 AM - 9:30 AM**

#### **Heat And Run, Genomic And Morphological Aspects Of Adaptation In The Rat's Heart**

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(No relationships reported)

**INTRODUCTION:** Heat acclimation (AC) and exercise training (EX) individually improves mechanical and metabolic performance of the isolated rat's heart. Combined heat acclimation and exercise training (EXAC) demonstrates an interactive/additive effect, manifested by greater systolic pressure generation than that shown by either alone. Given the opposing adaptive requirements of the two stressors, the underlying mechanisms of the combined EXAC affect is as yet unknown.

**PURPOSE:** 1. *in vivo* assessment of the physiological adaptation to the stressors 2. determining global genomic responses using gene profiling analyses 3. linking physiological and genomic responses.

**METHODS:** Rats were divided into: AC, EXAC (30d, 34°C), C, EX (30d, 24°C) groups. For Exercise training a progressive treadmill protocol was applied; *In vivo* cardiac performance was monitored using Echocardiography; global genomic response of homeostasis associated genes was detected using cDNA microarray.

**RESULTS:** Increased thickness of posterior and septum walls coincidentally with decreased chamber diameter was demonstrated in EX and EXAC groups. Longer duration of left ventricular ejection and circumferential fiber shortening, implying decreased contractile velocity was evident in the heat treated groups. Gene profiling demonstrated transcript upregulation in a stress specific manner. Focusing on metabolic, transport, stress and signaling GO categories, we demonstrated that EX and EXAC upregulated 37 and 43% (in metabolic) while AC and EXAC upregulated 25 and 21% (in transport) genes. Other categories changed similarly in all groups.

**CONCLUSION:** Exercise training was manifested in morphological changes; chronic heat overrode exercise training mediated contractile response. Principally, both stressors upregulated gene expression. Different gene profiles were detected, however, following the various treatments. Training affected metabolic pathways (most pronouncedly in the EXAC) while exposure to heat induced changes in genes linked to transport, EC coupling mechanism and cytoprotection. Concerted gene upregulation in all functional categories, in EXAC only, may account for the advantage in pressure generation seen in this group.

\*Haifa Univ. Physiotherapy.

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**2425 Board #70 May 29 8:00 AM - 9:30 AM**

**Effect Of Elevated Local Temperature On Cutaneous Vasoconstrictor Responsiveness In Humans**

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Cutaneous vascular conductance (CVC) increases in response to local skin heating. While attenuation of vasoconstrictor responsiveness due to local heating has been demonstrated, the mechanism(s) responsible for this attenuation remain unclear. Nitric oxide has been shown to at least partially contribute to this response, but other mechanisms also may be involved.

**PURPOSE:** To test the hypothesis that local heating diminishes cutaneous vasoconstrictor responsiveness through a nitric oxide independent mechanism by altering post-synaptic reactivity to norepinephrine. A follow-up protocol tested the hypothesis that local heating attenuates the pre-synaptic release of neurotransmitters that cause vasoconstriction, also via non-nitric oxide mechanisms.

**METHODS:** Protocol I: in 8 subjects, CVC was assessed while increasing doses of norepinephrine (via intradermal microdialysis) were administered at adjacent sites separately heated to 34 and 40 °C. Protocol II: in an identical but separate protocol, in 7 subjects, CVC was assessed while increasing doses of tyramine, which causes release of neurotransmitters from adrenergic nerves, were administered. At each site for both protocols, nitric oxide synthesis was inhibited (via microdialysis administration of *N*<sup>G</sup>-nitro-L-arginine methyl ester) and flow was matched (via microdialysis administration of adenosine), leaving temperature as the only variable different between sites.

**RESULTS:** For both protocols, non-linear regression analysis revealed no difference (*P* > 0.05) in the effective drug concentration causing 50% of the vasoconstrictor response. Minimum CVC (protocol I, mean ± SD: 6.3 ± 2.0 and 9.0 ± 4.0 %CVC<sub>peak</sub>; protocol II: 19.3 ± 9.3 and 20.5 ± 11.9 %CVC<sub>peak</sub> at the 34 and 40 °C sites, respectively) was not different between sites.

**CONCLUSION:** Independent of nitric oxide, local skin heating to 40 °C does not attenuate adrenergically-mediated cutaneous vasoconstriction through pre- or post-synaptic mechanisms.

Supported by NIH Grants HL61388, HL84072, and GM68865.

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**2426 Board #71 May 29 8:00 AM - 9:30 AM**

**Comparison Of Invasive And Non-invasive Measures Of Arterial Blood Pressure In Heat Stressed Humans.**

Manabu Shibasaki<sup>1</sup>, Thad E. Wilson<sup>2</sup>, Niels H. Secher<sup>3</sup>, Craig G. Crandall, FACSM<sup>4</sup>. <sup>1</sup>*Nara Women's University, Nara, Japan.* <sup>2</sup>*Ohio University College of Osteopathic Medicine, Athens, OH.* <sup>3</sup>*Rigshospitalet, University of Copenhagen, Copenhagen, Denmark.* <sup>4</sup>*University of Texas Southwestern Medical Center at Dallas, Dallas, TX.* (Sponsor: CraigCrandall@texashealth.org, FACSM)

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Arterial blood pressure is an important variable when evaluating physiological responses to whole-body heat stress. The Finometer™ is commonly used to evaluate this parameter because of its non-invasive and continuous measurement attributes. However, it is unknown whether the Finometer™ accurately tracks arterial blood pressure during heat stress.

**PURPOSE:** To test the hypothesis that the Finometer™ accurately assesses arterial blood pressure in heat stressed individuals, when compared to arterial blood pressure obtained via direct cannulation.

**METHODS:** 17 subjects underwent whole-body heat stress sufficient to increase internal temperature at least 1 °C. Arterial blood pressure was measured via brachial artery cannulation and via the volume-clamp method of the Finometer™. Two min averages of mean arterial blood pressure (MAP) were obtained while subjects were normothermic and after whole-body heat stress. Data were analyzed via 2 way repeated measures ANOVA with main factors of device (i.e., artery cannulation and Finometer™) and thermal status (normothermia and heat stress).

**RESULTS:** Whole-body heat stress reduced MAP when evaluated with both devices. However, a significant interaction from the ANOVA was identified (*P* < 0.001). Further analysis demonstrated that the reduction in MAP to the heat stress was almost two fold greater when evaluated with the Finometer™ (13.9 ± 8.0 mmHg; mean ± SD), relative to direct arterial cannulation (7.3 ± 4.6 mmHg; *P* < 0.001).

**CONCLUSIONS:** These data suggest that caution should be taken when evaluating MAP during heat stress when solely relying upon Finometer™ derived values. Other measures of MAP, such as direct cannulation or auscultation of the brachial artery, should be considered when measuring blood pressure in heat stressed individuals. Sponsored by NIH HL61388 & HL84072

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**2427 Board #72 May 29 8:00 AM - 9:30 AM**

**Mechanisms Of Orthostatic Intolerance During Passive Heat Stress**

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(No relationships reported)

Passive heat stress has been shown to cause orthostatic intolerance. The role of potential mediators remains unclear but should include factors that affect cerebral perfusion directly or indirectly. **PURPOSE:** To determine the roles of hyperthermic-induced hypocapnia and hypotension on orthostatic intolerance during graded hyperthermia.

**METHODS:** Eight healthy young males, resting supine in a water-perfused suit, were progressively heated in 1.0°C (oesophageal) increments from normothermia to +2°C. At each thermal state, orthostatic tolerance was assessed using progressive lower body negative pressure to -45 mm Hg or to pre-syncope. During all procedures, blood flow velocity in the middle cerebral artery (MCAv; transcranial Doppler ultrasound), mean arterial pressure (MAP), heart rate (HR) and the partial pressure of end-tidal carbon dioxide (PETCO<sub>2</sub>) were measured continuously.

**RESULTS:** All subjects tolerated +1°C, whereas only six subjects reached +2°C. During orthostatic stress, pre-syncope occurred in one participant at +1°C, and in four at +2°C. Heating alone reduced mean MCAv ( $-11 \pm 5\%$ ), MAP ( $-11 \pm 5$  mm Hg) and PETCO<sub>2</sub> ( $-7 \pm 5$  mm Hg), and elevated HR ( $21 \pm 5$  b/min; all  $P < 0.05$ ), but responses were alinear, except for heart rate. The entire drop in MAP across the range of heating occurred before 1°C, whereas the majority of the drop ( $\sim 68\%$ ) in MCAv occurred above 1°C. Orthostatic stress at normothermia did not reduce PETCO<sub>2</sub>, MAP or mean MCAv. Orthostatic stress reduced MCAv during heat stress; at +1°C this was related to the reduction in MAP only ( $r^2 = 0.72$ ;  $P = 0.008$ ), whereas at +2°C it was related to PETCO<sub>2</sub> only ( $r^2 = 0.77$ ;  $P = 0.049$ ).

**CONCLUSIONS:** Hypotension and hypocapnia both mediate (pre)syncope during passive heat and orthostatic stress, but in different patterns. Some hypotension develops at modest hyperthermia, whereas hypocapnia occurs more at higher temperatures and is associated with much lower cerebral perfusion and tolerance.

Supported by the Department of Physiology and Sport and Recreation New Zealand.

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**2428 Board #73 May 29 8:00 AM - 9:30 AM**

**The Effects Of Reduced End-tidal Carbon Dioxide Tension On Cerebrovascular Conductance During Heat Stress**

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(No relationships reported)

**PURPOSE:** Passive heat stress reduces arterial carbon dioxide (PaCO<sub>2</sub>) partial pressure as reflected by 3 to 5 mmHg reductions in end-tidal carbon dioxide tension (PETCO<sub>2</sub>). Heat stress also reduces cerebrovascular conductance (CBVC) by up to 30%. While PaCO<sub>2</sub> is a strong regulator of CBVC, it is unlikely that the relatively small changes in PETCO<sub>2</sub> during heating are solely responsible for the reductions in CBVC. The aim of this study was to test the hypothesis that PaCO<sub>2</sub>, referenced by PETCO<sub>2</sub>, is not the sole regulator of CBVC during heat stress.

**METHODS:** Mean arterial blood pressure (MAP), PETCO<sub>2</sub>, middle cerebral artery blood velocity (MCAV<sub>mean</sub>), and calculated CBVC (MCAV<sub>mean</sub> / MAP) were assessed in 7 healthy individuals, each wearing a water-perfused suit during three separate conditions performed sequentially 1) normothermia (NT), 2) control passive heat stress (HS), and 3) passive heat stress with PETCO<sub>2</sub> clamped at the normothermic level (HS + Clamp) using a computer controlled sequential gas delivery breathing circuit (Respiract™).

**RESULTS:** MAP was similar between the three thermal conditions (NT:  $85 \pm 9$ ; HS:  $84 \pm 10$ ; HS + Clamp:  $84 \pm 10$  mmHg;  $P = 0.46$ ). HS increased internal temperature (NT:  $36.9 \pm 0.2$ ; HS:  $38.3 \pm 0.4$  °C;  $P < 0.001$ ) while it decreased PETCO<sub>2</sub> (NT:  $40.7 \pm 2.6$ ; HS:  $34.8 \pm 4.6$  mmHg;  $P < 0.001$ ). MCAV<sub>mean</sub> (NT:  $58.7 \pm 4.5$ ; HS:  $40.8 \pm 8.3$  cm·s<sup>-1</sup>;  $P < 0.001$ ), and calculated CBVC (NT:  $0.70 \pm 0.1$ , HS:  $0.49 \pm 0.1$  CBVC units;  $P < 0.001$ ). During HS + Clamp internal temperature remained similar to that during the HS condition (HS + Clamp:  $38.5 \pm 0.4$  °C;  $P = 0.31$ ). HS + Clamp successfully restored PETCO<sub>2</sub> to the NT level (HS + Clamp:  $40.8 \pm 2.5$ ;  $P = 0.99$ ) and increased MCAV<sub>mean</sub> (HS + Clamp:  $50.1 \pm 5.4$  cm·s<sup>-1</sup>;  $P = 0.002$ ) and CBVC (HS + Clamp:  $0.6 \pm 0.1$  CBVC units;  $P = 0.008$ ) relative to HS however both variables remained reduced relative to NT ( $P = 0.005$  and  $0.03$ ; for MCAV<sub>mean</sub> and CBVC, respectively).

**CONCLUSIONS:** These results indicate that heat stress induced reductions in PaCO<sub>2</sub>, as referenced by PETCO<sub>2</sub>, contribute to the decrease in MCAV<sub>mean</sub> and CBVC however other factors (possibly elevated sympathetic nerve activity) are also involved in mediating this response.

Supported by NIH Grants HL61388 & HL84072 & The Research and Education Institute for Texas Health Resources

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**2429 Board #74 May 29 8:00 AM - 9:30 AM**

**Does Exercise Intensity Modulate The Thermoregulatory Responses To Intermittent And Continuous Exercise?**

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(No relationships reported)

Evidence for differences in thermoregulatory strain between intermittent (INT) and continuous exercise (C) performed at the same average exercise intensity is inconclusive. This uncertainty may be a consequence of the specific nature of the exercise protocol performed and/or the site of core temperature measurement.

**PURPOSE:** To determine the impact of exercise intensity on the thermoregulatory responses to INT and C.

**METHODS:** Seven male subjects (Age  $25 \pm 2$  yrs; Height  $1.80 \pm 0.70$  m; Body mass  $77.1 \pm 8.0$  kg; VO<sub>2max</sub>  $49.6 \pm 5.9$  mL·kg<sup>-1</sup>·min<sup>-1</sup>) volunteered to participate. Each subject completed 30 min bouts of INT with a 1:1 (45s:45s) exercise:rest ratio at two different intensities (Bout 1: INT<sub>100</sub>, 100% VO<sub>2max</sub>; Bout 2: INT<sub>50</sub>, 50% VO<sub>2max</sub>). Subjects also completed 2 x 30 min bouts of C at the same average exercise intensities as in INT (Bout 1: C<sub>100</sub>, 50% VO<sub>2max</sub>; Bout 2: C<sub>50</sub>, 25% VO<sub>2max</sub>). All exercise trials were completed in a randomised order at  $18 \pm 2$  °C on a cycle ergometer. Oesophageal, rectal, mean skin temperature and heart rate were monitored throughout exercise. Subjective ratings of thermal comfort and perceived exertion were recorded at 5 min intervals throughout exercise. Data were analysed using a 3-factor repeated measures general linear model.

**RESULTS:** Increases in rectal temperature were significantly greater (95% CI = 0.03 to 0.31,  $P = 0.005$ ) in INT<sub>100</sub> ( $0.6 \pm 0.1$  °C) and INT<sub>50</sub> ( $0.2 \pm 0.1$  °C) than during C<sub>100</sub> and C<sub>50</sub> ( $0.4 \pm 0.2$  °C and  $0.1 \pm 0.1$  °C respectively). Changes in oesophageal temperature were sensitive to increases in exercise intensity ( $P = 0.001$ ) but were not significantly different (95% CI = -0.30 to 0.29,  $P = 0.761$ ) between INT and C (INT<sub>100</sub>  $0.8 \pm 0.3$  °C; INT<sub>50</sub>  $0.3 \pm 0.3$  °C; C<sub>100</sub>  $0.8 \pm 0.3$  °C; C<sub>50</sub>  $0.2 \pm 0.4$  °C). All other variables were significantly affected by exercise intensity ( $P < 0.05$ ) but not exercise pattern.

**CONCLUSION:** We have observed a site-dependent variation in the thermoregulatory strain associated with moderate duration INT exercise performed in compensable environmental conditions. Exercise pattern is an important determinant of the thermoregulatory response to exercise irrespective of the exercise intensity employed.

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**2430 Board #75 May 29 8:00 AM - 9:30 AM**

**Impact Of Prior Heat Stress On Subsequent Aerobic Exercise Performance**

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(No relationships reported)

The impact of prior heat exposure on subsequent aerobic exercise-heat performance has not been studied. However, recent research shows that despite returning to normothermia, residual effects persisted during an orthostatic challenge.

**PURPOSE:**To determine if prior heat exposure degrades subsequent aerobic exercise performance in the heat.

**METHODS:**Eighteen non-heat acclimated males established their baseline aerobic exercise performance in temperate conditions (4 practice trials; 22°C) and then were divided into two (n=8) groups. One group (EUH<sub>PH</sub>; VO<sub>2peak</sub>, 44.4 ± 6 ml·kg<sup>-1</sup>·min<sup>-1</sup>) was tested after 90 minutes of recovery (22°C) from 3 hr of intermittent light intensity (< 30% VO<sub>2peak</sub>) exercise-heat (50°C) exposure where sweat losses were matched with fluid intake (3.5 ± 0.5 L) to maintain euhydration. The other group (EUH; VO<sub>2peak</sub>, 46 ± 5 ml·kg<sup>-1</sup>·min<sup>-1</sup>) was tested while euhydrated without prior exercise-heat exposure. Aerobic performance was determined from a 30-min cycling pre-load (50% VO<sub>2peak</sub>) followed by a 15 min time trial in 40°C. Total work during the 15-min performance time trial in EUH and EUH<sub>PH</sub> was compared, as were the percentage changes from their best practice trial.

**RESULTS:**Volunteers were euhydrated (plasma osmolality <290 mOsm·kg<sup>-1</sup>) and normothermic prior to each aerobic exercise performance trial. Therefore, the 90 rest was sufficient to recover from hyperthermia (core temperature elevation of 1.4 ± 0.5°C). Heart rate and core temperature were not different (p>0.05) between groups at any time point during exercise. Total work was not different (p>0.05) at baseline or between EUH (150.5 ± 28.3kJ; 2.0 ± 0.3 kJ·kg<sup>-1</sup>) and EUH<sub>PH</sub> (160.3 ± 24.0 kJ; 1.8 ± 0.2 kJ·kg<sup>-1</sup>) exercise-heat trials. The percent change in total work relative to baseline was not different (p>0.05) between EUH (-18.7 ± 9.2%) and EUH<sub>PH</sub> (-15.0 ± 7.8%).

**CONCLUSIONS:** If hydration and body temperatures recover, prior exercise-heat exposure does not result in a greater degradation in aerobic exercise performance in the heat compared to heat exposure alone.

Author's opinion, not government policy.

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**2431 Board #76 May 29 8:00 AM - 9:30 AM**

**High Solar Radiation Degrades Thermoregulatory Model Performance in Highly Fit Runners**

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(No relationships reported)

Solar radiation can add up to 1000 W/m<sup>2</sup> to the heat load that needs to be dissipated in order to maintain heat balance. The effect of solar radiation on models of human thermoregulation during self-paced outdoor running is unknown but suspected to increase model error.

**PURPOSE:** To evaluate the accuracy of a model of thermoregulation in highly fit runners during high and low solar radiant loads.

**METHODS:** On day 1, 5 runners (3 male, 2 female) completed a self-paced 8K run on a 400m outdoor track. On day 2, 5 different runners (2 male, 3 female) completed the same run. Core temperature was measured via telemetry pill (T<sub>pill</sub>). Dry bulb temperature (29.4±0.5 vs 30.2±0.3°C) and relative humidity (62±3 vs. 61±2%) were similar, while black globe (31.3±1.8 vs. 38.3±1.5°C, p<0.01) and mean radiant (38.2±6.4 vs. 70.5±4.5°C, p<0.01) temperatures were significantly higher on day 2. The Initial Capability Decision Aide (ICDA) model was used to predict T<sub>c</sub>. Non-parametric Bland-Altman analyses were performed to assess model performance, in which the proportion of predicted T<sub>c</sub> values within 0.20°C of actual was calculated.

**RESULTS:** The mean 8K time was lower for day 1 (1639±114 vs. 1858±126s, p<0.05) though final T<sub>c</sub> (40.4±0.3 vs. 40.3±0.3°C) was similar. The model predicted 70% of T<sub>c</sub> values within 0.20°C of actual values during day 1 (low solar radiation) conditions but only 27% during day 2 (high solar radiation) conditions. Model predicted metabolic rate was similar between groups (9.7±1.7 vs 9.7±2.7 METS, p=0.98).

**CONCLUSIONS:** These results indicate that high solar radiation degrades ICDA thermoregulatory model performance. Alternative methods for quantifying solar radiation may yield improved model results.

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**2432 Board #77 May 29 8:00 AM - 9:30 AM**

**The Heat Intolerant Phenotype. Physiological Responses And Lymphocyte Transcriptome**

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(No relationships reported)

**INTRODUCTION:** During physical training in the heat, extreme metabolic heat storage manifests (pending on the individual features) as a rise in body core temperature (T<sub>c</sub>).

Individuals, previously exposed to heat exhaustion/stroke and demonstrating an earlier/faster T<sub>c</sub> and heart rate rise within a cohort study, are defined as "heat intolerant" (HI). Whether HI is a transient phenotypic or genotypic response is yet unknown.

**PURPOSE:** To investigate whether HI and heat tolerant (HT) subjects differ in their lymphocyte gene profile.

**METHODS:** 68 healthy young male volunteers, 1-3 months post-exertion heatstroke, underwent a heat tolerance test (HTT), consisting of walking on a treadmill for 2h at a speed of 5 km·h<sup>-1</sup> and 2% grade in a climatic chamber (40°C, 40% relative humidity). T<sub>c</sub>, T<sub>skin</sub> (3 sites), and heart rate were continuously monitored and recorded. Blood samples were drawn before, at the end of the HTT and after 1h of recovery in an air-conditioned room (23°C). Global gene profile of 6 HT and 6 HI lymphocytes RNA samples (2 pools per group) was detected and analyzed using two-color gene chips and bioinformatic tools.

**RESULTS:** According to the HTT, 10 subjects were diagnosed as HI and 58 subjects as HT. T<sub>c</sub> at the end of HTT was elevated by 1.4 and 0.77°C in the HI and the HT subjects, respectively. T<sub>skin</sub> vs. T<sub>c</sub>, indicative of skin blood flow, implied a HI sluggish response (vs. HT) (P<0.01). Two different gene chip experimental paradigms indicated differences in gene profiles of the HI vs. the HT group, prior to and following recovery from HTT. Basal differences in biological functional categories among the groups included genes associated with immune responses, stress (e.g., apoptotic pathways), transport, molecular processes (DNA and RNA regulation and organization) and metabolism.

**CONCLUSIONS:** This study (as well as our previous reports) characterizes a distinct HI physiological phenotype. This characterization of the HI phenotype demonstrates a differential genomic profile found even prior to heat stress tests, adding a novel category to the defined reasons for potential congenital HI.

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**2433 Board #78 May 29 8:00 AM - 9:30 AM**

**Heat Illness Symptom Index Scale In Football Players Predictive Of Elevated Gi Temperature In Subsequent Practice**

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(No relationships reported)

Exertional heat illness is a significant morbidity and mortality risk in individuals exercising in hot, humid environmental conditions. The third leading cause of death in US high school athletes, it is of considerable concern to the sports medicine team.

**PURPOSE:** This study investigated the relationship between subjective symptom scores and gastrointestinal temperature, T<sub>gi</sub>, in elite football athletes during two a day practices in the heat and humidity of southern Florida.

**METHODS:** 66 division I collegiate football athletes participated in this study over two years of two a day preseason practices. Athletes ingested T<sub>gi</sub> temperature thermistors preceding each practice and were evaluated by a validated symptom questionnaire, the Heat Illness Symptom Index (HISI), following each practice.



**RESULTS:** 5552 data points were obtained on 66 athletes, covering an average of 4.4 hours per player. The data was collected over 25 early preseason practices, 12 am practices and 13 pm practices. Each player was monitored for an average of four practices. Statistically significant correlation was seen between multiple variables and Tgi. Time elapse ( $p<.0001$ ), was obviously a predictor of core temperature elevation, but also player position group ( $p=0.0003$ ), BMI ( $p=0.0001$ ), symptom score of same practice ( $p<0.0001$ ), symptom score of the preceding practice ( $p<0.0001$ ), and rating of perceived exertion ( $p<0.0001$ ).

**CONCLUSION:** HISI scores following each practice were predictive of core temperature elevations in the the following practice ( $p=0.0001$ ). Those at highest risk of elevated core temperature the following practice were those that ranked in the fourth (highest) quartile on HISI score ( $p=0.0001$ ). The HISI can be a valuable, simple tool in identifying those at risk of elevated core temperature in football athletes exercising in the heat.

**2434 Board #79 May 29 8:00 AM - 9:30 AM**

**Soccer Match-induced Heat Stress Effects On Blood Biochemistry And Serum Osmolality**

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(No relationships reported)

Exertional heat illness is one of the most important health problems of athletes who have to train and compete in hot and humid environmental conditions. To our knowledge there are no published data that reflect the effects of heat strain on soccer players under extreme heat conditions.

**PURPOSE:** The aim of this study was to evaluate the effect of a competitive soccer match played at high environmental temperature and humidity on serum electrolytes, serum biochemistry and serum osmolality.

**METHODS:** 21 soccer players aged  $20 \pm 2$  y (mean  $\pm$  SD) with  $\dot{V}\text{O}_{2\text{max}}$  of ( $60.9 \pm 5.1$  ml/kg/min) volunteered to join this study. During the match, the ambient temperature and humidity were  $34.3 \pm 0.6$  °C and  $64 \pm 2$  %, respectively. Blood samples were withdrawn from an antecubital vein 5 hours before and immediately after the game. Thermosensor pills were used for body temperature measurements. Paired sample t-test was used to evaluate the level of significance, and p values  $< 0.05$  were accepted as significant.

**RESULTS:** Significant increases were found after the game in BUN ( $14.9 \pm 3.3$  vs  $19.5 \pm 3.9$  mg/dL), creatinine ( $0.9 \pm 0.1$  vs  $1.5 \pm 0.2$  mg/dL), Na ( $143 \pm 2$  vs  $145 \pm 3$  mmol/L), K ( $4.5 \pm 0.4$  vs  $5.3 \pm 0.4$  mmol/L). The highest body temperature recorded during the game was  $39.5 \pm 0.6$  °C. Players had opportunities to consume plain water ad libitum during the game, but post-match serum osmolality values were significantly higher than pre-match values ( $293 \pm 11$  vs  $285 \pm 12$  mosm/kg;  $p < 0.05$ ). The hematocrit ( $48.7 \pm 3.0$  vs  $49.2 \pm 3.0$  %) and hemoglobin values ( $16.1 \pm 1.2$  vs  $16.3 \pm 1.2$  g/L) were used to calculate % plasma volume change ( $-2.1 \pm 7.4$  %).

**CONCLUSIONS:** Even though the players consumed plain water ad libitum during the game, increased serum osmolality may emphasize the effects of thermal stress during a soccer match under extreme heat and humidity. Significantly increased BUN and creatine values may indicate dehydration-induced reduced renal perfusion. Playing soccer under extreme heat and humidity requires special care for the players in terms of heat stress and accompanying biochemical changes.

*Acknowledge: This study was Supported by FIFA/FMARC and the Turkish FA.*

**2435 Board #80 May 29 8:00 AM - 9:30 AM**

**Thermoregulatory Response To Heat In Soccer**

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(No relationships reported)

Soccer teams may sometimes be obliged to play under difficult environmental conditions. Indoor laboratory measurements may underestimate the associated thermoregulatory heat stress.

**PURPOSE:** To evaluate the heat stress responses of players during soccer matches played in different environmental temperatures and humidity.

	Temperature (°C)	Humidity (%)	Peak Body Core Temperature (°C)	Sweat Loss (L)	Dehydration (%)
April	$23 \pm 0$	$39 \pm 3$	$39.0 \pm 0.4$	$1.9 \pm 0.4$	$1.3 \pm 1.1$
June	$34 \pm 1^*$	$38 \pm 2$	$39.3 \pm 0.3$	$2.8 \pm 0.4^*$	$2.3 \pm 0.7^*$
July	$36 \pm 0^{**}$	$61 \pm 1^*$	$39.6 \pm 0.4^*$	$2.8 \pm 0.6^*$	$2.0 \pm 0.7$

**METHODS:** Non-acclimatized soccer players ( $n=15$ ,  $21 \pm 2$  y,  $\dot{V}\text{O}_{2\text{max}} = 62.5 \pm 7.1$  ml/min/kg, due to different

reasons some players could not played in all three matches, missing players replaced by other non acclimatized players) played 3 matches in different environmental conditions (Table) Players ingested telemetric core temperature (Tc) sensors prior to each match. Body weight, fluid intake, and urine volume were measured to determine % dehydration and sweat loss volume.

**RESULTS:** Temperature and humidity in July was significantly higher than April. In all cases the peak Tc was recorded in the first half of the game. Peak Tc recorded in the July match was significantly higher than the April match. Sweat loss volume was calculated as a function of mass loss, the amount of urine production and the amount of water consumed. The amount of sweat lost in June and July was higher than April. The amount of dehydration in June was than April.

\*: significantly different than April value

#: significantly different than June value

**CONCLUSIONS:** In all matches peak body core temperature values recorded in the first half were higher than peak temperature values in the second half. Post-match temperature measurements may under-estimate peak match core temperature values. Hyperthermia may occur in football players in games played at high ambient temperatures.

*Acknowledge : This study was Supported by Turkish FA*

**2436 Board #81 May 29 8:00 AM - 9:30 AM**

**The Effect Of Mild Dehydration On Heat Shock Protein Induction During An Acute Cycling Bout**

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(No relationships reported)

Low to moderate doses of physiologic stressors, including heat, cold, and exercise have been shown experimentally to induce HSP72. However, the effect of dehydration on HSP72 expression has not been previously examined.

**PURPOSE:** The present study evaluates the effect of mild dehydration on HSP72 expression during 90 minutes of continuous exercise.



**METHODS:** Three male subjects (mean  $\pm$  SD; ht, 177.7  $\pm$  9.5 cm, wt 70.7  $\pm$  8.6 kg, BF%, 7.8  $\pm$  1.4%; cycle VO<sub>2</sub> pk 53.0  $\pm$  3.6 ml/kg/min<sup>-1</sup>) performed two cycling bouts at 70% VO<sub>2</sub> pk (37.1  $\pm$  2.5 ml/kg/min<sup>-1</sup>) in a temperate environment (21.8  $\pm$  0.8°C, RH 42  $\pm$  1 %) for 90 minutes. In one condition subjects were provided water for 48 hours prior to exercise testing to ensure euhydration, while in the other subjects were voluntarily dehydrated. Nude bodyweight and urine osmolality were measured both pre and post exercise. During exercise core temperature, oxygen consumption, and power output were measured every 15 minutes. HSP72 was measured in peripheral blood mononuclear cells separated from blood samples taken pre and 1 hour post exercise. Western blot was used to quantify HSP72, with pretest levels being normalized to 1.0 for each condition to increase interpretation.

**RESULTS:** There were no differences ( $p > 0.05$ ) in peak core temperature (38.99  $\pm$  0.15 vs. 38.74  $\pm$  0.25°C), exercise induced change in bodyweight (1.8  $\pm$  0.7 vs. 1.8  $\pm$  0.8%), power output (185  $\pm$  2 vs. 186  $\pm$  5 W), or oxygen consumption (36.9  $\pm$  3.2 vs. 36.4  $\pm$  2.4 ml/kg/min<sup>-1</sup>) between the dehydrated and euhydrated conditions, respectively. Urine osmolality was greater in the dehydrated condition both pre (808  $\pm$  159 vs. 163  $\pm$  78 mosm/kg;  $p < 0.001$ ) and post exercise (908  $\pm$  189 vs. 302  $\pm$  66 mosm/kg;  $p < 0.001$ ). Following exercise HSP72 expression in the euhydrated condition was 47% lower than the dehydrated condition. Although this difference was large, variability in dehydrated subjects post exercise HSP72 values prevented us from showing a significant difference ( $p = 0.14$ ).

**CONCLUSION:** Preliminary findings ( $n = 3$ ) indicate that mild dehydration may not be sufficient to induce HSP72 during an acute bout of exercise. Whether this trend will remain with greater  $n$  size remains to be determined.

**2437 Board #82 May 29 8:00 AM - 9:30 AM**  
**Assessment Of Heat Shock Protein 72 Day to Day Reliability**

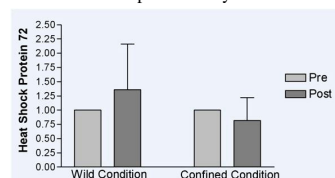
Matthew Kuennen<sup>1</sup>, Trevor Gillum<sup>1</sup>, Kevin Christmas<sup>1</sup>, Karol Dokladny<sup>2</sup>, Suzanne Schneider<sup>2</sup>, Pope Moseley, FACSM<sup>2</sup>. <sup>1</sup>University of New Mexico, Albuquerque, NM. <sup>2</sup>University of New Mexico Hospital, Albuquerque, NM.

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(No relationships reported)

Although extensive research has analyzed the stress inducible HSP72, a confounding variable has been the inter-subject variability existing at baseline. It remains to be determined whether greater experimental control can increase uniformity of basal HSP72 expression.

**PURPOSE:** The present study evaluates whether increasing control of subject diet, hydration, physical activity, and environmental exposure will reduce variation in HSP72.



**METHODS:** Four male subjects (mean  $\pm$  SD; ht, 176.8  $\pm$  8 cm; wt, 74.6  $\pm$  10.4 kg; age, 25  $\pm$  3 yrs) repeated two experimental conditions in a counterbalanced order. In the confined condition (CC) subjects became hospital inpatients for 48 hours. Caloric intake (60% CHO, 15% PRO, 25% FAT) was set according to current dietary reference intakes (activity factor = 1.4). Fluid and caffeine intake were controlled to ensure euhydration. Subjects were restricted to the hospital, ensuring they remained sedentary and were not exposed to UV light. In the wild condition (WC) subjects were on the honor system to follow the same guidelines, mimicking a traditional HSP72 protocol. HSP72 was measured in peripheral blood mononuclear cells separated from blood samples taken 1 hour post prandial at the beginning (Pre) and end (Post) of each condition. Western blot was used to quantify HSP72, with pretest levels being normalized to 1.0 for each condition to aid interpretation.

**RESULTS:** Following CC subjects were more hydrated than in WC (urine osmolality = 166  $\pm$  64 mosm/kg vs 850  $\pm$  154 mosm/kg;  $p < 0.01$ ). HSP72 was not different ( $p > .05$ ) from WC.

**CONCLUSION:** Preliminary data ( $n = 4$ ) reveal a difference in both intersubject and intrasubject variability following CC, but at this time these differences are not statistically significant.

**2438 Board #83 May 29 8:00 AM - 9:30 AM**  
**Time Course of Intracellular Heat Shock Protein 72 During And After Acute Cycle Ergometry**

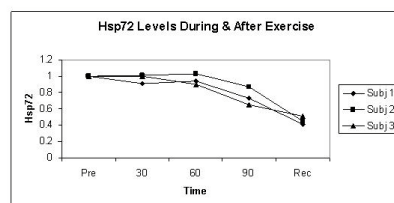
Trevor L. Gillum, Matthew Kuennen, Kevin Christmas, Karol Dokladny, Sue Schneider, Pope Moseley, FACSM. University of New Mexico, Albuquerque, NM.

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(No relationships reported)

Heat shock proteins (Hsp) are a ubiquitous family of proteins known to have cytoprotective functions. Previous data has shown that serum Hsp72 is known to increase in response to exercise, but the response and time course of intracellular Hsp72 in peripheral blood mononucleated cells (PBMCs) during exercise has yet to be critically examined.

**PURPOSE:** To measure the intracellular Hsp72 response in PBMCs to cycle ergometry. We hypothesized that Hsp72 will increase throughout the exercise bout.



**METHODS:** Three healthy, active (VO<sub>2</sub> pk 53.0  $\pm$  3.6 ml/kg/min) males (BW 70.7  $\pm$  8.6 kg) participated in this study. Subjects were confined to the hospital for the 48 hrs prior to exercise to minimize variance by standardizing activity, diet, hydration, & UV exposure. Cycle ergometry consisted of 90 min at 70% VO<sub>2</sub> max in a thermo-neutral environment (21.8  $\pm$  0.8°C, 44.2%  $\pm$  1.0 RH). Subjects consumed 125 mL of water every 15 min. Blood samples were collected pre, 30, 60, and 90 min, along with 1 hr post. Western blot was used to quantify the presence of Hsp72 in PBMCs during and after exercise.

**RESULTS:** Core temperature reached 38.63  $\pm$  .19°C during exercise and subjects body weight decreased 1.8  $\pm$  0.8%. In all three subjects, Hsp72 levels decreased 13-35% from pre to 90 min of exercise, and 48-58% from pre to 1 hr post exercise.

**CONCLUSION:** With exercise there is an initial depletion of intracellular Hsp72 levels. This preliminary data suggests the response of intracellular Hsp72 during exercise is opposite of serum Hsp72.

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## **E-31 Free Communication/Poster - Muscle Damage**

MAY 29, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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**2439 Board #84 May 29 9:00 AM - 10:30 AM**  
**Use Of Diffusion Tensor Magnetic Resonance Imaging For Assessment Of Musculoskeletal Structure Following High-force Eccentric Exercise: A Case Study**

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(No relationships reported)

Typically, only dramatic muscle damage associated with edema and hemorrhage has been visible with MRI as even with MRI's superior spatial resolution, subtle muscle tear evaluation has been limited. Recently however, diffusion tensor (DT) MRI has been successful in detecting abnormalities in muscle tissue induced by disease or traumatic injury (Zaraskaya, et al. 2006). DT-MRI offers not only a way to diagnose skeletal muscle disruption, but also to quantify the abnormality within the muscle tissue. As a noninvasive technique, DT-MRI makes it possible to perform repeat imaging and evaluate the duration and severity of the muscle injury over time. Strenuous unaccustomed exercise induces ultrastructural evidence of skeletal muscle disruption; however the potential use of DT-MRI to investigate exercise-induced muscle tissue alteration has not been examined.

**PURPOSE:** To investigate acute changes in musculoskeletal structure following a high-force eccentric exercise protocol previously shown to induce skeletal muscle disruption (Beaton et al., *Med Sci Sports Exerc* 34:798-805, 2002).

**METHODS:** A healthy active 39 year old man performed 24 sets of 10 maximal eccentric actions with the leg extensors of the dominant limb on a Biodex isokinetic dynamometer (0.52 rad\*s<sup>-1</sup>), separated by 30 s rest. The contralateral leg served as a non-exercised control limb. Isometric peak torque and DT-MRI was measured before and after exercise. DT-MRI was performed using a GE 3T excite-HD MRI system using 6 diffusion encoding directions (4 NEX, FOV=20cm, TE/TR=67/6000, 64x64 matrix, 3mm thick, 0 skip, b=400s/mm<sup>2</sup>). DT-MRI fractional anisotropy (FA) analysis was performed using diffusion toolkit software; while fiber tracking for visualization of muscle tears was done using TrackVis software.

**RESULTS:** Isometric peak torque was lower immediately following exercise compared to pre-exercise (202 vs 237 N•m) and remained lower after 24 h (208 N•m) of recovery. An increase in FA (typically seen in tissues that are exhibiting loss of cell membrane integrity) as well as muscle fiber disorganization was observed in the exercised limb. These changes were not visualized in the contralateral control limb.

**CONCLUSION:** Preliminary data suggest that DT-MRI is very sensitive to muscle tissue alteration following high-force eccentric exercise.

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**2440 Board #85 May 29 9:00 AM - 10:30 AM**  
**Effect Of b-hydroxy-b-methylbutyrate On Biomarkers Of Muscle Damage After Prolonged Downhill Running**

Elias Zacharogiannis<sup>1</sup>, Giorgos Paradisis<sup>2</sup>, John Karanikolas<sup>3</sup>, Mirsini Kolifa<sup>2</sup>, Nikos Anagnostou<sup>4</sup>, Dimitris Tsitsiropoulos<sup>5</sup>, Chrisoula Nikolaou<sup>3</sup>. <sup>1</sup>Univ. of Athens, Faculty of Physical Education and Sports Science, Athens, Greece. <sup>2</sup>Univ. of Athens, Faculty of Physical Education and Sports Science, Athens, Greece. <sup>3</sup>Department of Microbiology, Aiginitio Hospital, Athens Medical School, Athens, Greece. <sup>4</sup>Ippokratio General Hospital of Athens, Athens, Greece. <sup>5</sup>Touro College NY, USA, NY, NY.  
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The leusine metabolite beta-hydroxy-beta-methylbutyrate (HMB) has been shown to increase muscle mass and strength following resistance training and has been also proposed to function as an anticatabolic agent and decrease exercise induced muscle damage.

**PURPOSE:** The aim of this study was to investigate the effects of 14 days oral supplementation of HMB on muscle damage as a result of intense and prolonged uphill and downhill running.

**METHODS:** Subjects (n=22) well trained endurance runners were randomly assigned to treatment of either HMB (3g/day) or a placebo for 2 weeks before race. They all run Olympus mountain marathon (44km) consisted of 21km uphill to 2700m altitude and 23km continuous downhill. Venous blood samples were obtained from the participants before, immediately after the race, also 3 and 7 days post race. They were analysed with standard methods for creatine phosphokinase (CPK), lactate dehydrogenase (LDH) and myoglobin (MGL).

**RESULTS:** Mean±sd (n=22) pre race CPK (149.55±21.47 U/L), MGL (32.31±4.00 mcg/l) and LDH (327.27±34.43 U/L) increased 5 (714.06±203.02U/L), 20 (662.06±260.99mcg/l) and 2 (698.06±107.84 U/L) fold (p<0.01) respectively immediately after the race. Mean CPK (256.93 U/L), MGL (61.64 mcg/l) and LDH (467.21 U/L) activities remained elevated 1.7, 1.9, and 2.1 fold (p<0.05) respectively 72 hours after the race. The placebo-supplemented group exhibited significantly greater (p<0.05) plasma concentration of CPK, LHD and MGL post race, 3 days and 7 days after the race than did the HMB supplemented group. Placebo-supplemented group presented also greater (p<0.05) mean difference (post race minus pre race values) in muscle damage biomarkers.

**CONCLUSIONS:** The results of this study indicate that 2 weeks dietary supplementation of 3.0g HMB/day in endurance runners resulted in decreased CPK, LDH and MGL, after a very prolonged run. The finding agree with the hypothesis that HMB supplemented athletes experienced less muscle damage and also recovered at a faster rate.

References: Nissen S. et al. b-hydroxy-b-methylbutyrate (HMB) supplementation in humans is safe and may decrease cardiovascular risk factors. *J of Nutrition*. 2000, 130, 1937-1945, Kniteer A. E. et al. Effects of b-hydroxy-b-methylbutyrate on muscle damage after o prolonged run. *J. Appl. Physiol*. 2000, 89, 1340-1344.

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**2441 Board #86 May 29 9:00 AM - 10:30 AM**  
**Dietary Protease Supplementation Attenuates Eccentric-exercise Induced Force Production Decrements By Regulating Leukocyte Activity**

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Dietary protease supplementation has been purported to reduce the damaging effects of eccentric exercise and accelerate recovery of muscle function, possibly by regulating local inflammation.

**PURPOSE:** To determine the effectiveness of prophylactic protease supplementation in attenuating eccentric-exercise induced skeletal muscle damage and inflammation.

**METHODS:** Following standard physical and hemodynamic assessment subjects donated fasting venous blood samples. Subjects then performed isokinetic extension/flexion of the quadriceps group on a Biodex isokinetic dynamometer at 60°/s, followed by VO<sub>2</sub>max testing. Subjects were randomly assigned to consume 5.83g daily of either a cellulose placebo (N= 15; 22.27±3.33 yr, 71.17±2.91 in, 179.4±24.05 lb, 50.55±5.66 ml/kg/min) or a proteolytic supplement containing fungal proteases, bromelain, and papain (N= 14; 22.85±5.9 yr, 70.0±2.67 in, 173.11±29.94 lb, 49.69±6.15 ml/kg/min) for a period of 21 days. Following the supplementation period, subjects donated blood samples prior to performing a 45 minute downhill (-17.5%) treadmill protocol at 60% of VO<sub>2</sub>max. An additional 4 blood draws and 3 muscle function tests were performed over the next 48h. Blood was analyzed using standard hematology and clinical chemistry, ELISA, and bead-array. Blood data were analyzed using MANOVA with repeated measures, while Biodex data were analyzed using MANOVA on %D values.

**RESULTS:** Significant group differences (T1-T3, p= 0.033; T1-T4, p= 0.043) and another strong trend (T1-3h, p= 0.055) were observed for flexion peak torque %D at 60°/s. No significant differences were observed for extension. Following eccentric exercise, muscle force in the protease group actually increased (T1-3h: 4.73%, T1-T3: 3.01%, T1-T4: 6.44%), while the placebo group experienced significant force decrements (T1-3h: -19.54%, T1-T3: -27.94%, T1-T4: -25.87%). Significant group x time interactions (p < 0.05) for the protease group were observed with increases in circulating eosinophils, basophils, and decreases in serum COX2, IL-6, and IL-12.

**CONCLUSION:** Protease supplementation appears to attenuate muscle strength loss following eccentric exercise by altering leukocyte activity and inflammatory responses.

Funded by Transformation Enzyme Corp. (Houston, TX) & ACSM Texas Chapter.

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**2442 Board #87 May 29 9:00 AM - 10:30 AM**

**Delayed Inflammation-regeneration Response Following Eccentric Contractions In Diabetic Rat Skeletal Muscle**

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(No relationships reported)

Background: Resistance training using eccentric contractions (ECC) can induce muscle hypertrophy more effectively compared with isometric and concentric contractions but also can incur substantial muscle damage. In diabetes mellitus (DIA) skeletal muscle atrophies and there is a pressing need for therapeutic strategies for sustaining muscle mass. Unfortunately DIA is also accompanied by increased muscle fragility and ECC in DIA might cause more extreme and prolonged muscle damage.

**PURPOSE:** To test the hypothesis that DIA is associated with a delayed muscle recovery (phagocytosis and regenerative action) following ECC.

**METHODS:** Ten-week-old male Wistar rats were divided randomly into diabetic (DIA: 65 mg/kg Streptozotocin i.p.) and nondiabetic groups (NORM: saline injection). Four weeks later the right tibialis anterior (TA) muscles in both NORM and DIA were subjected to 40 electrically-induced eccentric contractions (10 volt stimulation, 100 Hz frequency, 700 msec stimulation period i.e., 70 pulses) and synchronous stretching (lengthened from 50 to 180 degrees of the ankle joint) by electromotor. The contralateral TA muscle served as control for each group. TA muscle was dissected after 1(1D), 3 (3D), 7 (7D) and 14 days (14D) following ECC (each time point, n = 5-8). Damaged fibers were defined as those with: swollen appearance, infiltration by inflammatory cells, pale staining of the cytoplasm, or central nuclei (hematoxylin-eosin (HE) stain). The inflammatory cells (neutrophils, ED1+ and ED2+ macrophages) were identified immunohistologically.

**RESULTS:** Damaged muscle fibers appeared swollen and infiltration of inflammatory cells were present on 1D to 7D in both NORM and DIA. The extent of muscle damage was lower (P<0.05) in DIA (1D: 0.9±/ 0.4%, 3D: 9.7±/ 1.7%, 7D: 3.7±/ 2.6%, 14D: 0.1±/ 0.0%) than NORM (1D: 0.9±/ 0.4%, 3D: 19.1±/ 4.5%, 7D: 1.6±/ 0.7%, 14D: 0.2±/ 0.1%). ED1+ macrophages were observed mostly at 3D in NORM but continuously expressed until 7D in DIA. The number of pale staining fibers (invasion end phase) was higher in DIA than NORM at 7D. Muscle fibers with central nuclei were persisted from 7D to 14D in NORM but detected only at 14D in DIA.

**CONCLUSION:** The ECC-induced inflammation-regeneration response is delayed in diabetes.

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**2443 Board #88 May 29 9:00 AM - 10:30 AM**

**Location Of Damage In Skeletal Muscle After Lengthening Contractions**

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(No relationships reported)

Submaximal lengthening ("eccentric") contractions are used in everyday life, but high force lengthening contractions are associated with muscle damage and pain. The muscle-tendon junction (MTJ) is commonly cited as the primary area where myofiber damage occurs.

**PURPOSE:** To study the location of myofiber damage resulting from muscle strain injury. In mammalian skeletal muscle, myofibers do not extend the length of the muscle. Thus, even if an injury extends throughout the cell, it cannot be assumed that damage observed in a cross section is similar throughout the whole muscle. We hypothesized that the most damage to the fibers after lengthening contractions occurs in the middle of the muscle.

**METHODS:** Injury to the rat (N=10) tibialis anterior muscle (TA) was induced by lengthening contractions (described previously, 2007). High resolution (250µm in-plane @ 1mm slice thickness) multi-echo proton density/T2-weighted spin-echo MR images (TE1/TE2/TR=13/48/2000ms) were acquired on a Bruker Biospec 7T/30 Avance MR system to assess muscle damage on the day of injury (D0) and days 1 and 3 (D1; D3). TAs were harvested either on D0 to quantify the number of fibers with membrane damage (using IP injections of Evans Blue Dye [EBD]), or on day 14 to quantify the number of centrally nucleated fibers (using HE stain to visualize CNFs). CNFs are an accepted a marker of myogenesis that occurs after myofibers damage, but they do not appear immediately after injury.

**RESULTS:** Injury was confirmed by a significant loss of torque (45 %). On D0, T2 values were elevated (60%) throughout the muscle belly, but limited to the MTJ by D1 after injury. The number of fibers with membrane damage was much higher in the middle of the muscle (30 ± 12% of fibers) than in the distal portion of the muscle (4 ± 1% of fibers). The occurrence of CNFs was much higher in the middle of the muscle (40 ± 8% of fibers) than in the distal muscle (5 ± 3% fibers).

**CONCLUSIONS:** If treatments are delivered to muscle tissue to foster myogenesis and facilitate muscle growth, it is important to know where the damage is occurring. Our results suggest that myofiber injury occurs primarily in the middle portion of the muscle and that the consequent edema is initially widespread, but then limited to the MTJ. Thus, findings on MRI several days after injury may not necessarily reflect damage to the myofibers.

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**2444 Board #89 May 29 9:00 AM - 10:30 AM**

**Transcriptional Response Of Nitric Oxide Synthase In Pressure-induced Muscle Damage**

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(No relationships reported)

Although pressure, shear and ischemia have been identified in the etiology of pressure ulcer, the molecular mechanisms contributing to the development of pressure ulcer are still unclear.

**PURPOSE:** To scrutinize the mRNA expression of NOS-1 and NOS-2 in rat skeletal muscle in the molecular regulation of pressure-induced deep tissue injury.

**METHODS:** Eight adult Sprague Dawley rats were subjected to an deep tissue injury protocol as induced by moderate prolonged compression. Static pressure of 100mmHg

loading was applied to an area of 1.5cm<sup>2</sup> in the tibialis region of the right limb of the rats for 6 hours each day on two consecutive days. The loading force was continuously monitored by a 3-axial force transducer equipped in the load indenter. A laser Doppler flowmetry with a contact probe was used to monitor the blood flow of the loading site. The left unloaded limb served as intra-animal control. Tissues directly underneath the loading region were collected and quickly frozen. Upon analysis, total RNA was extracted from both the control and loading muscle samples. The gene expression level of NOS-1 and NOS-2 were determined by real time reverse transcript-polymerase chain reaction (RT-PCR). Data were expressed as the fold differences (mean  $\pm$  SEM) over controls normalized to the housekeeping GAPDH gene. Paired t-test was used to examine differences between control and compressed groups. Level of statistical significance was accepted at  $P < 0.05$ .

**RESULTS:** Blood flow of the loading area was reduced by ~50% as determined by the Doppler flowmetry. No significant difference was found in the mRNA level of NOS-1 between control and compressed rat skeletal muscle ( $p > 0.05$ ). NOS-2 transcript content was observed to be folds-upregulated ( $421.26 \pm 263.14$  fold, ranging from 8 to 2187 fold) in all the compressed muscles relative to control but this change did not reach statistical significance level probably due to the large variability in the increasing response of NOS-2 mRNA to compression.

**CONCLUSIONS:** We interpret our data that NOS-2 transcript is probably upregulated in pressure-induced deep tissue injury as induced by prolonged moderate compression. Additional study is needed to further examine the involvement of NOS in deep pressure ulcer.

Supported by Hong Kong Polytechnic University Research Funds A-PH69, A-PA7N and G-U469.

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**2445 Board #90 May 29 9:00 AM - 10:30 AM**

**Sex Difference In Intracellular  $\text{Ca}^{2+}$  Accumulation Following Eccentric Contractions Of Rat Skeletal Muscle**

Takashi Sonobe<sup>1</sup>, Jun Nagata<sup>1</sup>, Tadakatsu Inagaki<sup>1</sup>, David C. Poole, FACSM<sup>2</sup>, Yutaka Kano<sup>1</sup>. <sup>1</sup>University of Electro-Communications, Chofu, Tokyo, Japan. <sup>2</sup>Kansas State University, Manhattan, KS.

(No relationships reported)

Skeletal muscle damage is lower in females than males following unaccustomed intense eccentric exercise (e.g., Komulainen et al. Acta Physiol. Scand. 165: 57-63, 1999). The mechanistic bases for this gender-specific phenomenon remain to be resolved. Muscle damage has been linked to loss of  $\text{Ca}^{2+}$  homeostasis and resultant intramyocyte  $\text{Ca}^{2+}$  accumulation ( $[\text{Ca}^{2+}]_i$ ) and it is possible, therefore, that males experience greater eccentric exercise-induced muscle damage because of more pronounced  $\text{Ca}^{2+}$  accumulation.

**PURPOSE:** To test the hypothesis that, following repeated bouts of unaccustomed eccentric contractions, the rise in  $[\text{Ca}^{2+}]_i$  evident in males would be either reduced or absent in females.

**METHODS:** The experiments were performed by  $\text{Ca}^{2+}$  imaging using fura2-AM in rat spinotrapezius muscle *in vivo*. Adult Wistar rats were divided into three groups: Male, Female and, to investigate the effects of estrogen specifically, ovariectomized females (OVX). For *in vivo* microscopic observation, animals were anesthetized and the spinotrapezius muscle exteriorized maintaining principal blood vessels and neural pathways intact. Tetanic eccentric contractions (100Hz, 700 ms duration, 20 contractions per minute for a total of 10 sets of 50 contractions) were elicited by electrical stimulation during synchronized muscle stretch of 10% resting muscle length evoked via a stimulator-linked stretching unit. Change of fluorescence ratio (340/380 nm) was determined from fluorescence images captured following each set of contractions, and used to estimate  $[\text{Ca}^{2+}]_i$  and changes thereof.

**RESULTS:** Following eccentric contractions  $[\text{Ca}^{2+}]_i$  increased significantly in Male ( $42.8 \pm 5.3\%$ ,  $P < 0.01$ ) but not in Female ( $9.4 \pm 3.5\%$ ) rats. OVX evidenced an intermediate response ( $17.0 \pm 1.2\%$ ) that remained significantly reduced compared with Male.

**CONCLUSIONS:** These results demonstrate that Females maintain  $[\text{Ca}^{2+}]_i$  homeostasis following novel eccentric contractions whereas Males do not which is consistent with a role for elevated  $[\text{Ca}^{2+}]_i$  in eccentric exercise-induced muscle damage. The presence of estrogen is not obligatory for this gender difference.

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**2446 Board #91 May 29 9:00 AM - 10:30 AM**

**Muscle Force And Indirect Markers Of Exercise-induced Muscle Damage**

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(No relationships reported)

**PURPOSE:** To identify the heterogeneity of responses in muscle force production and other indirect measures of exercise-induced muscle damage following a bout of eccentric exercise; and, to determine the level of agreement between the magnitude of responses in muscle force production and indirect measures of muscle damage.

**METHODS:** 46 male participants, who were unaccustomed to eccentric exercise, performed a damaging bout of exercise comprising 3 sets of 15 maximal lengthening contractions of the elbow flexors at  $30^\circ \cdot \text{s}^{-1}$ . Elbow flexor isometric torque (MVC), CK activity in blood (CK), muscle soreness (SORE) using the Talag scale, elbow range of motion (ROM) and upper arm girth (GIRTH), were measured pre-exercise and at 48 h and 96 h post-exercise. Cluster analysis of the peak responses in dependent variables was performed to identify LOW, MEDIUM and HIGH responders to the exercise protocol; comparison between MVC and other dependent variables for LOW, MEDIUM and HIGH was made.

**RESULTS:** For MVC, 29 cases were classified as LOW (mean  $\pm$  SD =  $-15.0 \pm 6.6\%$ ), 12 cases as MEDIUM ( $-32.5 \pm 5.1\%$ ) and 5 cases as HIGH ( $-52.7 \pm 8.9\%$ ). For CK, 15 cases were classified as LOW ( $292.7 \pm 108.8$  IU/L), 18 cases as MEDIUM ( $723.7 \pm 171.0$  IU/L) and 13 cases as HIGH ( $1455.5 \pm 273.5$  IU/L). For SORE, 21 cases were classified as LOW ( $2.6 \pm 0.5$ ), 16 cases as MEDIUM ( $4.0 \pm 0.2$ ) and 9 cases as HIGH ( $5.2 \pm 0.4$ ). For ROM, 27 cases were classified as LOW ( $-7.1 \pm 2.8\%$ ), 11 cases as MEDIUM ( $-16.7 \pm 2.6\%$ ) and 8 cases as HIGH ( $-27.1 \pm 3.6\%$ ). For GIRTH, 24 cases were classified as LOW ( $0.9 \pm 0.3\%$ ), 20 cases as MEDIUM ( $2.0 \pm 0.5\%$ ) and 2 cases as HIGH ( $3.9 \pm 0.1\%$ ). Comparison of LOW, MEDIUM and HIGH group membership revealed poor agreement between MVC and the indirect measures of muscle damage.

**CONCLUSIONS:** This study supports previous literature reporting a high level of heterogeneity in the manifestation of signs and symptoms associated with exercise-induced muscle damage. In addition, there appears to be only limited agreement between the magnitude of response in muscle force production and that of indirect measures following eccentric exercise.

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**2447 Board #92 May 29 9:00 AM - 10:30 AM**

**Gene Expression In Human Skeletal Muscle Following An Acute Bout Of Concentric Or Eccentric Exercise In Young Women**

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(No relationships reported)

**PURPOSE:** To investigate changes in mRNA expression of muscle atrophy F-box (MAFbx), p70S6 kinase (p70<sup>S6k</sup>), forkhead box 3A (FOXO3a) and myogenic differentiation factor (MyoD) at rest and in response to a single bout of concentric or eccentric contractions in young women.

**METHODS:** Twelve recreationally active young women were divided into two groups to perform unilateral, leg extension resistance exercise: 6 ( $24 \pm 0$ yr,  $65 \pm 7$ kg) in the concentric (CON) group performed 10 sets of 10 repetitions of maximal concentric contractions, while 6 ( $25 \pm 1$ yr,  $59 \pm 7$ kg) in the eccentric (ECC) group performed 10 sets of 10 repetitions of maximal eccentric contractions. Muscle biopsies were taken from the vastus lateralis before and 8 hours after the exercise bout. mRNA from the muscle

samples were evaluated using RT PCR and normalized to 18s (house keeping gene). *t* tests were used to compare gene expression changes within and between groups with significance set at  $p < 0.05$ .

**RESULTS:** In response to exercise, MAFbx expression decreased by  $43 \pm 23\%$  ( $p = 0.007$ ) in the CON group, and by  $81 \pm 13\%$  ( $p < 0.001$ ) in the ECC group. The decrease in MAFbx was significantly different between groups ( $p = 0.007$ ). MyoD expression increased  $135 \pm 11\%$ , ( $p = 0.03$ ) in the CON group and  $61 \pm 47\%$  ( $p = 0.025$ ) in the ECC group.  $p70^{S6k}$  and FOXO3a demonstrated no significant change in gene expression.

**CONCLUSIONS:** These data indicate that a single bout of maximal CON or ECC training does not influence mRNA gene expression for  $p70^{S6k}$  and FOXO3a. Data also indicate that a single bout of maximal ECC training has greater down regulation of MAFbx, a known regulator of muscle protein breakdown. This suggests that contraction mode may be important in mediating specific myogenic regulatory genes.

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**2448 Board #93 May 29 9:00 AM - 10:30 AM**

**Traumatic Skeletal Muscle Injury Alters Post-translational Matrix Metalloprotease-3 Expression**

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Matrix metalloproteases (MMPs) are regulatory enzymes that function in proteolytic cascades and extracellular matrix (ECM) remodeling. Since skeletal muscle injury is accompanied by major changes in the ECM (e.g., inflammation, degeneration, satellite cell activation) it is important to characterize the role of MMPs in the injury process. Stromelysin-1 (MMP-3) has particular significance in muscle injury since it degrades numerous ECM proteins and the expression and activation of MMP-3 is a critical regulatory step in the activation of other MMPs and possibly, satellite cells.

**PURPOSE:** To characterize the time course and profile of MMP-3 expression and activity post-injury in skeletal muscle.

**METHODS:** Forty-two C57BL/6J mice were anesthetized, one tibialis anterior (TA) muscle was exposed, and injury was induced by applying a steel probe (cooled to -79 C) to the belly of the TA muscle for 10s. Muscle samples were collected from both uninjured and injured legs at 3, 10, 24, 48, and 72 h post-injury. Quantitative Real Time Polymerase Chain Reaction (qRT-PCR), immunoblotting, and immunohistochemistry (IHC) were used to quantify/localize MMP-3 expression and activity. IHC for PAX-7 was used to identify satellite cell activation.

**RESULTS:** Relative to the uninjured leg, the MMP-3 mRNA level increased 2.7-, 18.7- and 12.0- fold at 3, 10, and 24 h post-injury ( $p < 0.01$ ), and returned to baseline levels 48 h post-injury. Latent (57/59 kDa) MMP-3 protein levels increased 24.8-, 24.9-, 31.1-, 29.9-, and 23.5-fold at 3, 10, 24, 48, and 72 h post-injury ( $p < 0.05$ ). In contrast, active (45 kDa) MMP-3 protein levels were decreased by 4.0-, 5.4-, 5.2-, 4.9-, and 7.2- fold at 3, 10, 24, 48, and 72 h post-injury ( $p < 0.05$ ), respectively. There was a concomitant increase in MMP-3 staining and macrophage infiltration between 3 and 24 h, with macrophage infiltration and PAX-7 staining peaking 72h post-injury. Increased skeletal muscle expression of MMP-3 mRNA appears to drive increases in the latent form of the MMP-3 protein post-injury. However, post-translational processing of the MMP-3 protein to its active form is decreased post-injury.

**CONCLUSION:** Regulation of latent and active MMP-3 protein levels at this post-translational step may be a critical therapeutic target for the control of ECM remodeling post-injury.

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**2449 Board #94 May 29 9:00 AM - 10:30 AM**

**Impact Of Two Different Resistive Exercise Methods In Post-exercise Creatine-kinase Plasma Levels**

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(No relationships reported)

**PURPOSE:** The aim of this investigation was to determine the effect of two different RE methods on creatine-kinase (CK) plasma levels.

**METHODS:** Young adult men ( $n = 10$ ,  $26.1 \pm 6.3$  years old;  $174.0 \pm 5.4$  cm height;  $76.4 \pm 13.3$  kg weight;  $15.48 \pm 5.42$  % body fat) with previous experience in RE were divided in to two groups and both performed an exercise sessions in two different intensities determined by one maximum repetition (1MR) tests, with one week interval between them. The training sessions consisted in three consecutive exercises for the same muscle group (bench press, incline bench press, peck deck); the variable intensity (VI) session performed 3 sets for each exercise performed at 67%, 75% and 80% of 1MR while the constant intensity (CI) group performed 3 sets for each exercise at 75% of 1MR. Blood samples were obtained from the antecubital vein at rest, immediately after, 24, 48 and 72 after the exercise sessions. CK levels were analyzed using the spectrophotometry method (Bio System). Friedman-Anova was applied to analyze blood CK. Wilcoxon test was utilized to detect differences.

**RESULTS:** The results will be presented on the table below:

**CONCLUSIONS:** Is well established on the literature that muscle contractions can provoke muscle damage specially 24-48 hours after the end of the exercise session. We observed an increase in CK levels 48-72 hours after the end of both exercise sessions, indicating that blood CK level may not be a good indicator of muscle damage.

Creatine-kinase (U/L)	Pre (x±s)	Post (x±s)	24h (x±s)	48h (x±s)	72h (x±s)
CI	220,9± 99,8	236,2± 93,5	480,1± 402,4	1.236,6± 1.686,4	2.708,9± 1.936,5*
VI	336,3± 206,7	601,2± 522,7	1.178,2± 1.109,2	1.811,0± 2.050,1*	2.199,4± 1.747,0*

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**2450 Board #95 May 29 9:00 AM - 10:30 AM**

**Increased Mechano-growth Factor Gene Expression Following Stretch-shortening Contraction Loading: Impact Of Glutathione And Age**

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(No relationships reported)

Specific genes regulating multiple pathways in the adaptive response in skeletal muscle following glutathione modulation and repetitive mechanical loading are not known.

**PURPOSE:** The purpose of this study was to characterize gene transcripts influenced by dietary supplementation with a glutathione antagonist (L-Buthionine Sulfoximine (BSO)) following chronic high-intensity mechanical loading via stretch-shortening contractions (SSCs) in young and old rats.



**METHODS:** Left dorsiflexor muscles of young (12 weeks, N= 32) and old (30 months, N = 30), vehicle- (VEH) and BSO-treated rats were exposed 3 times per week for 4.5-weeks to a protocol of 80 maximal SSCs per exposure *in vivo*, while cage, age-matched rats served as controls (CON). Messenger levels for MyoD, Bax, Bcl2, Caspase-9, IL-15, IL-1-b, MCP-1, TGF-b1, IL-10, mechano-growth factor (MGF), and 18s (control) genes were characterized by RT-PCR analysis following the SSC-exposure period.

**RESULTS:** Following 4.5 weeks of SSC loading only MGF mRNA levels were significantly altered by treatment (young BSO increased versus young VEH;  $p < 0.05$ ) and age (young BSO increased versus old BSO;  $p < 0.05$ ).

**CONCLUSIONS:** Even though MGF mRNA was the only transcript influenced by glutathione modulation and/or aging, further investigation is needed to evaluate changes in protein levels. However, the present study clearly demonstrates that MGF mRNA is influenced by both glutathione modulation and aging.

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**2451 Board #96 May 29 9:00 AM - 10:30 AM**

**Glutamine Supplementation Preserves Skeletal Muscle Force During Acute Inflammation**

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(No relationships reported)

Acute and chronic inflammatory diseases are often associated with respiratory and skeletal muscle weakness and potential muscle wasting. Decrements in muscle function under these conditions may be mediated in part by elevated levels of catabolic cytokines such as TNF $\alpha$ , which has been shown to independently and acutely reduce contractile function. Glutamine has been shown to protect in various tissues against inflammatory insults, in part by the up-regulation of protective heat shock proteins (HSP) and/or reducing catabolic cytokine levels.

**PURPOSE:** To test the hypothesis that acute Glutamine (GLN) supplementation can counteract skeletal muscle contractile dysfunction occurring in response to an inflammatory insult by elevating muscle Hsp expression and reducing systemic and muscle cytokines.

**METHODS:** Mice received 5mg/kg Lipopolysaccharide (LPS) concurrently with 1g/kg GLN or saline (Sal) vehicle treatments. Plantarflexor isometric force-production was measured 2 hours post-injection in anesthetized mice with a lever/footplate system able to simultaneously control length and measure force. Sciatic nerve stimulation was used to elicit 10 repetitions (5-sec rest) to capture maximal force and fatigue. Immediately after the last contraction, blood and gastrocnemius muscles were collected. Serum and muscle TNF $\alpha$  and IL-6 were quantified by Elisa and muscle Hsp72 and Hsp25 by Western blot.

**RESULTS:** Sal/LPS-treatment was associated with a 33% reduction in maximal force and elevated serum TNF $\alpha$  and IL-6 compared to the Sal/Sal group ( $p < .05$ ). GLN completely prevented the force decrement with LPS, however, GLN alone did not affect force (i.e., no differences among Sal/Sal, GLN/Sal, and GLN/LPS groups). No group differences were found for muscle fatigue. Additionally, no main effect for GLN was found on muscle or serum TNF $\alpha$  or IL-6, however muscle Hsp72 was significantly reduced by 47% in the GLN/LPS group compared to the other 3 groups.

**CONCLUSIONS:** GLN supplementation provides an effective, novel, and clinically applicable means of preserving muscle force under conditions of acute inflammation. These data indicate that preservation of force is not dependent on reductions in muscle or serum cytokines or elevated Hsp levels, as these measures were not altered with GLN treatment.

Supported by funding from NSMRC

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**2452 Board #97 May 29 9:00 AM - 10:30 AM**

**Plasma Matrix Metalloproteinase-9 Activity As A Marker Of Exercise-induced Muscle Injury In Humans**

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(No relationships reported)

**PURPOSE:** The role of matrix metalloproteinases (MMPs) in skeletal muscle remodeling has received increasing scientific attention regarding its role in skeletal muscle damage and repair. The purpose of this study was to determine if eccentric exercise-induced changes in plasma MMP-9 activity were correlated with indices of muscle damage post-exercise in humans.

**METHODS:** Fifteen males unaccustomed to eccentric exercise participated in a protocol involving eccentric exercise (120% concentric maximum) of the non-dominant upper arm. The dependent measures included force/angle curves, range of motion (ROM), arm circumference, soreness perception, plasma MMP-9, & creatine kinase (CK) levels. Dependent measures were re-assessed Immediately Post (IP), 1-, 2-, 4-, and 7-days post task. Functional and biochemical variables were correlated in time and magnitude of response with Spearman's rho correlational analyses.

**RESULTS:** Plasma MMP-9 activity increased up to an average of 137% of pre-levels during follow-up time points; however, the timing and magnitude of the increase varied across subjects. There were significant increases in soreness perception (45.27/100 mm 2-days post), optimal angle of force production (+10.5 degrees IP), biceps belly and elbow joint circumference (+8.27 mm 4-days post and +10.76 mm 7-days post, respectively), and CK activity (12.3 fold increase 4-days post), and significant decreases in ROM (-18.57 degrees IP), and force production (53.9% IP, 57.7% 1-day post) during the week following the exercise task. Immediately post eccentric exercise, changes in MMP-9 activity were temporally correlated with a change in the optimal angle of force production ( $r=0.580$ ). At the timepoint of peak perceived soreness (2-days post), MMP-9 activity was significantly correlated with both CK activity ( $r=0.636$ ) and an increase in elbow joint circumference ( $r=0.554$ ).

**CONCLUSIONS:** These data demonstrate that plasma MMP-9 activity is increased following a damaging eccentric exercise task in humans and that the change in MMP-9 activity is correlated with indices of muscle damage.

Supported by NIH Grant KO1 AR050505-01.

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**2453 Board #98 May 29 9:00 AM - 10:30 AM**

**The Effect Of Different Management For Muscle Performance On Acute Stage Muscle Damage**

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(No relationships reported)

**INTRODUCTION:** Muscular injury is one of the most common sports injuries. When the athletes suffer from injury, they usually need to receive emergent management to come back competition. Cold agents are used popularly as first-aid in management acute sports trauma. However, cold agents may cause joints stiffness and decreasing soft-tissue flexibility, it will influence the performance in the next round or section of the competition.

**PURPOSE:** This study was designed to find the best way for short-term performance outcomes and long-term physical recovery outcomes to manage muscle damage in the acute stage.

**Method:** 36 subjects performed one set of eccentric exercise protocol (ECC1). After the ECC1, subjects were randomly placed into cryotherapy group (n=12), electrical therapy group (n=12) or control group (n=12), and accepted treatment protocol with cryotherapy, transcutaneous electrical nerve stimulation (TENS) modality or resting without management for one hour. When treatment protocol finished, all subjects performed the second set of eccentric exercise protocol (ECC2). Active range of motion (ROM), upper arm circumference (CIR), Serum creatine kinase (CK-MM) and maximal voluntary isometric contraction (MVC) were assessed immediately before and after each eccentric exercise bout and day2, day4, day7, day10. CK-MM was collected at ECC1b and 2d, 4d, 7d, 10d.

Result: The short term performance ability showed significant changes ( $p<0.05$ ) in MVC between ECC1b and ECC2b in electrical therapy group, but not in cryotherapy group. The long term recovery outcomes showed significant changes ( $p<0.05$ ) in ECC1b CK-MM on day2 and day7 in electrical group, and on day4 in control group. In intergroup analysis, CK-MM showed significant different ( $p<0.05$ ) between electrical group and cryotherapy group on day2, day4, day7 and day10, and the same results between electrical group and control group.

**CONCLUSIONS:** The long-term recovery outcomes showed cryotherapy is the most beneficial for muscle damage management between repeated sets, the short-term outcomes showed cryotherapy and resting are beneficial to the muscle performance, such as muscle strength and active range of motion. Electrical therapy is disadvantaged to manage muscle damage between repeated sets exercise.

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**2454 Board #99 May 29 9:00 AM - 10:30 AM**  
**Glucose Uptake And Fiber Damage In Skeletal Muscle Stimulated With Different Frequencies**

Julia M. Santos<sup>1</sup>, Sandra A. Benite-Ribeiro<sup>1</sup>, Gloria Queiroz<sup>2</sup>, Hans-Joachim Appel<sup>3</sup>, José A.R. Duarte<sup>1</sup>. <sup>1</sup>Faculty of Sport- University of Porto, Porto, Portugal. <sup>2</sup>Faculty of Pharmacy - University of Porto, Porto, Portugal. <sup>3</sup>German Sport University, Cologne, Germany. (Sponsor: FCT, FACSM)  
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(No relationships reported)

**PURPOSE:** Glucose uptake of skeletal muscle has widely been studied *in vitro* using electrical stimulation, being accepted that high stimulation frequencies comparing to low frequencies result in higher rates of glucose uptake. However, it can be hypothesised that slow-twitch muscles, such as *soleus*, are physiologically not capable to sustain high frequency stimuli without the development of severe homeostatic alterations. Therefore, since the enhanced glucose uptake observed under these conditions might be the result of non-physiological mechanisms, the aim of this study was to analyse the effects of low vs. high frequency stimulation on *in vitro* glucose uptake and on muscle structure in the slow rat *soleus* muscle.

**METHODS:** Eighteen Wistar rats were assigned to two groups: electro stimulation at 10Hz and at 100Hz. Muscles were isolated and incubated in an oxygenated Krebs buffer. After a stabilization period 0.2 mCi/ml of 2- [<sup>3</sup>H] -deoxy-D-glucose and 0.06  $\mu$ Ci/ml of [<sup>14</sup>C] -D mannitol were added in the buffer and muscles were electro stimulated (10V, 0.2ms pulse width, 10 sec/min) with their pre-determinate frequency. Followed, a group of muscles (n=24) were homogenised for biochemical analysis while other were processed for morphological (n=12) examination. Glucose uptake was determined by scintillation spectrophotometry and the intrafiber localization of GLUT4 was assessed by immunohistochemistry. As an estimate for potential damage were quantified the release of taurine into the buffer by HPLC, cleaved caspase-3 by immunohistochemistry and westernblot, and morphological signs of fiber damage in muscle slides stained by hematoxylin/eosin.

**RESULTS:** Stimulation at 100Hz resulted in a more pronounced glucose uptake than at 10Hz despite of the similar distribution on GLUT4 at the sarcolemma ( $P<0.05$ ). The signs of cellular and membrane damage were more apparent in muscles stimulated at 100Hz than at 10Hz evidenced by an increase of taurine release, cleaved caspase-3 and the presence of eosinophilic and swelling fibers ( $P<0.05$ ).

**CONCLUSION:** It is concluded that cellular damage might accounted for an artificial glucose influx from the buffer by muscles stimulated at 100Hz. It therefore does not seem meaningful to study glucose uptake in slow muscles with non-physiologically high stimulation frequencies.

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**2455 Board #100 May 29 9:00 AM - 10:30 AM**  
**Time-Dependent Effects Of Prior Fatigue On Cyclical Power Output After Eccentric Muscle Damage.**

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(No relationships reported)

**PURPOSE:** Power output is reduced in skeletal muscles subjected to either fatiguing contractions or to damaging eccentric activity. Because many physical activities have the potential to induce both fatigue and eccentric damage, we examined the separate and combined effects of these two treatments on the cyclical power output of the mouse soleus.

**METHODS:** Solei were subjected to work loops *in vitro* at 35°C. Pre-treatment, immediate post-treatment, and post-recovery cyclical power was assessed using 3 consecutive work loops that optimized pre-treatment power output (5 Hz cycles;  $\pm 5\%$  fiber length strain). The fatigue protocol consisted of 25 consecutive optimal cycles. Damage was induced by stimulating muscles during the lengthening phase of 10 consecutive low frequency (2 Hz), high amplitude ( $\pm 25\%$  strain) cycles. Data were analyzed using a repeated ANOVA (treatment x recovery time,  $p < 0.05$ ).

**RESULTS:** Mean ( $\pm$  SE) pre-treatment cyclical power did not differ between treatment groups ( $35.6 \pm 1.4$  W/kg). Control muscles ( $N = 7$ ) showed no change in power over the course of the experiment. Solei subjected to fatiguing contractions ( $N = 7$ ) showed an immediate  $21 \pm 2\%$  reduction in power, with complete recovery after 30 minutes of rest. Muscles subjected to damaging contractions ( $N = 7$ ) showed a significantly greater immediate reduction in power ( $33 \pm 2\%$ ) that failed to completely recover (final reduction of  $20 \pm 8\%$ ). Solei that were fatigued and then immediately subjected to lengthening cycles ( $N = 7$ ) showed an immediate reduction in power that was significantly greater than all other treatments ( $64 \pm 2\%$ ). Nevertheless, these muscles showed complete restoration of power after 30 minutes of recovery. Reassessment of optimal length (an index of muscle damage) at the conclusion of the recovery period revealed a shift towards longer lengths for the damage-only treatment ( $110 \pm 1\%$  of pre), a significantly smaller shift for the fatigue and damage trial ( $104 \pm 1\%$  of pre), and no change for the fatigue-only or the control trials.

**CONCLUSIONS:** Prior muscle fatigue, 1) exacerbates the short-term reduction in cyclical power that occurs after eccentric activity, but 2) reduces long-term muscle damage and contractile dysfunction.

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**2456 Board #101 May 29 9:00 AM - 10:30 AM**  
**Exercise Intensity And Desmin Protein In Rodents**

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(No relationships reported)

An intricate network of filament proteins in muscle fibers is responsible for force transmission, structural integrity and possibly cellular signaling. Desmin (53kD) is an intermediate filament protein that integrates myofibrils at the level of the Z disk and connects the network of myofibrils to the sarcolemma via costameric interactions. Our laboratory has reported increased desmin concentrations in human skeletal muscle following exercise training. This study was designed to assess the impact of exercise intensity on desmin content in skeletal muscle. To accomplish this 21 adult male Sprague-Dawley rats weighing between 245-350 grams were randomly assigned to one of three groups: cage control (CC); continuous exercise training, 60 min /day at 72% (LI) and high intensity, intermittent exercise training, 8 bouts of 4 min at 98% followed by 5 min at 48% (HI). Animals completed 12, equal volume, training sessions over a 2 week period. 24 hours after the last training session the rats were anesthetized and the gastrocnemius muscle was dissected and stored for later analysis. Immunoblot analysis showed no difference in desmin concentration in LI and HI when compared to CC. Previous research suggests increased muscle tension is required for desmin alterations. These data demonstrate that the muscle force and metabolic stress associated with treadmill exercise is insufficient to elicit changes in desmin content within a 12 day training period.

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**2457 Board #102 May 29 9:00 AM - 10:30 AM**  
**Nandrolone Decanoate And Mouse Tibialis Anterior Muscle Regeneration: The Effect Of Fiber Type**

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(No relationships reported)

Skeletal muscle has the capacity to regenerate and even hypertrophy after damaging stimuli. Bupivacaine is a local anesthetic that is widely used to induce muscle damage. Although Nandrolone Decanoate (ND) has been shown to increase fiber area, its effect on regeneration from bupivacaine-induced damage is not well understood.

**PURPOSE:** The purpose of study was to determine the effect of ND administration on the recovery of type IIa and IIb fiber cross-sectional area (CSA) in the mouse tibialis anterior (TA) muscle after muscle injury induced by bupivacaine (INJ).

**METHODS:** To induce muscle injury the TA from 8 week old castrated C57BL/6 mice was injected with PBS (n=10) or bupivacaine (n=9). Mice were then divided into sesame oil (n=10) or ND (n=9) that was administered at the time of injury and then every 7 days for 6 weeks. After 42 days of recovery from injury, the TA muscles were removed and frozen in OCT for histological and immunohistochemical analysis. Cross-sections (12  $\mu$ m) were taken from the mid-belly. Type IIa and type IIb fibers were identified by immunohistochemical staining. Fiber CSA and fiber type distribution were quantified.

**RESULTS:** Both INJ and ND treatments increased the mean CSA of type IIb fibers 13% (p=.035) and 28% (p<.001), respectively, but not type IIa fibers. No interaction between INJ and ND was observed on mean CSA. Changes in muscle growth were also examined by the distribution of large and small diameter fibers. Both INJ (p=.002) and ND (p<.001) treatments significantly decreased the percentage of small diameter type IIa and IIb fibers. INJ (p<.001) and ND (p<.001) also significantly increased the percentage of large diameter type IIa and IIb fibers. Neither INJ nor ND significantly changed the overall percentage of IIa and IIb fibers.

**CONCLUSION:** During the recovery from bupivacaine injury ND induces preferential hypertrophy of type IIb fibers without changing the overall fiber type distribution of the muscle.

Supported by NIH Grant 5R03AR051434-02.

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## E-32 Free Communication/Poster - *Neural Control of Movement I*

MAY 29, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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### 2458 Board #103 May 29 8:00 AM - 9:30 AM Relationship Between Time To Stabilization Measures And Demographic And Self-reported Data

Kimitake Sato, Gary D. Heise, Kathy Liu. *University of Northern Colorado, Greeley, CO.*  
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(No relationships reported)

**PURPOSE:** Determine correlations between time-to-stabilization (TTS) and body mass, height, foot size, and leg length. In addition, self-reported leg dominance, brace-use, and past injury were examined with respect to TTS.

**METHODS:** 83 collegiate football players participated in TTS test. Anthropometric data (see Table 1), leg dominance, brace-use, and past injury were gathered. In a bare-foot condition, participants performed a "step-step-hop" approach, hopped over a 15-cm hurdle which was placed 100% of leg-length from the center of the force plate, and landed on one foot. They performed randomly ordered L- and R-foot landings. GRF were sampled at 200 Hz, and smoothed with Fast Fourier Analysis. TTS was calculated by determining when the sequential average of ML or AP GRF reached  $\pm 0.25$  standard deviation of the overall mean. TTS and anthropometric data were analyzed using Pearson correlation coefficient, and independent t-tests were used to evaluate differences in TTS between self-reported data.

**RESULTS:** Anthropometric data were moderately correlated with both L- and R-foot AP force TTS but not with ML force TTS (see Table 1). Only R-foot dominant subjects showed significantly higher AP force TTS from R-foot trials (R: 4.664 vs. L: 4.578 sec,  $p < .05$ ). No differences in TTS measures were found between conditions of brace-use and past injury.

**CONCLUSIONS:** Positive correlations between AP force TTS and anthropometric data suggest that a higher center of mass location requires longer TTS. These results are consistent with those from static stability tests. Self-reported comparisons indicate that R-foot dominant individuals are more stable on their non-dominant leg, but the same cannot be said for L-dominant subjects.

Correlation between the anthropometric (mean $\pm$ SD) & TTS.				
	R-Foot AP	R-Foot ML	L-Foot AP	L-Foot ML
Height (184.35 $\pm$ 7.17cm)	.389**	-.003	.400**	-.055
Body mass (100.65 $\pm$ 18.84kg)	.373**	.035	.505**	-.038
Foot size (28.51 $\pm$ 1.45cm)	.267*	.078	.282**	-.104
Leg length (98.65 $\pm$ 4.45cm)	.308**	.058	.334**	-.031

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### 2459 Board #104 May 29 8:00 AM - 9:30 AM Knee Function Following Perturbation Training In Potential Copers And Noncopers

David Logerstedt<sup>1</sup>, Lynn Snyder-Mackler<sup>1</sup>, Michael J. Axe<sup>2</sup>. *<sup>1</sup>University of Delaware, Newark, DE. <sup>2</sup>First State Orthopaedics, Newark, DE.*  
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Single leg hop tests have been used to assess knee function in athletes following an ACL injury. Side-to-side hop symmetry less than 85% represent abnormal knee function. Most noncopers (NC) can be unwilling to hop and those that do hop demonstrate different movement strategies than copers. The use of perturbation training has only been previously used to train knee function in potential copers (PC).

**PURPOSE:** To assess knee function utilizing a series of 4 hop tests in the involved (INV) and uninvolved (UNINV) limb following perturbation training (Fitzgerald et al, 2000) in NC and PC.

**METHODS:** 56 subjects with an acute ACL tear who participated regularly in level I or II activities were screened following an injury to the index limb and classified as a PC (15 women, 24 men; 25.2  $\pm$  9.9 yrs) or NC (5 women, 13 men; 31.9  $\pm$  11.6 yrs). Knee function was assessed using 4 single leg hop tests before and after perturbation training. Independent t-tests were used to study differences between PC and NC in the INV and UNINV limbs. Paired t-tests were used to study differences between limbs in PC and NC.

**RESULTS:** NC hop index was significantly less than PC in the single hop for distance (SHP), triple hop (THP), and the 6-m timed hop (TimHP) pre-training (PrTr) and

significantly less in the SHP and the THP post training (PoTr). In NC, THP index was significantly higher PoTr as compared to PrTr ( $p < .05$ ). SHP and THP scores were significantly lower in the INV as compared to the UNINV PrTr ( $p < .05$ ) and PoTr ( $p < .05$ ). SHP scores significantly higher in the INV and UNINV limbs PrTr to PoTr ( $p < .05$ ) and in the INV THP scores PrTr to PoTr ( $p < .05$ ). In PC, SHP and THP index are significantly higher PoTr as compared to PrTr ( $p < .05$ ). SHP and TimHP scores were significantly lower in the INV as compared to the UNINV PrTr ( $p < .05$ ) and PoTr ( $p < .05$ ). Cross-over hop (XHP) and THP scores were significantly lower in the INV as compared to the UNINV PrTr ( $p < .05$ ). TimHP scores significantly higher in the INV and UNINV PrTr to PoTr ( $p < .05$ ) and in the INV XHP and THP scores PrTr to PoTr ( $p < .05$ ).

**CONCLUSIONS:** Perturbation training can improve knee function in the INV in NC and PC. The differences between limbs and between groups may be due to the number of training sessions, training plateau effect, or neuromuscular differences within and between groups.

Supported by NIH Grant R01HD037985-6.

**2460 Board #105 May 29 8:00 AM - 9:30 AM**  
**Reliability Of Single Leg Stance And MVC Methods Of Electromyography Normalization In The Lower Extremity**

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(No relationships reported)

Normalization of electromyographic (EMG) activity is necessary for comparisons between subjects or across muscles. However, there is no consensus on the most reliable and efficient method for performing this normalization procedure.

**PURPOSE:** To evaluate the intrasession reliability and measurement precision of EMG activity in six lower extremity muscles during single leg stance (SLS) and maximal voluntary isometric contraction (MVC).

**METHODS:** EMG activity was recorded in 20 healthy subjects (10 male, 10 female,  $20.7 \pm 2.4$  years) during three 5-second trials of SLS and MVC for the following muscles of the dominant leg: gluteus maximus, gluteus medius, rectus femoris, vastus lateralis, adductor group, and biceps femoris. RMS EMG amplitude was calculated over the middle 3 seconds of each trial. Intraclass correlation coefficients (ICC 2,1) and standard errors of measurement (SEM) were calculated to assess reliability and precision. Kinematic analysis was used to evaluate hip and knee motion during SLS.

**RESULTS:** ICCs and SEMs for each muscle are presented in Table 1. Kinematic angles during SLS were consistent across trials (Mean  $\pm$  SD): knee flexion ( $1.3 \pm 6.0^\circ$ ), hip extension ( $7.4 \pm 6.0^\circ$ ), and hip abduction ( $0.7 \pm 4.1^\circ$ ).

**CONCLUSION:** SLS demonstrated similar reliability compared to MVC with minimal kinematic variation indicating a standardized subject position. As SLS allows for normalization of multiple muscles at one time, its use may be preferred in protocols evaluating several muscles or when pain limits use of a MVC. In addition, the SLS method measures coordinated muscle activity during a functional task compared to an isolated MVC. Future research should evaluate what influence this may have on the interpretation of EMG amplitudes.

		Gluteus Maximus	Gluteus Medius	Rectus Femoris	Vastus Lateralis	Adductor Group	Biceps Femoris
SLS	ICC (2,1)	0.85	0.93	0.94	0.90	0.94	0.80
	SEM (mV)	8.5	19.5	18.6	27.3	6.1	11.2
MVC	ICC (2,1)	0.95	0.98	0.95	0.98	0.84	0.99
	SEM(mV)	49.4	50.4	120.8	84.0	201.0	30.7

**2461 Board #106 May 29 8:00 AM - 9:30 AM**  
**Corticomuscular Coherence Immediately After Eccentric And Concentric Exercise**

Takashi Endoh<sup>1</sup>, Norio Saga<sup>2</sup>, Junichi Ushiba<sup>3</sup>, Motoi Tsuchiya<sup>2</sup>, Tsugutake Yoneda<sup>2</sup>. <sup>1</sup>Research institute, National Rehabilitation Center for Persons with Disabilities, Tokorozawa, Japan. <sup>2</sup>Juntendo University, Inba, Japan. <sup>3</sup>Keio University, Yokohama, Japan.

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(No relationships reported)

It is noted that muscle damage was induced by intense eccentric exercise and affected not only muscle structure but also central nervous system. Recently, it was reported that electromyographic (EMG) activity and force fluctuation were increased immediately after eccentric exercise. However, it is unclear what neural mechanisms underlie these phenomena.

**PURPOSE:** We determined the effect of muscle damage induced by eccentric exercise on motor control during sustained submaximal voluntary contractions by using electroencephalogram (EEG) - EMG coherence measurement.

**METHODS:** Eleven healthy male volunteers (21-31 yrs) performed brief MVCs and submaximal voluntary contractions (5, 10, 20 and 50%MVC) with dorsiflexion before and immediately after eccentric (ECC) and concentric (CON) exercise, which consisted of 30 contractions at maximal effort. During voluntary contractions, the surface EMG of tibial anterior and EEG around Cz were recorded in order to analyze the EEG-EMG coherence. Force fluctuation was also measured during voluntary contractions. In addition, indirect markers of muscle damage, such as MVC, pressure pain threshold and range of motion, were measured before and immediately after and 1 days following these exercises.

**RESULTS:** A significant decline in MVC without any sign of muscle soreness was observed immediately after CON and ECC (72.7% vs. 65.7%). One days after the exercises, all indirect markers of muscle damage, such as the decline in MVC and ROM and the increase in muscle soreness, were significantly greater in ECC than CON ( $p < 0.05$ ), and these markers had recovered fully in CON. During submaximal voluntary contractions, EMG activity and force fluctuation were significantly higher in ECC than CON ( $p < 0.05$ ). The peak value of EEG-EMG coherence in the beta range (13-30 Hz) during 10 and 20%MVC was significantly increased in ECC ( $p < 0.05$ ), but not in CON.

**CONCLUSIONS:** It is suggested that increase in EMG activity and force fluctuation immediately after eccentric exercise, which induce acute muscle damage, were attribute in part to increase in corticomuscular coherence.

**2462 Board #107 May 29 8:00 AM - 9:30 AM**  
**Influence Of Fatigue-induced Muscle Afferent Stimulation On Motor Evoked Potentials**

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(No relationships reported)

Post-exercise muscle ischemia (PEMI)-induced stimulation of muscle afferents depresses motoneuron excitability (Martin et al., J Neurosci, 2006). However, little is known regarding the influence of muscle afferents on motor evoked potential (MEP) characteristics.

**PURPOSE:** The purpose of this study is to determine the effect of a submaximal fatiguing elbow extensor muscle contraction followed by 2-min of PEMI on MEP amplitude and the duration of corticospinal silent period (SP).

**METHODS:** Fifteen subjects (9 men and 6 women; 22.2±4.1 yrs) performed a submaximal elbow extensor fatigue task to failure at 15% of max strength. Immediately following the fatigue task, a 2-minute PEMI period was induced. Mean arterial blood pressure (MAP) and heart rate (HR) were measured on a beat-by-beat basis. Before, during, and after the exercise task, electromyographic responses were recorded from the lateral head of the triceps brachii in response to transcranial magnetic stimulation (TMS) pulses to the motor cortex and electrical stimulation of the brachial plexus to evoke a maximal muscle action potential (Mmax). MEP amplitude was normalized to the Mmax, and the SP duration was determined.

**RESULTS:** The fatigue task was performed for 482±33.4 sec. MAP increased from 93±5.8 mmHg at rest to 148±8.9 mmHg at task failure ( $p<0.05$ ), and remained elevated above resting conditions during PEMI (125±6.8 mmHg;  $p<0.05$ ). HR also increased from 71±3.5 bpm at rest to 97±3.7 bpm at task failure ( $p<0.05$ ); however, HR returned to resting levels during PEMI (75±2.3 bpm). MEP amplitude increased from 28±3.8% of Mmax at the start of exercise to 72±8.2% of Mmax at task failure ( $p<0.05$ ), and remained elevated above pre-fatigue levels during PEMI (56±5.8% of Mmax;  $p<0.05$ ). SP duration increased from 114±7.5 msec at the start of exercise to 176±14.0 msec at task failure ( $p<0.05$ ); however, SP duration returned to pre-fatigue levels during PEMI (140±11.5 msec).

**CONCLUSIONS:** These findings suggest that stimulation of muscle afferents via PEMI facilitates MEP amplitude without affecting the SP duration. Further work is required to determine the relative influence of spinal versus cortical modulation on these observations, as well as their functional implications on the mechanisms of muscle fatigue.

*Supported by SURF and PURF Awards from Ohio University.*

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**2463 Board #108 May 29 8:00 AM - 9:30 AM**  
**Bilateral Neuromuscular Plasticity Associated With Unilateral Resistance Training Of The Ankle Dorsiflexor Muscles**

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*(No relationships reported)*

In the early weeks of high-intensity resistance training (RT), strength gains are attributed to plasticity within the nervous system. Unilateral RT causes adaptation in both the trained and untrained limb, i.e. a muscular crossed effect. H-reflex amplitude has been shown to increase only in the trained plantarflexor (SOL) muscle despite comparable changes in strength bilaterally. However, it is unknown whether similar changes occur in the functional antagonist of the SOL, the tibialis anterior (TA). Also, following RT it is unknown whether reduced reflex activity in the functional antagonist muscle contributes to strength gains in the agonist muscle in either limb.

**PURPOSE:** To examine the effects of high-intensity unilateral ankle flexor (TA) RT on agonist and antagonist (SOL) muscular strength and H-reflex response in the trained and untrained limbs.

**METHODS:** Ankle flexor torque and SOL and TA H-reflex responses were observed before and after 5wks of unilateral dorsiflexion RT, and compared to controls. During data collection, bilateral H-reflexes were evoked via stimulation delivered to either the tibial (SOL) or CP nerves (TA). EMG recordings were taken from the SOL, TA, VL, PD and AD muscles. In TA and SOL H-reflex measurements were taken from recruitment curves and included modulation of 50% Hmax and Hmax.

**RESULTS:** Following RT, TA force was significantly ( $p < 0.05$ ) increased in both the trained and untrained limb by 14 and 8%, respectively, without concomitant changes in H-reflex amplitude.

**CONCLUSIONS:** These results further extend evidence of muscular crossed effects to the ankle dorsiflexor muscles. This is also the first work to quantitatively measure spinal reflex activity in a muscle functionally antagonist to a RT movement, and the relative size of any resulting reflex modulation is unknown. Thus, H-reflex may not be a sensitive enough measure to detect subtle changes in TA / SOL spinal excitability following ankle flexor RT.

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**2464 Board #109 May 29 8:00 AM - 9:30 AM**  
**Does Strength Training The Free Limb Attenuate Strength Loss During Unilateral Immobilization?**

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*(No relationships reported)*

**PURPOSE:** The objective was to determine if strength training the free limb during a 3-week period of unilateral immobilization attenuates strength loss in the immobilized limb, through cross-education.

**METHODS:** Thirty right-handed participants were assigned to three groups. One group ( $n=10$ ) wore a cast and trained the free arm (CAST-TRAIN). A second group ( $n=10$ ) wore a cast and did not train (CAST). A third group ( $n=10$ ) received no treatment (CONTROL). Casts were applied to the non-dominant (left) wrist and hand by a physician. Strength training was maximal isometric ulnar deviation (right hand) 5 days/week. Peak torque (dynamometer), electromyography (EMG), and muscle thickness (ultrasound) were assessed in both arms before and after the intervention.

**RESULTS:** CAST-TRAIN improved right arm strength (14.3[SD5.0] to 17.7[SD4.8] Nm;  $p<0.05$ ) with a trend for muscle hypertrophy (3.73[SD0.43] to 3.84[SD0.52] cm;  $p=0.09$ ). The immobilized arm of CAST-TRAIN did not change in strength (13.9[SD4.3] to 14.2[SD4.6] Nm) or muscle thickness (3.61[SD0.51] to 3.57[SD0.43] cm). The immobilized arm of CAST decreased in strength (12.2[SD3.8] to 10.4[SD2.5] Nm;  $p<0.05$ ) and muscle thickness (3.47[SD0.59] to 3.32[SD0.55] cm;  $p<0.05$ ). CONTROL showed no changes in the right (strength: 15.3[SD6.1] to 14.3[SD5.8] Nm; muscle thickness: 3.57[SD0.68] to 3.52[SD0.75] cm) or left arm (strength: 14.5[SD5.3] to 13.7[SD6.1] Nm; muscle thickness: 3.55[SD0.77] to 3.51[SD0.70] cm). Agonist muscle activation remained unchanged after the intervention for both arms (Right: 302[SD188] to 314[SD176]  $\mu$ V; Left: 261[SD139] to 288[SD151]  $\mu$ V) with no group differences.

**CONCLUSIONS:** Strength training of the free limb attenuated strength loss in the immobilized limb during unilateral immobilization. Strength training may have prevented muscle atrophy in the immobilized limb.

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**2465 Board #110 May 29 8:00 AM - 9:30 AM**  
**H-reflex Modulation During Different Head Movements**

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*(No relationships reported)*

Head movement stimulates the vestibulospinal tract, which contributes to the balance system. Head movement increased our postural sway amplitude. The amplitude of the soleus spinal stretch reflex was decreased by contralateral side head movement. However, it has yet to be investigated if presynaptic inhibition to the soleus Ia afferents is modulated by the head movement.

**PURPOSE:** To examine the modulation of the soleus H-reflex and presynaptic inhibition (PI) to the soleus Ia afferents during standing with head movement.

**METHODS:** Seven young active subjects (mean: 23.3 yrs) were examined. The H-wave and M-responses of the right soleus were determined for each subject during a static standing position. Each subject turned the head up and contralaterally or ipsilaterally with or without hands on table for support while the H-reflexes were examined. To examine H-reflex modulation, a PI H-reflex



conditioning protocol was administered. The control H-reflex stimulus was set at 10% of M-max. PI was induced via conditioning of the soleus H-reflex with peroneal nerve stimulation at 100 msec prior to the test stimulus on the tibial nerve. The conditioning stimulus was delivered once the EMG activity of sternocleidomastoid muscle occurred as a trigger signal for lateral head movements. For the head up movement, an electrogoniometer was placed on the cervical spine and this was used as a trigger signal. Each mean of PI H-reflexes was normalized by the amplitude of control H-reflex (%). For data analyses, a 2 x 4 repeated measures ANOVA was used to determine each mean of H-reflex and PI-H reflex.

**RESULTS:** The H/M-max ratio during standing without hands on the table was 41%. The ratio of PI H-reflex to the control H-reflex was 68.5% and 85.7% during standing with and without hands on the table, respectively. The mean ratio of PI H-reflex to control H-reflexes was decreased when the head was turned contralaterally by 8.4% and 13.5% with and without hands on the table, respectively. The ratio was decreased by 27.0% when the head was turned ipsilaterally with hands on the table, whereas it was not changed without hands on the table.

**CONCLUSIONS:** The soleus H-reflex was modulated during head movements. PI to the soleus Ia afferents was decreased when the head was turned laterally, yet the modulation was dependant on the head movement and body stability.

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**2466 Board #111 May 29 8:00 AM - 9:30 AM**  
**Differences In Obstacle Crossing Performances And The Associated Attentional Demands Between Elderly And Younger Adults**

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(No relationships reported)

The walking patterns and the performances of stepping over obstacles change with age. This has implications for the problem of falls in elderly adults.

**PURPOSE:** To investigate the differences in obstacle crossing performances and the associated attentional demands between elderly and younger adults under the single or dual task condition.

**METHODS:** In total, twelve healthy elderly adults and fifteen healthy younger adults were included in this study. The sound operating system was used to provide a stimulus tone to the subject. Two in-series force platforms were used to record ground reaction forces. A three dimensional motion analysis system was used to collect the motion data. During reaction time (RT) test, a self-assembly radio telemetry handheld trigger was used to signal a response. Single-primary task (obstacle crossing alone), single- secondary task (hand button pressing alone), and dual-task (obstacle crossing plus hand button pressing tasks) were tested for each participant.

**RESULTS:** The medial COM-COP inclination angles were significantly smaller in the elderly subjects than in younger subjects. However, no group differences were detected for peak anterior and posterior inclination angles. In addition, significant decreases in COM peak velocities in the A/P and M/L directions were detected in the elderly group when compared to the younger group during all tasks. The RT was significantly faster for all participants in the single- secondary task than for the dual-task condition. Task differences in reaction time were almost 100 ms for both the younger and elderly groups. During the dual-task test, the accuracy decreased for both the younger and elderly groups. In addition, the accuracy in the tone discrimination task was significantly higher for elderly participants in the single- secondary task condition than for the dual-task condition. However, no significant differences were detected for younger adults.

**CONCLUSIONS:** Our study has verified that aging might delay early sensory processing and cognitive functioning. In addition, aging will also influence the gait strategy to maintain stability during obstacle crossing.

*This work was Supported by the National Science Council.*

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**2467 Board #112 May 29 8:00 AM - 9:30 AM**  
**Fatigue Induced Changes In Vertical Jumping Performance Following A Simulated Team Handball Match**

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**PURPOSE:** In the light of the importance of explosive strength in elite sports, we examined how neuromuscular activity and force-generating capacity was affected in response to a simulated team handball match.

**METHODS:** Eight female elite team handball players (age  $24 \pm 5$  years, height  $170 \pm 6$  cm, weight  $73 \pm 6$  kg) were tested before and after a simulated team handball match for maximal strength in knee extensors and flexors (MVC) and countermovement jumping ability (CMJ) by means of force plate analysis. Electromyography (EMG) recordings from the quadriceps (VL, VM, RF), hamstrings (BFcl, ST), gluteus medius (GT) and triceps surae (GL, GM) were obtained during the CMJ. The simulated handball match consisted of a series of intermittent exercises (side steps, cross over steps, jumps, high and low intensity running and sprinting) mimicking handball match activity (50 min).

**RESULTS:** The simulated team handball match induced reductions in MVC (knee extensors:  $-15.5\% \pm 11.1$ ,  $P = 0.046$ , knee flexors:  $-16.2\% \pm 7.9$ ,  $P = 0.028$ ) and in several of the mechanical CMJ parameters: Jump height ( $-8.2\% \pm 6.1$ ,  $P = 0.017$ ), Peak force in the eccentric phase ( $-6.1\% \pm 6.4$ ,  $P = 0.017$ ), Work in the concentric phase ( $-5.5\% \pm 5.5$ ,  $P = 0.012$ ) and mean power in concentric phase ( $-5.2\% \pm 5.3$ ,  $P = 0.036$ ). The ability to rapid force exertion in the final part of the plantar flexor phase seemed also slightly reduced (increased negative impulse in the plantar flexor phase:  $10.8\% \pm 10.0$ ,  $P = 0.025$ ). Normalized EMG was unaltered for all muscles during the CMJ, suggesting the existence of a robust muscle stimulation pattern (motor program) that can not be easily changed with fatigue.

**CONCLUSION:** Several muscle mechanical parameters were acutely affected by the simulated team handball match, potentially leading to impaired functional performance. However, no clear evidence of altered neuromuscular activity was found.

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**2468 Board #113 May 29 8:00 AM - 9:30 AM**  
**Multiple Strategies Are Used To Maintain Fixed Head Position During Higher-frequency Anterior-posterior Oscillations**

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Our study of postural responses to anterior-posterior (A-P) cyclic perturbations confirmed that as frequency increased, head movement decreased until it was relatively stationary.

However, multiple strategies were used to limit head movement. A lower body (LB) strategy fixed the upper body in space while allowing rotation of the lower body about the hip.

Alternately, a whole-body (WB) strategy fixed head position while allowing progressively larger linear displacements with increased distance from the head. These multiple strategies may be driven by idiosyncratic characteristics such as body geometry, reaction time, or overall stability. Identification of these drivers could lead to better balance training for athletes and more specific rehabilitation for those with diminished balance.

**PURPOSE:** Identify stereotypical muscle activation and kinematic patterns used to establish stable head position at higher-frequency A-P oscillations.

**METHODS:** Motion, force, and EMG data were collected and synchronized for 11 able-bodied subjects standing on a research platform during A-P sinusoidal translations at 0.1, 0.25, 0.5, 0.75, 1.0, and 1.25 Hz with a peak-to-peak amplitude of 12 cm. Each frequency progression was repeated twice.

**RESULTS:** Five subjects used the LB strategy, five used the WB strategy, and one subject used an atypical strategy that did not fix head position. For the third repetition at 1.25

Hz, the LB strategy had well-stereotyped kinematics, with translations <7.5 mm and rotations <1.4 deg for all joints above the hip. Joint rotation was largest at the hip (10.7±1.4 deg). Mean center-of-pressure (COP) excursion decreased from 148 to 79.5 mm with repetition and was out-of-phase with center-of-mass (COM) displacement. For the WB strategy, kinematic, EMG, and COP/COM patterns were far less consistent. However, the significantly larger mean head displacement for the WB strategy (25.9 vs. 10.6 mm ( $p = 0.045$ )) decreased with repeated exposure until head displacements for each strategy were not statistically different (9.22 vs. 7.54 mm ( $p = 0.51$ )).

**CONCLUSION:** Although people tended to fix their head in space at higher A-P cyclic frequencies, there was one strategy (LB) that was well-stereotyped and another (WB) that was a collection of unique strategies that were equally effective at fixing head position.

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**2469 Board #114 May 29 8:00 AM - 9:30 AM**

**The Relationship Between The Knee Joint Moment And The Control Of The Center Of Mass.**

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(No relationships reported)

**PURPOSE:** To understand how the control of the center of mass (CoM) affects the frontal-plane knee joint moment.

**METHODS:** Based on the principle of virtual work, the joint moment  $\tau$  of the link system can be written as  $\tau = J^T F$ , where  $J$  (the Jacobian matrix of the link system) is a function of joint angle,  $F$  is a ground reaction force (GRF). On the other hand, the GRF  $F$  acting on the distal edge of the link system can be expressed using the acceleration of CoM as  $F = Mc - Mg$  ( $M$ : total mass,  $c$ : acceleration of CoM,  $g$ : acceleration of gravity). From these two equations, the joint moment  $\tau$  can be then written as  $\tau = J^T(Mc - Mg)$ . This means that the joint moment  $\tau$  depends on the acceleration of CoM. To check this equation in actual human movement, we conduct a landing experiment. 7 healthy adults jumped from 30 cm high box and landed using their dominant leg. The target on the force platform which subjects were asked to land were pointed by the PC-controlled laser pointer. The landing target randomly changed to another point after the landing action started. The purpose of this random landing task is to make various landing posture.

**RESULTS:** Fig.1 shows the frontal-plane knee joint moment as a function of the frontal-plane component of the vector of GRF with respect to leg coordinate system(A), and as a function of the frontal-plane component of the vector of estimated GRF based on the acceleration of CoM with respect to leg coordinate system. These two plots showed quite similar results.

**CONCLUSIONS:** Fig.1(B) showed that estimated GRF affects the frontal-plane knee joint moment as the real GRF does. For the prevention of ACL injury, not only the control of lower limb alignment, but also the control of CoM plays an important role in decreasing the valgus knee moment.

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**2470 Board #115 May 29 8:00 AM - 9:30 AM**

**Open And Closed Kinetic Chain Exercises Increase Wrist Stability During A Forward Fall**

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(No relationships reported)

Limited research has been conducted on open (OKC) and closed kinetic chain (CKC) wrist exercises and the impact on controlling a fall. It is uncertain if wrist exercises have an effect on increasing wrist stability by enhancing neuromuscular pathways during a forward fall.

**PURPOSE:** To determine if wrist exercises in the OKC and CKC can enhance neuromuscular pathways, aiding in wrist stability during a forward fall.

**METHODS:** Thirty healthy college students (23.0±2.0 yrs) with no upper extremity injuries in the past 6 months volunteered for the study. Subjects were randomly assigned to an OKC, CKC exercise group or a control group (no exercise). Subjects met with the researcher for six weeks to perform exercises for the dominant (writing hand) hand and wrist. Training included five wrist-specific weight-bearing exercises for the CKC group and five wrist-specific non-weight bearing exercises for the OKC group that increased in reps, sets, or time per week. Pre-post testing was performed using the Biodex Stability System (BSS) at levels 8,6,4, and 2. Each subject performed three practice trials for body placement and how to fall on the platform. One trial was performed for each of the four randomized stability levels for a total of four trials. The randomized levels of stability were used to simulate the element of surprise associated with falling on different types of surfaces. The stability levels were averaged over a stability level continuum producing one value for each stability index (anterior/posterior, medial/lateral and overall stability).

**RESULTS:** For medial/lateral stability, a significant main effect existed for time ( $F_{1,30} = 12.986$ ,  $P = .001$ ). Post-test stability index decreased indicating greater stability than pre-test. For overall stability, a significant interaction existed for group by time ( $F_{1,30} = 5.675$ ,  $P = .006$ ), time ( $F_{1,30} = 18.70$ ,  $P = .001$ ), and group ( $F_{1,30} = 6.295$ ,  $P = .009$ ). Although post-test results decreased for the CKC group, only the OKC and control groups were different for overall stability ( $p = .001$ ). All other results were not significant.

**CONCLUSIONS:** Open and closed kinetic chain exercises can be effective in integrating new neuromuscular patterns. Future research should continue to investigate the use of OKC and CKC wrist specific exercises to aid in wrist stability during a forward fall.

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**2471 Board #116 May 29 8:00 AM - 9:30 AM**

**Upper Extremity Activity And Strenght Characteristics Between Thrower And Non-trower During Isokinetic Shoulder Muscle Action**

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(No relationships reported)

**PURPOSE:** To examine the patterns of electromyography(EMG) activity and torque values during maximal, isokinetic muscle action with shoulder flexion (Flex<sub>Con</sub>/Flex<sub>Ecc</sub>), abduction (Abd<sub>Con</sub>/Abd<sub>Ecc</sub>) and diagonal activities (Dia<sub>Con</sub>/Dia<sub>Ecc</sub>), and to determine whether concentric or eccentric contractions or any of the obtained values were correlated with thrower and non-throwers at 60 and 180°/s on the dynamometer.

**METHODS:** The participants for this investigation were 18 males who assigned to two groups, thrower group of 9 male subjects (mean age, 21.9±1.2 years; mean height, 177.2±4.2 cm; mean body mass, 74.8±4.7 kg) that volunteered from university students who participate in overhead sports at least three days a week and non-thrower group of 9 healthy male subjects (mean age, 24.3±1.7 years; mean height, 175.9±2.5 cm; mean body mass, 65.1±6.4 kg). We assessed muscle activation of the anterior deltoid, middle deltoid, posterior deltoid, upper trapezius, middle trapezius, lower trapezius, pectoralis major, and biceps brachii muscles by surface electromyography.

**RESULTS:** The anterior deltoid and biceps brachii muscle activities were significantly greater for thrower group than non-thrower group during Abd<sub>Con</sub>/Abd<sub>Ecc</sub>, at 60 (both,  $P < 0.05$ ) and 180°/s (both,  $P < 0.001$ ). The middle and posterior deltoid muscle activities were significantly greater for thrower group than non-thrower group during Flex<sub>Con</sub>/Flex<sub>Ecc</sub> (both,  $P < 0.05$ ) and Abd<sub>Con</sub>/Abd<sub>Ecc</sub> (both,  $P < 0.001$ ) at 180°/s. The middle trapezius muscle activity was significantly greater for thrower group than non-thrower group during all tasks at 60°/s (Flex<sub>Con</sub>, Dia<sub>Con</sub>, and Abd<sub>Ecc</sub>,  $P < 0.05$ ; the other tasks,  $P < 0.001$ ). In the upper trapezius and pectoralis major muscle activities were not found to be dependent on all tasks of the velocity (60 or 180°/s) and the mode (Con or Ecc). The muscle strength value on thrower group was significantly higher for eccentric than concentric contraction in all the tasks (Abd,  $P < 0.05$ ; the other tasks,  $P < 0.001$ ).

**CONCLUSIONS:** This study has provided evidence that isokinetic eccentric muscle strength testing of the posterior upper extremity muscle is effective to develop of a proper program for overhead athlete requires forceful stability during throwing phases.

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**2472      Board #117      May 29      8:00 AM - 9:30 AM**  
**The Effect Of Workload On Measures Of Gross Motor Performance While Cycling**

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**PURPOSE:** Several studies have investigated physiological and biomechanical factors which may impact cycling training and performance. However, variables such as neuromuscular efficiency or gross motor performance while cycling have received relatively little attention. Knowledge of performance from this perspective may help scientists understand factors which influence related physiological and biomechanical issues or help coaches optimally apply the principle of specificity in ways which boost performance or lower risk of injury or overtraining. This study investigated the influence of workload on measures of gross motor performance during submaximal cycling.

**METHODS:** Fourteen avid recreational cyclists (47.20 ± 11.93 yr, 181.40 ± 5.85 cm, 80.58 ± 7.67 kg) volunteered for this study. Each completed three submaximal exercise bouts during two separate sessions. Each participant completed three submaximal exercise trials at workload (Watts) to bodyweight (kg) ratios of 1.5:1, 2.0:1, and 2.5:1. The order of the two sessions and three workloads were randomized. Numerous dependent measures of gross motor performance, perceived effort, and physiologic response were collected throughout each trial.

**RESULTS:** A two-way within-subjects analysis of covariance (2 x 3) was conducted to evaluate the effect of workload on dependent variables. Significant differences ( $p < 0.05$ ) were found for measures of workload (wattage), and gross motor performance (SpinScan™ and average torque angle), and perceived effort (RPE and OMNI). Post-hoc analysis showed subjects demonstrated significantly greater pedaling efficiency as the workload level increased during steady state cycling ( $p < 0.016$ ). HR responses for the different workloads approached statistical significance ( $p < 0.05$ ).

**CONCLUSIONS:** This study showed that workload level significantly influenced measures of gross motor performance or pedaling efficiency. These findings suggest that neuromuscular coordination responses contribute greatly to cycling performance and that such responses differ slightly from, and may interact in interesting ways with, the physiological and biomechanical responses seen also during cycling. More study is needed on the relationship between gross motor performance and cycling intensity.

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**2473      Board #118      May 29      8:00 AM - 9:30 AM**  
**The Effect Of 6weeks Intensive Core Stability On Functional Fitness And Postural Control Ability Of Stroke Patients**

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**PURPOSE:** The purpose of this study was to investigate the effects of core stability training on functional fitness and postural control ability of stroke patients.

**METHODS:** Nineteen subjects volunteered to participate and divided into two group: exercise group (EG; n=14), comparative group (CG; n=5). Muscular strength, muscular endurance, and flexibility for functional fitness were measured by PASS (Postural Assessment Scale for Stroke Patients) which was divided into two subscales: Maintaining a posture and changing posture.

**RESULTS:** Regarding the functional fitness variables, there were no significant differences in muscular strength. However, time x group interactions ( $p < 0.018$ ) and time ( $p < 0.043$ ) differences were shown significantly in upper and lower muscular endurance, respectively. In flexibility, significant difference were shown in time ( $p < 0.005$ ) and time x group interactions ( $p < 0.04$ ). Regarding to posture variables, significant time x group interaction was shown in controlling posture ( $p < 0.046$ ) and maintaining a posture ( $p < 0.008$ ).

**CONCLUSIONS:** according to the results, the effect of core stability training on stroke patients was positive. Therefore, core stability exercise should be included in the treatment for stroke patient during the post stroke rehabilitation stage.

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**2474      Board #119      May 29      8:00 AM - 9:30 AM**  
**Decoupled Elliptical Machine Training: Withdrawal And Crossed-extensor Reactions During Bipedal Stance**

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When rapid ankle inversion is sensed, the withdrawal and crossed-extensor reflex unloads the ipsilateral limb and extends the contralateral limb. This reflex response potentially protects against ankle sprains.

**PURPOSE:** To determine if the withdrawal and crossed-extensor reflex response could be heightened through bilateral training on a human-powered, decoupled elliptical machine.

**METHODS:** Five male subjects who had completed a challenging series of skill progressions on the machine were compared to matched controls who had never used the machine (PS = Progressed Subjects, CS = Control Subjects). A bipedal standing test with electrical stimulation to either ankle was conducted to elicit the withdrawal and crossed-extensor reflex. Once the 50 ms stimulus was felt, the subject lifted the stimulated foot completely off the ground as quickly as possible. Ten noxious stimulus trials were followed by ten sub-noxious trials (five to each ankle randomly). Ground reaction forces under each foot and surface EMG of vastus lateralis and biceps femoris muscles were recorded bilaterally. Differences in time to react were assessed at  $p < 0.10$  for the five stimuli trials to the dominant ankle in each condition.

**RESULTS:** Age, height, body mass, reported athletic participation/accomplishment, and current physical activity were similar in PS and CS. In general, the PS reacted faster for both noxious and sub-noxious stimuli. PS withdrew the ipsilateral foot more rapidly in both noxious ( $308 \pm 33$  vs  $389 \pm 85$  ms,  $p = 0.083$ ) and sub-noxious trials ( $320 \pm 44$  vs  $437 \pm 69$  ms,  $p = 0.013$ ). Also, during sub-noxious trials the PS activated the ipsilateral ( $114 \pm 8$  vs  $133 \pm 15$  ms,  $p = 0.035$ ) and contralateral biceps femoris more rapidly ( $101 \pm 15$  vs  $175 \pm 087$  ms,  $p = 0.094$ ) and produced the first detectable change in contralateral force more rapidly ( $136 \pm 19$  vs  $165 \pm 20$  ms,  $p = 0.047$ ). Reactions by both groups were generally faster in the noxious condition, as expected.

**CONCLUSIONS:** These preliminary findings indicate that decoupled elliptical training may enhance the withdrawal and crossed-extension response during both reflex and non-reflexive conditions; potentially reducing the likelihood of ankle sprain.

*This project was funded in part by Shifter, Inc. The investigators have no financial conflict of interest.*

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**2475      Board #120      May 29      8:00 AM - 9:30 AM**  
**The Effect Of Retro Locomotion On Flexibility Of The Low Back And Hamstrings**

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(No relationships reported)

Low back pain (LBP) is a serious health problem in America affecting over 80% of the population (NIH, 2006) and is often characterized by a lack of flexibility of the low back and hamstrings.

**PURPOSE:** To explore whether retro locomotion can be an effective means to increase flexibility of the low back and hamstrings, ultimately decreasing LBP.

**METHODS:** Ten healthy female adults (29.9±10.0 yrs; 165.1±8.2 cm; 68.53±18.4 kg) presenting without LBP within the past four months volunteered to participate. The pre-test consisted of participants first warming up with a 2-5 minute forward walk at a personally comfortable velocity followed by three trials of the YMCA Sit-and-Reach test to measure low back and hamstrings flexibility. A biaxial electrogoniometer (Biometrics, model SG 150) was secured externally to the low back vertically spanning T12-S2. Participants then walked backward on a treadmill at their preferred velocity for 10-15 minutes. Low back motion data from the electrogoniometer (1000 Hz) was obtained for 20 sec during the sixth minute of the walk capturing 10 complete walking strides. Following the pre-test, participants completed four weeks of backward walking on a treadmill or over ground for 10-15 minutes/day, four days/week, at the participant's chosen velocity. After completing the intervention, a post-test session which duplicated pre-test procedures was conducted. Four dependent variables were identified including maximum sit-and-reach score (SR), walking velocity (Vel) and average sagittal (sROM) and coronal (cROM) range of motion (cROM) of the low back averaged across 10 walking strides. Pre-post differences were evaluated with correlated t-tests ( $\alpha = 0.05$ ).

**RESULTS:** Statistically greater post-test SR ( $p < 0.001$ ) and Vel ( $p < 0.001$ ) values were observed with no differences for sROM ( $p = 0.289$ ) or cROM ( $p = 0.320$ ).

**CONCLUSION:** Retro locomotion may be a practical means to improve flexibility of the low back and hamstrings as evidenced by improved SR scores. Low back range of motion may not be similarly influenced; however individual responses in low back motion were evidenced.

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**2476 Board #121 May 29 8:00 AM - 9:30 AM**  
**Prophylactic Ankle Stabilizers Affect Ankle and Knee Joint Kinematics During Landing**

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(No relationships reported)

**PURPOSE:** Ankle joint dorsiflexion contributes to energy absorption when landing, but wearing ankle stabilizers has been shown to restrict passive and active measures of dorsiflexion. Recent changes in stabilizer design and materials have been intended to improve support to the lateral ankle joint without restricting sagittal plane motion. This study compared the effects of various ankle stabilizers on ankle and knee joint kinematics during soft and stiff landings.

**METHODS:** Subjects ( $N=11$ ) performed two-legged landings off a 0.32-m platform onto a force platform while recorded with an optotrak system (200 Hz). Five soft and five stiff landings were performed in five bilateral ankle stabilizer conditions (no stabilizer; standard taping; neoprene shell with support; reinforced lace up boot; hinged lace up boot), a total of fifty trials per subject. Stabilizer and style conditions were randomized across subjects. Each subject's five-trial mean value of selected ankle and knee kinematic variables for each landing style/stabilizer condition was entered into a two-way repeated measures ANOVA ( $\alpha=0.05$ ).

**RESULTS:** As previously reported in the literature, joint ROMs were less in stiff landings than soft landings. Compared with the no stabilizer condition, the ROM at the ankle and knee were reduced in most stabilizer conditions, reflecting a more extended landing position at both ground contact and maximum joint flexion when using an ankle stabilizer. Stabilizer effects at the ankle joint were of similar magnitude to soft vs stiff differences, but of a smaller magnitude at the knee joint.

**CONCLUSIONS:** In spite of design and material changes to the stabilizers, the results indicate that some ankle stabilizers still adversely affect ankle joint kinematics during landing, possibly inducing changes in the knee joint kinematics.

**ACKNOWLEDGEMENTS:** Ankle stabilizers were supplied at no-cost by the manufacturers. The financial support of IAHPERD through a *Jump Rope for Heart* grant is gratefully appreciated.

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**2477 Board #122 May 29 8:00 AM - 9:30 AM**  
**Effect Of Mandibular Orthopedic Repositioning Device On Neuropsychological Measures**

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(S.G. Piland, Shock Doctor, Inc., Salary; Shock Doctor, Inc., Contracted Research.)

Mandibular orthopedic repositioning appliances (MORA) have been purported to enhance human performance related to muscular strength, balance, concentration, attention and coordination. However, limited scientific evidence is available for review, thus claims are mostly supported anecdotally.

**PURPOSE:** To determine the effect of treatment condition (Control or MORA) on measures of attention, concentration, dexterity, visual sequencing, coordination and reaction time of physically active college-aged individuals.

**METHODS:** Twenty-seven physically active male subjects (age = 21.33 ± 2.22 yr; ht = 177.0 ± 7.26 cm; wt = 85.85 kg) were group matched on age, height and weight then placed into a prospective randomized, doubly multivariate, crossover design over a period of 4 weeks. The aforementioned constructs were measured using a battery of neuropsychological tests to include: Comprehensive Trail-Making Test (CTMT), the ImPACT computerized neurocognitive program and the Grooved Peg Board Test (GPBT). Pre-crossover data were used to determine the effect of the IV (treatment: control, MORA) on the DV's (mean composite CTMT score, mean ImPACT composite reaction time and visual composite scores, and mean GPBT score) using four separate Univariate analysis with age, height, weight, and grade level as covariates.

**RESULTS:** With no significant covariates noted, no statistically significant differences were found between the MORA and Control group for composite CTMT score, ImPACT composite reaction time and visual composite scores,  $p = .454$ ,  $p = .711$  and  $p = .630$  respectively. No statistically significant differences were found between the MORA and Control group for dominant and non-dominant hand GPBT,  $p = .257$  and  $p = .136$  respectively.

**CONCLUSIONS:** Contrary to anecdotal claims, the use of a MORA device does not increase attention, coordination, reaction time, visual sequencing demands, reaction time and dexterity as measured by the utilized neuropsychological assessment battery.

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**2478 Board #123 May 29 8:00 AM - 9:30 AM**  
**Motor Variability In A Hand Muscle: Greater Visuomotor Contribution To Force Fluctuations For Older Adults**

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Muscle force fluctuations depend primarily on the neural signal to the motor unit pool. For older adults, the neural signal can be more variable and contribute to the amplitude of force fluctuations when visual feedback is important to task performance - for large proximal muscles. For distal hand muscles however, the afferent sensory feedback, neural inputs to motor neurons, and typical use is very different.

**PURPOSE:** The purpose was to determine age-related differences in the contribution of visuomotor correction to force fluctuations during contractions of the first dorsal interosseus (FDI).

**METHODS:** Young ( $N = 21$ , 22 ± 7 yrs) and elderly adults ( $N = 12$ , 72 ± 9 yrs) underwent assessment of maximum voluntary contraction (MVC) and force fluctuations during constant-force (CF) isometric contractions of the left FDI muscle. Subjects were seated with the elbow at a right angle, palm down, and wrist, thumb, and fingers 3-5 restrained. They produced steady abduction forces of the index finger at each target force (2.5, 30, and 65% MVC) in random order. For each trial, visual feedback of the force was provided for 8-10 s (VIS) and removed for 8-10 s (NOVIS). Mean force, standard deviation (SD), and coefficient of variation (SD/mean force, CV) of force was calculated for VIS and NOVIS data segments. Drift of the force signal away from the target (< 0.5 Hz) was removed from all data before fluctuation analysis.



**RESULTS:** MVC force tended to be lower for elderly adults ( $32 \pm 11$  N vs.  $38 \pm 9$  N,  $P = 0.12$ ). For young adults the CV of force was similar between VIS and NOVIS for the 2.5% ( $4.9 \pm 1.8\%$ ), 30% ( $3.4 \pm 1.4$ ) and 65% ( $4.2 \pm 1.5\%$ ) target forces. In contrast, for elderly adults the CV of force was greater for VIS than NOVIS for 2.5% MVC ( $7.1 \pm 2.9\%$  vs.  $4.5 \pm 1.8\%$ ), but not for the 30% ( $2.6 \pm 1.6\%$ ) and 65% ( $3.4 \pm 2.1\%$ ) target forces. The effect of visual feedback was greater for elderly than young subjects (vision x age group interaction,  $P = 0.004$ ).

**CONCLUSION:** As with large proximal muscles, visuomotor correction contributed substantially to the amplitude of force fluctuations in a small hand muscle. The fluctuations increased by 58% for older adults when vision was used as a source of feedback, suggesting a reduced ability to process visuomotor information and execute ongoing corrections during simple motor tasks.

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**2479 Board #124 May 29 8:00 AM - 9:30 AM**

**A Novel Ankle-supinating Device**

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Lateral ankle sprains (LAS) are common injuries and while many are resolved with treatment, others develop Ankle Instability (AI). It follows that considerable attention has been directed towards understanding the underlying causes of this pathology, however little is known to date concerning the neuromuscular mechanisms behind the development of AI, possibly due to a dearth of analyses of individuals with AI in dynamic conditions.

**PURPOSE:** To perform a pilot kinematic and EMG analysis of the landing phase of a drop jump onto a device which simulates the mechanism of a LAS in persons with AI (AI group), persons who've suffered a LAS, but did not develop AI (NO group), and uninjured controls (CO group).

**METHODS:** Six subjects with bilaterally equivalent ankle status were divided equally into the 3 groups. A pneumatic rotary actuator powered the rotation of a landing plate via a linkage system, aiming to safely mimic a LAS event. The protocol included subjects dropping off a take-off platform (test leg first) and landing with both feet simultaneously onto the device and surrounding landing platform; followed by an immediate jump "as high and fast as possible". Subjects were familiarized with the protocol, then 10 experimental trials were performed with 3 supinating and 7 non-supinating trials in a random order, unknown to the subject. Markers were placed according to a modified Helen Hayes marker set and EMG was performed on the Tibialis Anterior (TA) and Peroneus Longus (PL). Due to the pilot nature and low power, only descriptive statistics were calculated.

**RESULTS:** Kinematics indicated that the platform created a perturbation causing increased ankle plantar flexion ( $\sim 8^\circ$ ), adduction ( $\sim 9^\circ$ ), and inversion ( $\sim 13^\circ$ ). The EMG data suggests NO subjects demonstrate an increased activation of the PL prior to landing and in response to a perturbation, relative to the other groups.

**CONCLUSION:** The device adequately simulates the mechanism of a LAS in a safe, controlled environment, even in individuals with AI. The preliminary EMG data suggests the work evaluating subjects who have a previous history of at least one LAS and don't experienced recurrent symptoms may help elucidate some compensatory mechanisms or more appropriate neuromuscular control strategies following a LAS, so more appropriate treatment paradigms can be developed.

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**2480 Board #125 May 29 8:00 AM - 9:30 AM**

**Steadiness During Plantar Flexion Is Associated With Postural Sway In Young But Not Elderly Adults**

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(No relationships reported)

Fluctuations in motor output during steady isometric contractions with a muscle or muscle group are often greater in elderly than young adults, but the functional significance of force fluctuations during isolated muscle contractions is not determined.

**PURPOSE:** The present study examined the association between force fluctuations during isolated contractions with plantar flexor muscles and postural sway during quiet standing in young and elderly adults.

**METHODS:** Twenty young ( $28.1 \pm 4.0$  yrs) and 20 elderly ( $69.7 \pm 2.8$  yrs) subjects performed a force-matching task with unilateral isometric plantar flexion (PF) at 2.5%, 5%, 10%, 15%, and 20% of subjects' maximal voluntary contraction (MVC) for 30 s. The knee joint was fully extended and the ankle joint was in the neutral position during PF. They also maintained quiet standing (QS) on a force platform for 30 s as a separate task. To quantify the variability of motor output, the coefficient of variation (CV) of force during PF and the CV of center of pressure displacement during QS were calculated. Surface electromyogram (EMG) was recorded from the soleus, medial gastrocnemius and lateral gastrocnemius muscles during PF and QS. Power spectrum density of the rectified EMG was calculated to characterize the muscle activation strategies.

**RESULTS:** In young subjects, a significant ( $P < 0.05$ ) positive correlation was found in the CV between QS and PF at lower contraction intensities (2.5% and 5% of MVC). There was no correlation between QS and PF at any contraction intensity in elderly adults. During PF, the EMG power around 10 Hz was significantly ( $P < 0.05$ ) greater in the medial gastrocnemius in elderly than young adults at low contraction intensities (2.5% and 5% of MVC). There was no difference in the EMG power distribution in other muscles between young and elderly adults during PF. During QS, the EMG power around 10 Hz was significantly ( $P < 0.05$ ) greater in all the muscles in elderly than young adults.

**CONCLUSION:** The variability in postural sway during quiet standing was correlated to the force fluctuations during isolated plantar flexion at low contraction intensities in young but not elderly adults. The presence or absence of association between postural sway and force fluctuations may be influenced by the muscle activation strategy around 10 Hz.

*Supported by NIH Grant NS052480*

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**2481 Board #126 May 29 8:00 AM - 9:30 AM**

**Exploration Of Muscle Activity Patterns During Deep Water Running**

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(No relationships reported)

Deep water running (DWR) simulates running while submerged in the water up to neck level and unable to touch the bottom of the pool. It is not known which aspects of DWR are critical to provide a cross-training stimulus for on land running. We sought to understand the coordination between select lower extremity muscles.

**PURPOSE:** To compare the magnitude of co-contraction between select muscles during DWR and treadmill running (TMR).

**METHODS:** Subjects ( $n=7$ ,  $26.3 \pm 4.3$  yrs,  $158 \pm 9.9$  cm,  $61 \pm 6.6$  kg) were instrumented to record electromyography (EMG) of the Rectus Femoris (RF), Biceps Femoris (BF), Gastrocnemius (GA), and Tibialis Anterior (TA). Subjects first completed three exercise conditions during DWR at Rating of Perceived Exertion (RPE) levels of 11 (fairly light), 13 (somewhat hard), and 15 (hard). Subjects then completed the same RPE levels during TMR. EMG data were recorded (1500 Hz) and a 25-s data set extracted for analysis. EMG data were smoothed (500 Hz), zero-offset removed, rectified and normalized to maximal voluntary contraction. A co-contraction index (CCI) was calculated for RF-BF and GA-TA muscle combinations using the formula:  $CCI(i) = (M1(i)/M2(i) \times (M1(i) + M2(i)))/2$  for  $i=0-25$ s, M1 is the lower and M2 the higher EMG at each time. Average CCI for RF-TF and GA-TA was calculated across the 25-s data set and compared across Mode (DWR, TMR) and RPE (11, 13, 15) using a 2 x 3 repeated measures ANOVA. Planned comparisons were conducted using paired t-tests to compare CCI between DWR and TMR at each RPE level.



**RESULTS:** RF-BF CCI was influenced by the interaction of Mode and RPE ( $p=0.036$ ) whereas GA-TA CCI only tended to be different between modes ( $p=0.069$ ). It was determined that RF-BF CCI was lower ( $p<0.05$ ) during DWR then TMR at RPE 11 (DWR  $1.94\pm0.64\%$ , TMR  $7.65\pm6.1\%$ ) and RPE 13 (DWR  $2.76\pm1.4\%$ , TMR  $7.49\pm5.2\%$ ) but not at RPE 15 (DWR  $4.46\pm2.34\%$ , TMR  $9.59\pm7.4\%$ ,  $p>0.05$ ). GA-TA CCI was lower ( $p<0.05$ ) during DWR than TMR at RPE 11 (DWR  $1.65\pm1.2\%$ , TMR  $8.89\pm3.7\%$ ) and RPE 13 (DWR  $1.99\pm2.2\%$ , TMR  $8.61\pm3.7\%$ ) and tended to be lower at RPE 15 (DWR  $3.20\pm3.8\%$ , TMR  $8.07\pm6.43\%$ ,  $p=0.08$ ).

**CONCLUSION:** There was less co-contraction for flexor/extensor pairs of muscles during DWR then TMR at lower intensities. It appears that higher intensity DWR is needed to achieve similar co-contraction magnitudes of lower intensity TMR.

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**2482 Board #127 May 29 8:00 AM - 9:30 AM**  
**A Lack Of Peripheral Fatigue Effects On Force Sense At The Knee**

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(No relationships reported)

Peripheral fatigue impacts neuromuscular control of knee joint stability as evidenced by reports of injuries occurring during the latter stages of competition. Previous research has demonstrated that fatigue can affect proprioception, as measured by threshold to detect passive motion (TTDPM). The effects of peripheral fatigue on proprioception measured actively by force sense (FS) have not been investigated. FS measures an individual's ability to produce a measured amount of force and may provide insight into feedback from musculotendinous mechanoreceptors.

**PURPOSE:** To determine the effects of peripheral fatigue on quadriceps and hamstrings FS.

**METHODS:** A total of twenty healthy and physically active females and males (age:  $23.4\pm2.7$  years, mass:  $69.5\pm10.9$ kg, height:  $169.7\pm9.4$ cm) participated. FS of the hamstrings and quadriceps was tested on separate days before and after three sets of isokinetic knee flexion and extension to fatigue. Prior to the fatigue protocol, each individual performed a maximum isokinetic test to determine peak torque production. The first two sets were 40 repetitions, with the last set truncated at 90 repetitions or stopped if torque production dropped below 25% of peak torque. Electromyographic data of the tested musculature were collected in order to calculate and determine median frequency shift. FS was measured by examining the ability to produce a target isometric torque (25% MVIC) with and without visual feedback (FS Error). Separate dependent t-tests were conducted to examine pre-fatigue and post-fatigue FS Error for flexion and extension.

**RESULTS:** Despite verification of fatigue via torque production decrement and shift in median frequency, no significant differences were observed in FS Error for either knee flexion (pre= $0.54\pm2.28$  N-m; post= $0.47\pm1.62$  N-m ( $p=.45$ )) or extension (pre= $0.28\pm2.69$  N-m; post= $0.21\pm1.78$  N-m ( $p=.44$ )) pre-fatigue compared to the post-fatigue condition.

**CONCLUSION:** Although previous research has demonstrated that peripheral fatigue negatively affects TTDPM, it did not affect FS as measured in this study. The peripheral fatigue protocol may have a greater effect on the mechanoreceptors responsible for TTDPM than those responsible for FS. Further investigation into the effects of fatigue across various aspects of proprioception is warranted.

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**E-33 Free Communication/Poster - Older Adults**

MAY 29, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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**2483 Board #128 May 29 9:00 AM - 10:30 AM**  
**The Effect Of High Velocity Resistance Training In Older Men And Women**

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(No relationships reported)

Traditional resistance training (RT) with a strengthening component improves muscle strength and power in older adults; however, the strenuous nature of traditional RT can make adherence to this regimen difficult. Alternative RT protocols are needed in this population to ensure continued participation.

**PURPOSE:** To evaluate the effects of traditional RT (high load, slow velocity) compared to high velocity RT (low load, high velocity) on muscle strength (MVC), peak power (PP), functional performance, work, and rating of perceived exertion (RPE) in older adults.

**METHODS:** 38 men and women (Age:  $72.4\pm5.9$  years) were randomly assigned to one of three groups for a 12-week study: Strength (STR:  $n=13$ ), Velocity (VEL:  $n=13$ ), or Control (CON:  $n=12$ ). STR performed 3 sets of 8-10 reps at 80% 1RM slowly (concentric portion: 2-s) 3x/wk; VEL performed 3 sets of 12-14 reps at 40% 1RM as quickly as possible concentrically 3x/wk. STR, VEL, and CON all performed stretching exercises 3x/wk. Lower extremity MVC and PP were obtained using computer-interfaced Keiser a420 knee extension machines. Functional measures included timed up and go, tandem walk, habitual and maximal gait speed, timed stair climb and descent, and 400 meter walk. Statistical analyses included repeated measures (group x time) ANOVA and independent samples t-tests. Statistical significance was accepted at  $p<0.05$ .

**RESULTS:** With training, MVC increased by 26% and 25% in STR and VEL, respectively, compared with CON (ANOVA;  $p=0.002$ ). With training, PP increased similarly in STR and VEL by 12% and 24%, respectively, compared with CON ( $p<0.001$ ). There was no improvement in any functional measure between STR and VEL (all  $p>0.05$ ). There was no difference in work performed between STR (3673 J) and VEL (4070 J) ( $p=0.47$ ), but RPE during resistance training was lower in VEL (RPE=14.6) compared with STR (RPE=16.7) ( $p=0.002$ ).

**CONCLUSIONS:** Traditional RT with a strengthening component and high-velocity, low load RT both showed increases in strength and power, but had no effect on function. Despite similar effects on muscle performance and similar amounts of work performed, high-velocity RT was perceived to be less strenuous than traditional RT. Employing high velocity RT could have a beneficial impact on exercise adherence in this population.

Supported by NIA grant #R03AG025141-02.

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**2484 Board #129 May 29 9:00 AM - 10:30 AM**  
**Development Of A Metabolic Equation For Nustep® Recumbent Stepper Exercise In Older Adults**

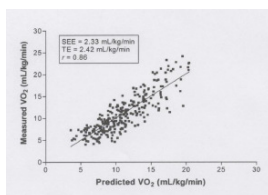
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(No relationships reported)

Exercise professionals frequently rely upon metabolic equations to prescribe exercise intensity and to estimate the energy expenditure of different exercise modalities (Franklin, 2000). To date there has been no research performed to develop accurate prediction equations for the NuStep® (NS) recumbent stepper.

**PURPOSE:** The purpose of this study was to develop an accurate metabolic equation for estimating steady-state  $\text{VO}_2$  during submaximal NS exercise.



**METHODS:** Forty male and female participants (mean  $\pm$  SD, age:  $64.0 \pm 6.5$  yr.; height:  $170.1 \pm 9.1$  cm; weight:  $85.7 \pm 19.9$  kg) performed two randomized testing sessions. Each session consisted of six stages with combinations of four workloads (1, 3, 5, and 7) at 3 cadences (60, 80, and 100 steps/min). Steady-state  $\text{VO}_2$  measurements from the last 2 min of each workload were used to develop a metabolic prediction equation for NS exercise.

**RESULTS:** Multiple regression analysis to predict steady-state  $\text{VO}_2$  from NS workload (W), NS steps/min (s/min), and subject body mass resulted in the following model ( $R^2 = .733$ ): Steady-state  $\text{VO}_2 = 3.5 - 0.53(W \cdot \text{s/min}) + 0.92(\text{s/min}) + 0.16(\text{wt})$ . The standard error of the estimate (SEE) and total error (TE) for the prediction of steady-state  $\text{VO}_2$  under all NS workload conditions were 2.3 mL/kg/min and 2.4 mL/kg/min respectively (see Figure). The correlation coefficient between predicted  $\text{VO}_2$  and measured  $\text{VO}_2$  values was significant ( $p < .05$ ),  $r = 0.86$ .

**CONCLUSION:** SEE and TE values for the developed NS metabolic equation are similar to those reported in previous studies investigating the accuracy of metabolic equations for other exercise modalities. These findings support the use of the equation developed in the present study to predict steady-state  $\text{VO}_2$  for NS exercise.

**2485 Board #130 May 29 9:00 AM - 10:30 AM**  
**Falls Prediction By Physical Function And Health Status In Elderly Men And Women.**

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(No relationships reported)

Fullerton batteries have been used by exercise professionals to assess physical function and balance in elderly, however there is no sufficient knowledge about its capacity to discriminate fallers from nonfallers.

**PURPOSE:** To analyse falls prediction by physical function attributes (evaluated by field tests), age and health status in elderly men and women.

**METHODS:** Participants were 549 community-dwelling persons, aged 50-87 yrs ( $68.1 \pm 6.8$  yrs): 317 fallers vs. 154 nonfallers females and 100 fallers vs. 18 nonfallers males. Body weight, height, body mass index, lower and upper body strength and flexibility, agility, aerobic endurance (AE), and multidimensional balance (MB) were evaluated by Fullerton batteries. Body fat mass percentage (BFM%) was evaluated by bioimpedance using a HBF-306C, and waist circumference (WC) was measured at navel level. Age, sum of the number of diseases and incapacities (DI-number) and the occurrence of falls in the last year were evaluated through questionnaire by interview. Fallers were those who had fallen at least once within the last 12 months.

**RESULTS:** Chi-Square revealed that women fell more than men (33 vs 23%,  $p=0.020$ ). T-Student showed that women presented a lower body weight, height, WC, strength, agility, AE, and MB, but higher flexibility, BFM%, and DI-number than men ( $p \leq .01$ ). T-Student also showed that fallers were older and had lower muscle strength, flexibility, AE, and MB, and higher BFM%, DI-number than nonfallers ( $p \leq .05$ ). Logistic regression with backward stepwise selection, showed that predictor variables to falls occurrence were gender OR=2.1, 95% CI (1.003-4.529), weight OR=0.974, 95% CI (0.954-0.994), BFM% OR=1.063, 95% CI (1.023-1.105), DI-number OR=1.212, 95% CI (1.108-1.327) and MB OR=0.934, CI 95% (0.908-0.961). The analysis of the area under the receiver operating characteristics (ROC) curve was 0.70, 95% CI (0.65-0.75), with a specificity of 0.64 and sensitivity of 0.65 for a cut point  $p=0.3$ .

**CONCLUSION:** Men fall less than women, perhaps due to a better physical function, body composition and health status. However, for a similar MB, body weight, BFM%, and DI-number, men is more prone to falling than women. Regarding overall accuracy of ROC curve, these predictor variables may discriminate fallers from nonfallers.

**2486 Board #131 May 29 9:00 AM - 10:30 AM**  
**Self-selected Walking Intensity Of Healthy Older Women (65-74yr) During Treadmill And Over-ground Walking**

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**BACKGROUND:** Current exercise guidelines for older adults recommend at least 30 min of physical activity (PA) on most days of the week ( $\geq 4/\text{wk}$ ) performed at 55-90% of maximum heart rate (HRmax). While the recommended frequency and duration of PA can be easily self-selected, it is unclear if older adults are able to select the recommended exercise intensity.

**PURPOSE:** To determine if healthy women (65 - 74 yr) are able to self-select a walking intensity that is within the current recommendations for daily PA during treadmill (TM) and over-ground (OG) walking.

**METHODS:** Nine healthy older women (age =  $68.5 \pm 3.2$  yr, BMI =  $26.2 \pm 5.7$  kg/m<sup>2</sup>, peak O<sub>2</sub> uptake ( $\text{VO}_{2\text{peak}}$ ) =  $22.7 \pm 4.7$  mL/kg/min) performed four, 30-min walking trials (two TM and two OG) in a counterbalanced, randomized order. For the initial TM and OG trials, subjects self-selected their walking speed. Walking speed, heart rate (HR) and ratings of perceived exertion (RPE) were recorded during these trials. For the second TM and OG trials, walking speed was controlled to match the speeds selected during the initial TM and OG trials. During the second TM and OG trials, pulmonary gas exchange was measured using a COSMED K4b2, in addition to HR and RPE.

**RESULTS:** Exercise intensity during self-selected TM and OG walking were within the current guidelines for daily PA (TM = 70% HRmax, 95%CI = 66 - 75%; OG = 73% HRmax, 95%CI = 67 - 79%). Differences in the HR and  $\text{VO}_2$  responses for TM and OG walking were not significant (%HRmax,  $p = .06$ ; % $\text{VO}_{2\text{peak}}$ ,  $p = .08$ ), while walking speed during OG was significantly greater than TM walking ( $p = .01$ ).

**CONCLUSION:** Healthy older women are able to self-select a walking intensity that is suitable for meeting the current recommendations for daily PA during both TM and OG walking.

*This project is Supported by the National Health and Medical Research Council of Australia.*

**2487 Board #132 May 29 9:00 AM - 10:30 AM**  
**"Tailored" Step Test For Rapid, Accurate And Safe  $\text{VO}_{2\text{max}}$  Determination In Healthy Elderly.**

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**PURPOSE:** The study aimed at developing and validating a "tailored" version of the Åstrand step test, suitable for  $\text{VO}_{2\text{max}}$  determination in healthy elderly. Furthermore, we tested the hypothesis that a direct measure (compared to estimation) of the step test  $\text{VO}_2$ , adds accuracy to  $\text{VO}_{2\text{max}}$  determination in this population, characterized by low fitness and muscle strength and reduced coordinative ability.

**METHODS:** In 27 healthy elderly (age 68±5, 14 M, 13 F) a target  $\dot{V}O_2$  ( $\dot{V}O_{2t}$ ) for the step test was calculated as 60% of the  $\dot{V}O_{2max}$  (predicted based on their referred activity pattern). Thereafter, subjects performed a 5-min test, on a 30 cm step, with a stepping rate (10-25 steps\*min<sup>-1</sup>) “tailored” based on  $\dot{V}O_{2t}$  and the predicted cost of stepping. Heart rate (HR) and  $\dot{V}O_2$  were measured using a portable, hand-held, metabolic analyzer.  $\dot{V}O_{2max}$  was estimated based on Åstrand equation and age correction using either  $\dot{V}O_{2t}$  ( $\dot{V}O_{2max, t-est}$ ) or measured  $\dot{V}O_2$  ( $\dot{V}O_{2max, m-est}$ ). Finally,  $\dot{V}O_{2max}$  was measured directly ( $\dot{V}O_{2max, d}$ ) during an incremental cycling test to exhaustion with breath by breath determination of cardiorespiratory variables, with a traditional metabolic chart. Agreement among  $\dot{V}O_{2max, t-est}$ ,  $\dot{V}O_{2max, m-est}$ ,  $\dot{V}O_{2max, d}$  was evaluated by Bland Altman analysis.

**RESULTS:** All the subjects completed the incremental exercise to exhaustion (maximal HR 98±7% of age-predicted value, maximal respiratory quotient 1.1±0.04). Mean ± standard deviation  $\dot{V}O_{2max}$  was 27±5 ml\*kg<sup>-1</sup>\*min<sup>-1</sup>. All the subjects were also able to complete the “tailored” step test with no difficulty.  $\dot{V}O_{2max, m-est}$  was not significantly different from  $\dot{V}O_{2max, d}$  (bias -0.3, not different from 0; precision 4.1 ml\*kg<sup>-1</sup>\*min<sup>-1</sup>). On the contrary,  $\dot{V}O_{2max, t-est}$  was significantly underestimated compared to  $\dot{V}O_{2max, d}$  (bias -2.3, ≠ 0; precision 4.6 ml\*kg<sup>-1</sup>\*min<sup>-1</sup>).

**CONCLUSION:** The study developed and validated a “tailored” version of the Åstrand step test, suitable for a rapid (5 min duration), safe (submaximal test) and accurate (unbiased)  $\dot{V}O_{2max}$  determination in healthy elderly individuals. In this population, estimation of the step test  $\dot{V}O_2$  leads to a small (9%) yet significant error in  $\dot{V}O_{2max}$  estimation. Therefore, our data suggest that a direct measure of the step test  $\dot{V}O_2$  should be performed to assure accuracy to  $\dot{V}O_{2max}$ -estimation.

*The study was Supported by Cosmed, Italy.*

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**2488 Board #133 May 29 9:00 AM - 10:30 AM**  
**Changes In Health-related Quality Of Life And Functional Ability With Exercise Training In Senior Center Members**

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(No relationships reported)

Successful aging encompasses physical, functional, social, and psychological health, which are all important aspects in maintaining quality of life.

**PURPOSE:** To determine the effect of exercise on health-related quality of life (HRQL) and functional ability, as assessed by ability to carry out activities of daily living (ADL), in older adults who attend senior centers.

**METHODS:** Changes in HRQL and ability to carry out ADLs were assessed after 12 weeks of endurance training (ET), following ACSM guidelines, in 16 previously inactive older (72±6 yrs) men (n=3) and women (n=13) and compared with changes in HRQL and ability to carry out ADLs in 16 aged-matched (76±7 yrs) inactive controls (men (n=1), women (n=15)). All research participants were members of the Baltimore County Department of Aging Senior Centers. Changes in HRQL for several domains including: physical functioning, physical health-related role limitations, bodily pain, general health, vitality, social functioning, mental health-related role limitations, and mental health were assessed by the Medical Outcomes Survey Short Form-36 (MOS SF-36) questionnaire. Changes in ability to carry out ADLs were assessed using the Senior Fitness Tests (SFT), which included: chair stand, arm curl, 2-minute step, chair sit-and-reach, back scratch, and 8-foot up-and-go tests. ANCOVA was used to test for significant differences in changes in HRQL and ability to carry out ADLs between the ET and control groups.

**RESULTS:** There was a significantly greater increase in the physical health-related role limitations domain in the ET group compared with controls (12±19 vs. -8±20, P=0.01). Also, there was a significantly greater increase in the number of steps completed in the 2-minute step test in the ET group compared with controls (15±10 vs. 4±8, P=0.01). There were no other significant differences between the ET and control groups for changes in the other HRQL domains or the other SFTs.

**CONCLUSIONS:** These preliminary results suggest that in older adults who attend senior centers, ET may improve aerobic fitness and the ability to carry out work and other physical daily activities.

*Supported by Towson University Faculty Development and Research Committee Grant*

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**2489 Board #134 May 29 9:00 AM - 10:30 AM**  
**The Effect Of High-Speed Power Training On Muscle Performance In Older Men And Women.**

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Peak power is a key outcome measure of muscle performance in older adults. Peak power is typically obtained by choosing the highest power output measured across a range of external resistances (40%-90% 1RM). Although resistance training (RT) improves peak power in older adults, few studies have examined how different RT protocols impact muscle power and its individual components (force and velocity) across a range of external resistances.

**PURPOSE:** To compare the effects of high-load, slow-speed RT and low-load, high-speed RT on muscle power and the components of force and velocity across a range of external resistances in older adults.

**METHODS:** 38 men and women (Age: 72.4 ± 5.9 years) were randomly assigned to one of three groups for a 12 wk training study: strength training (STR: n=13), high-speed power training (HSPT: n=13), or control (CON: n=12). STR performed 3 sets of knee extension (KE) exercise (8-10 reps; 80% 1RM slowly [concentric: 2 s]; 3x/wk); HSPT performed 3 sets of KE exercise (12-14 reps; 40% 1RM [concentric: as fast as possible]; 3x/wk). All groups performed stretching exercises 3x/wk. Knee extension peak power (PP), peak power force (PPV), peak power velocity (PPV), and peak velocity (PV) across 6 different external resistances (40%-90% 1RM) were obtained at baseline and after 12 weeks using Keiser a420 equipment. Change scores were calculated from baseline to 12 weeks and analyzed using a 3 x 6 repeated measures (group x time) ANOVA. Statistical significance was accepted at p<0.05.

**RESULTS:** PP and PPF increased across a range of external resistances in both STR and HSPT compared to CON (p<0.001), but there was no difference between active treatments (all p>0.05). Although PPV was not different among groups at any external resistance (p=0.08), change in PV was higher in HSPT compared to STR (at 40%, 50%, 60% 1RM) and CON (at 50% and 60% 1RM) (all p<0.05).

**CONCLUSIONS:** Both high-load, slow-speed RT and low-load, high-speed RT increased peak power and the force component of power across a range of external resistances. HSPT increased contraction speed at lower external resistances while STR reduced contraction speed across all external resistances. If contraction speed is critical to muscle performance in older adults, HSPT may be a preferred RT format in this population.

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**2490 Board #135 May 29 9:00 AM - 10:30 AM**  
**Functional Fitness Differences Among Males And Females Greater Than 70 Years Of Age**

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(No relationships reported)

By 2030, it is projected that there will be 71 million older adults in the U.S. It is imperative that we understand the aging process.

**PURPOSE:** To assess the functional fitness of older adults to analyze the differences among males and females.

**METHODS:** 108 older adults (>70 years of age) were recruited. All participants were apparently healthy and lived independently. Participants were assessed on physical activity, cognitive status, depression, activities of daily living, and nutrition. Functional fitness was assessed using the following: 1) 30-sec chair stand; 2) 30-sec arm curl; 3) 2-min step-n-place;

4) chair sit-n-reach; 5) back scratch; and 6) 8-ft up-n-go. Participants were placed into four categories based on the SFT scores: 1) at risk for loss of mobility (AR); 2) below average (BA); 3) average (A); and 4) above average (AA).

**RESULTS:** 73 females and 35 males completed all assessments. Males had higher incomes, physical activity, strength and faster times on the 8-ft up-n-go than females. Females had greater flexibility than males. Males and females were compared separately by category on each of the six SFT. Females: 1) on chair stand those BA were older than the other three categories and those AR were on more meds than BA and AA; 2) on arm curl age was not different; 3) on step-n-place those BA were less active than the other three categories; 4) on sit-n-reach there were no differences; 5) on back scratch AA had lower BMI than AR; AA had fewer meds than AR & A; 6) on 8-ft up-n-go AR were older than BA & A; AA had lower BMI than the other three groups; AR had lower activities of daily living than the other three groups; AA had fewer meds than the other three groups. Males: 1) on chair stand AA had lower BMI than AR & BA; AR had higher scores on depression than the other three groups; 2) on arm curl BA had higher depression scores than the other three groups; 3) on step-n-place AR were older than BA & A; 4) on sit-n-reach there were no differences; 5) on back scratch there were no differences; 6) on 8-ft up-n-go AR had higher depression scores than A & AA; BA had lower scores on nutrition than the other three groups.

**CONCLUSION:** For females, the most common difference between categories was age followed by meds and BMI. For males, depression scores were higher for those at risk for loss of mobility and below average on three of the six functional tests.

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**2491 Board #136 May 29 9:00 AM - 10:30 AM**  
**A Targeted Balance And Mobility Program Is Effective For Treatment Of Arthritis In Older Adults**

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(No relationships reported)

**PURPOSE:** The primary objective was to investigate the short-term effectiveness of a targeted balance and mobility training program on balance, strength, and flexibility in a group of older adult women with osteoarthritis and/or rheumatoid arthritis. The secondary objective was to evaluate the responsiveness of the Berg Balance Scale in detecting meaningful change in the intervention group.

**METHODS:** Thirty-five independently residing women (Mean = 79 years) with a primary diagnosis of osteoarthritis and/or rheumatoid arthritis participated in this study. The intervention group (N=20) attended two, one-hour balance and mobility classes per week for eight weeks. The program incorporated exercises designed to improve the multiple dimensions of balance, mobility, upper and lower body strength, and flexibility. All participants were also included in the responsiveness analyses. Responsiveness was calculated using two

**METHODS:** (1) Standardized Response Mean (SRM) which is the mean change in scores divided by the standard deviation of the change in scores; (2) Responsiveness-Retrospective (RR) Coefficient which is the mean change of intervention subjects divided by the standard deviation of change of the control (stable) subjects.

**RESULTS:** The intervention group demonstrated significant improvements in balance, upper and lower body strength, and flexibility. The SRM results indicated that the intervention group exhibited a medium to large effect size (SRM = 0.74) compared to the small effect size demonstrated by the control group (SRM = 0.09). The RR coefficient indicated that mean change for the intervention group demonstrated a large effect size (RR = 1.85) when adjusted for the spurious change reflected in the variability in score changes among the control group.

**CONCLUSION:** Older adult females with arthritis can derive significant benefits from an intervention that focuses on improving balance and mobility in a full weight-bearing environment.

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**2492 Board #137 May 29 9:00 AM - 10:30 AM**  
**Age Scale For Assessing Functional Fitness In Korean Older Adults**

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**PURPOSE:** Considerable variability exists in physical health status including functional fitness among older adults. Previous research has examined to help individuals age "actively", "healthfully", "successfully" and has shown that individuals who maintain a physically active life-style in middle and old age are significantly less likely to experience age-related decrements in their ability to perform activities of daily living compared with less active individuals of the same chronological age (CA). With this in mind, the purpose of present study was to develop an age scale for the assessment of functional fitness in Korean older women.

**METHODS:** This study was a cross-sectional analysis and the subject inclusion criteria were age of 60 years or older, living in the community. Korean older women volunteered and they were divided into three groups: a) less active (n=138), b) sedentary (n=25), and c) active (n=25). The less active group was used for the development of the functional fitness age (FFA), while data from sedentary and active groups were utilized for the assessment of the criterion-related validity. Six functional fitness variables were selected as test items related to ADL.

**RESULTS:** After applying the principal component analysis to the correlation matrix among 6 items, functional fitness score (FFS)=0.065X<sub>1</sub>+0.868X<sub>2</sub>+0.035X<sub>3</sub>+0.163X<sub>4</sub>+0.066X<sub>5</sub>+0.236X<sub>6</sub>-9.806, where X<sub>1</sub>=grip strength (kg), X<sub>2</sub>=waist hip ratio, X<sub>3</sub>=functional reach (cm), X<sub>4</sub>=walking around two cones (s), X<sub>5</sub>=tandem balance (s), X<sub>6</sub>=chair-sit-to stands (s). FFA=-5.0FFS+70.9. The mean CA of the 3 groups were not significantly different from one another. The mean FFA of less active group (70.9±5.0years) obtained from this equation was matched with their mean CA (70.4±7.2years). The mean FFA of the sedentary group (76.7±5.4years) was significantly higher than their mean CA, and the mean FFA of the active group (65.7±4.7years) was significantly lower than their mean CA.

**CONCLUSIONS:** The criterion-related validity of the FFA equation was clearly demonstrated as a means to assess the functional fitness in Korean older women. FFA will provide a simple way for this subjects to become aware of their current functional status, and motivate them to maintain a active life-style.

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**2493 Board #138 May 29 9:00 AM - 10:30 AM**  
**Effects Of A Physician-Based Exercise Counseling Program For Improving Aerobic Fitness In Older Adults**

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(No relationships reported)

Unequivocal evidence supports healthy lifestyles for cardiovascular disease prevention. Family physicians are ideally positioned to address this care gap.

**PURPOSE:** To determine the impact of an exercise prescription for older sedentary adults in family practice.

**METHODS:** The Step Test Exercise Prescription (STEP) was a 12 month trial with 360 older adults (50-85 years) from 40 family practices in four regions of Canada. Intervention physicians were trained to deliver a tailored exercise prescription and transtheoretical behavior change counseling program. Control physicians were trained to deliver the exercise prescription alone. Primary outcome measures were cardiorespiratory fitness (VO<sub>2</sub>max) and energy expenditure (7-day PAR).

**RESULTS:** Participants (intervention, n=193; control, n=167) were healthy community men (48%) and women (52%) with a mean age of 64.9 ±7.1 years. In both groups, VO<sub>2</sub>max significantly increased (p<0.001) for the intervention (+2.88 ±4.22 ml·kg<sup>-1</sup>·min<sup>-1</sup>) and control (+2.56 ±5.20 ml·kg<sup>-1</sup>·min<sup>-1</sup>) at 12 months, however there was no difference between groups. Women in the intervention improved their fitness significantly higher than control (+2.99 ±4.38 ml·kg<sup>-1</sup>·min<sup>-1</sup>). The intervention group had a 4mmHg reduction in systolic blood pressure (0.4 mmHg in the control (p<0.001)). The mean energy expended (EE) significantly increased but was higher in the intervention vs



control (69.06 ±169.87 vs -6.96 ±157.06 Kcal-d-1). There were no significant practice setting differences among the primary outcomes.

**CONCLUSIONS:** STEP exercise and behavioral intervention improved fitness, activity and lowered systolic blood pressure across a range of Canadian practices. Women showed higher levels of fitness than control while men showed similar improvement in both groups.

*This trial was registered by UWO ethics on September 24, 2003. REB#E7247 entitled: Improving exercise prescription among Canadian family physicians*

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**2494 Board #139 May 29 9:00 AM - 10:30 AM**

**Assessment Of Leg Muscle Power Using A Stair-climbing Power Test In Community-dwelling Elderly People**

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(No relationships reported)

A stair-climbing power test (SCPT) is an inexpensive, practical test that is simple to perform. An individual's lower extremity power is a critical element regarding both mobility and the activities of daily living, while it is also a key determinant of independence for elderly people.

**PURPOSE:** To determine the usefulness of the SCPT, a modification of the Margaria stair-climbing power test, by comparing the results obtained from the SCPT with those from a leg power test in community-dwelling elderly people.

**METHODS:** The subjects of this study consisted of physically-independent elderly men (N=19, aged 75+/-6 yrs) and women (N=18, aged 77+/-6 yrs). The stair-climbing power was measured using ordinary stairs (17.5cm step height, 6-stair flights, 105 cm total height). The time spent in stair climbing was measured by a stopwatch. The subjects were instructed to ascend the stairs as fast as they could. The stair-climbing power was then calculated with the body mass, the time spent in stair climbing, the vertical height travelled, and the gravitational acceleration. The bilateral leg extensor power (LEP) was measured using an isotonic leg power system (Combi, Anaero Press 3500, Japan) in a sitting position. The isometric knee extension strength was measured on each side of the knee using a specially designed dynamometer (Yagami, Japan).

**RESULTS:** The stair-climbing power was 297.6+/-60.3 watts (mean +/- SD) for men and 199.1 +/-60.6 watts for women. LEP was 768.2+/-324.6 watts for men and 361.6+/-152.8 watts for women. The knee extension strength was 39.4 +/-9.2 kg for men and 24.0 +/-6.8 kg for women. The stair-climbing power correlated closely with both the leg extensor power (r=0.557, p<0.05 in men and r=0.541, p<0.05 in women) and with the knee extension strength (r=0.566, p<0.05 in men and r=0.657, p<0.05 in women).

**CONCLUSIONS:** From a practical viewpoint as a field test, the SCPT was found to be useful for assessing the functional leg power levels in physically-independent, ambulatory elderly people.

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**2495 Board #140 May 29 9:00 AM - 10:30 AM**

**Water-based Exercise: Balance Benefits To Land For Older Women In The USA And Japan**

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(No relationships reported)

Both land- and water-based exercise (WEX) programs have been shown to improve the fitness levels of older adults. However, the extent to which WEX improves balance on land is not well understood.

**PURPOSE:** The purpose of this study was to determine the impact of a WEX program on balance performed on land by older women.

**METHODS:** A USA pilot study was conducted and then replicated in Japan. Data were analyzed by the same investigators. The 16-week USA pilot study included women (60-89 yr of age) who self-selected to a training (TR) group (n=44) or control (n=17). The USA training consisted of a 16-wk (45 min.day-1, 3 d-wk-1) supervised WEX program that included 10 min warm-up (water walking), 30 min skill learning and practice of progressions designed to target land-based balance using navel to nipple depth water exercises (feet grounded), using resistance and buoyancy for challenge and support, and 5 min warm-down exercise. In Japan, women (50-80 yr of age) volunteered to participate in an ongoing replicated community-based program that was conducted in chest to shoulder depth water (feet somewhat off-loaded), self-selecting to attend 1, 2 or 3 d-wk-1. USA Participants performed static and dynamic balance tests at baseline and 16 weeks. Japanese participants were assessed at baseline and 36 weeks for dynamic balance (n=47).

**RESULTS:** In the USA, TR improved (p<.05) static balance on right and left legs (42%, 40% respectively) and (p<.001) dynamic balance (10.2%) while controls did not change significantly. In Japan, dynamic balance did not change significantly among participants. No injuries were reported by the USA or Japanese groups.

**CONCLUSIONS:** These results reveal that this WEX program, when conducted in navel to shoulder depth is a safe and effective training mode that results in improved balance skills, suggesting that the benefits of WEX do transfer to land-based activities under certain training conditions.

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**2496 Board #141 May 29 9:00 AM - 10:30 AM**

**Resistance Training And Activities Of Daily Living Training Improves Functional Performance In Elderly Women**

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Functional ability has been inversely correlated with short-term morbidity and the need for assisted living among older adults. As the aging population increases in number, it is imperative to devise measures which enable them to maintain high levels of physical function.

**PURPOSE:** To evaluate the effect of two different training methods on functional performance in elderly women.

**METHODS:** Sixty women over the age of 70 were randomly assigned to either a resistance training group (RT; n = 20); an activities of daily living group (ADL; n = 20); or a non-intervention control group (C; n = 20). The C group was instructed to maintain normal levels of activity; the exercise groups completed 3 sessions of exercise per week for 24 weeks. The RT group completed 3 sets of 15, bilateral repetitions, of 13 different strength training exercises using Thera Band® resistance bands and hand weights while the ADL group completed a battery of ADL's and flexibility exercises. Physical outcome measures were taken from the Senior Fitness test: 30-second chair stand, 30 second arm curl, chair sit-and-reach, back-scratch, get-up-and-go and the 6-minute walk. Other self-reported measures included Self-perceived Function (SF36) and Instrumental Activities of Daily Living (IADL). Each test was analyzed separately using a 3 (Groups: C v. RT v. ADL) X 2 (Time: baseline v. post) Analysis of Variance (ANOVA) with repeated measures on the second factor. Simple effects and the modified Bonferroni post-hoc procedure were used to respectively assess significant interactions and main effects. The statistical package used to run all analysis was SPSS (Ver. 16.0), Chicago, IL.

**RESULTS:** There was a significant main effect of group or time and a significant interaction on every measure except back-scratch. Post-hoc analysis revealed that both training groups increased in measures from the Senior Fitness Test, SF36 and IADL, compared to the controls. The ADL group was significantly higher than the RT group at post in sit-and-reach and back-scratch, while the RT group was significantly higher than ADL in arm curl and 30-second chair stand.

**CONCLUSIONS:** This data suggests that both methods of training are effective for increasing select measures of functional performance in elderly women.



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**2497 Board #142 May 29 9:00 AM - 10:30 AM**  
**Functional Fitness And Health-Related Quality Of Life Differences In Older Adults With And Without Extended Care In Japan**  
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Several assessments of functional fitness in older adults have shown consistent declines with advancing age. These declines in functional fitness often lead to physical dependence and poor health-related quality of life (HRQOL). However, few studies have focused on differences in functional fitness and HRQOL between those who live in the community and require extended care (dependent older adults) and those not requiring such care (independent-living older adults).

**PURPOSE:** The purpose of this study was to compare functional fitness and HRQOL in older Japanese community-dwelling adults who use extended care to those who do not.

**METHODS:** Participants included 16 older adults (age  $82.8 \pm 3.3$ ) with extended care (group1) and 20 older adults (age  $81.3 \pm 2.3$ ) without extended care (group2) who lived in the community. Seven performance tests, including 30-sec arm curl (AC), 30-sec chair stand (CS), sit and reach (SR), back scratch (BS), up & go (UPGO), functional reach (FR), and 12-min distance walk (12W), were conducted to assess four components (endurance, flexibility, muscle strength, balance) of functional fitness and the MOS 36-Item Short-Form Health Survey (SF-36) was used to assess HRQOL. T-tests were employed to analyze differences ( $p < 0.05$ ).

**RESULTS:** There were significant differences in functional fitness: AC ( $10 \pm 4$  vs.  $18 \pm 3$ ), CS ( $8 \pm 4$  vs.  $16 \pm 3$ ), UPGO ( $10.1 \pm 3.4$  vs.  $5.9 \pm 1.0$ ), SR ( $3.6 \pm 10.1$  vs.  $5.9 \pm 1.0$ ), BS ( $-20.1 \pm 12.8$  vs.  $-9.35 \pm 13.7$ ), FR ( $16.8 \pm 6.1$  vs.  $22.2 \pm 4.3$ ), 12W ( $342 \pm 240$  vs.  $849 \pm 06$ ), and physical health factors of HRQOL: physical functioning ( $22.8 \pm 21.2$  vs.  $40.3 \pm 16.4$ ), role-physical ( $23.1 \pm 18.1$  vs.  $46.2 \pm 8.9$ ), and general health ( $40.0 \pm 12.5$  vs.  $49.0 \pm 12.5$ ) between group1 vs. group2, respectively.

**CONCLUSIONS:** These results suggest that functional fitness (endurance, flexibility, muscle strength, and balance) and physical health factors of HRQOL are lower but mental health factors of HRQOL are not different in community-dwelling older adults who need extended care compared to those who do not. Further research is needed to develop and evaluate well-rounded exercise programs that improve functional fitness and physical health factors in this population.

(Supported by the Grants-in-for Scientific Research of MEXT Japan.)

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**2498 Board #143 May 29 9:00 AM - 10:30 AM**  
**Response Of Perceived And Performance Based Function In Older Adults With Exercise Intervention**  
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Exercise interventions have been used to increase physical function in older adults. However, with some older adults, measures of perceived and performance-based physical function are not aligned. Individuals who express little or no perceived functional limitation may have low performance based function putting them at risk of future dependency (Cress & Meyer, 2003).

**PURPOSE:** This study evaluates the influence of exercise on both perceived and performance-based physical function with the hypothesis that after the exercise intervention, more individuals would have alignment between perceived and performance-based function.

**METHODS:** Using a cross-sectional and longitudinal designs, older adults, 74.5 years  $\pm$  6.21 ( $n=73$ ), from the community at large or retirement dwellings responded to the SF36 physical function (SF36PF) questionnaire and performed the Continuous Scale Physical Functional Performance (CS-PFP) test. SF36PF  $\leq$  65 (0-100) and CS-PFP  $<$  57 (0-100) are associated with increased dependence, "at risk" (Cress & Meyers, 2003). Participants were randomly assigned to either a control or an aerobic/strength combined or walking exercise group. The predictive value of the SF36 PF using a cutoff of  $\leq 65$  was determined based on the CS-PFP (gold standard) using a cutoff of  $< 57$ . For analysis, participant's baseline results were stratified into four groups (CS-PFP  $<$  57 and SF36 scores  $\leq 65$ , CS-PFP  $\geq 57$  and SF36  $\leq 65$ , CS-PFP  $<$  57 and SF36  $\geq 65$ , and CS-PFP  $\geq 57$  and SF36  $>$  65 scores).

**RESULTS:** The predictive value of the SF36PF, using a cutoff of  $\leq 65$ , was determined based on the CS-PFP (gold standard) using a cutoff of  $< 57$ . The SF36PF specificity was 100% and the sensitivity was 23.9%. At baseline testing, the prevalence of those "at risk" was approximately equal in the exercise (48.6%) and control (47.3%) groups. Following the intervention, the control group showed a slight decrease (7.89%) in the prevalence of "at risk" participants, however, the decrease in the (25.72%) exercise (25.7%) was dramatic. The bulk of the responders were those with high perceived and low performance based function.

**CONCLUSION:** The non-alignment of perceived and performance-based function can be an effective tool for targeting individuals at greatest risk of dependency, while exercise interventions can reduce the prevalence of that risk.

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**2499 Board #144 May 29 9:00 AM - 10:30 AM**  
**A Simple Training Program For Reducing Fall Risk In The Elderly In Group And Independent Settings**  
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Previous research has demonstrated that a simple exercise training program delivered individually in-home increased balance, mobility and lower extremity strength in older adults. It is unlikely that this delivery method is either realistic or affordable on a large scale.

**PURPOSE:** To determine if a simple training program delivered in group or independent settings is effective in reducing fall risk in older adults.

**METHODS:** Twenty-nine sedentary subjects, 65 years or older (mean =  $82.4 \pm 4.8$  yrs), were recruited. Nineteen senior-residence dwellers participated in the group program (GP) while 10 in-home dwelling subjects were in the independent program (IP). Postural sway, mobility and isotonic lower extremity strength were measured in the laboratory. Both groups participated in the training program two times a week for a period of six weeks. The GP was led by two of the investigators, while the IP group trained independently using standardized instructions. IP subjects were contacted weekly by phone to encourage adherence. Training consisted of eight lower extremity exercises focusing on balance and strength development using elastic bands. Data were analyzed by dependent t-tests, with  $p < 0.05$  for significance.

**RESULTS:** The training program was completed by 80% and 40% of the GP and IP subjects, respectively. The GP subjects improved mobility time ( $12.7 \pm 8.6$  to  $11.2 \pm 7.8$  s,  $p < 0.05$ ) and increased lower extremity strength values ( $195 \pm 48$  to  $240 \pm 62$  lbs,  $p < 0.05$ ). The GP subjects decreased their mediolateral sway distance ( $90.4 \pm 23.7$  to  $80.2 \pm 18.5$  cm,  $p < 0.05$ ), but had no changes in the anteroposterior direction. Apparent changes in mobility, strength and postural sway in the IP group were not statistically significant, likely due to the small sample who completed the study.

**CONCLUSIONS:** A simple exercise training program proved to be effective in increasing mobility, lower extremity strength and balance in the group setting, and appeared effective in individual settings. Greater adherence was seen with the GP, possibly due to the more formal structure, group encouragement and leader expectations. We can conclude that this training program is effective in improving variables associated with fall risk in the elderly.

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**2500 Board #145 May 29 9:00 AM - 10:30 AM**

## Effect Of Machine And Stability Strength Training On The Walking Speed Of Postmenopausal Women

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The increased risk of bone mineral density loss and sarcopenia makes postmenopausal women a target for intervention to reduce the risk of fractures and falls. Though exercise brings benefits, it is yet to be determined which methods of strength training would be most beneficial in regards to decreased fall risk and increased walking function.

**HYPOTHESIS:** Performing resistance training using a rubber domed device (D.D.) may be more beneficial than using a leg press (L.P.) machine to increase walking speed in postmenopausal women.

**METHODS:** Women (N=18; mean age=61 yrs) were randomly assigned to one of three groups: D.D. squats, L.P. machine, or control group. The L.P. group performed 2 sets of 12 repetitions seated leg press exercises on a Life Fitness machine. The D.D. group performed 2 sets of 12 repetition rubber dome device squats (with weight). Exercises were performed 2 nonconsecutive days a week for 4 weeks. The control group maintained their current workout status (walking). All groups completed a six-minute walk test at self-selected speeds on a treadmill prior to and following the four week trial. At both baseline and completion, a questionnaire that assessed the likeability and perceived future adherence was completed by the participants to determine the practicality of the exercise.

**RESULTS:** There was no significant difference in the starting walking speed for all groups. The D.D. group increased walking speed 6.6%, the L.P. group increased 15.3%, and the control group increased walking speed 1.0%. The D.D. group ( $p=0.013$ ) and L.P. group ( $p=0.007$ ) showed significant difference between their starting and ending walking speeds. The control group ( $p=0.791$ ) did not show significant difference. The L.P. group showed the greatest increase in preferred walking speed of all three groups and is significantly different from the controls ( $p=0.037$ ).

**CONCLUSION:** Both activity groups improved self-selected walking speed with the L.P. group showing the greatest increase therefore the hypothesis is rejected. In further research sample size and study length will be increased, a measure of force distribution will be collected to account for changes in accessory muscle group strength, and measures of stability changes in order to better account for the possibility that a D.D. might decrease the risk of falling.

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### 2501 Board #146 May 29 9:00 AM - 10:30 AM

#### The Impact Of A University-based Exercise Program On Functional Abilities In Elderly Population

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Functional capacity typically begins to decline after approximately 30 yrs of age. This is believed to be a normal response to the aging process. However, it has been demonstrated that regular participation in exercise may attenuate this age-related decline in functional capacity in the older adult. **PURPOSE:** The purpose of the present investigation was to determine if participation in an exercise program designed for the older adult slows or prevents the expected functional decline in this age group.

**METHODS:** Eight male (76.6  $\pm$  3.1 yrs of age) and 7 female adults (72.3  $\pm$  9.8 yrs of age) volunteered to participate in an exercise program for a period of two years. The program consisted of three, 60-minute sessions per week. Functional fitness parameters that were evaluated at the start and end of the program included: upper body strength (arm curl test), lower body strength (chair stand test), upper body flexibility (back-scratch test), lower body flexibility (chair sit and reach test), agility/dynamic balance (8-foot and go) and aerobic endurance (6-minute walk test).

**RESULTS:** Gender (male, female) by time (pre, post) ANCOVAs, co-varying for total attendance, demonstrated no significant decreases in functional fitness parameters over time ( $P = 0.10$ ), nor were there any main or interaction effects of gender ( $P = 0.12$ ). While not statistically significant participants exhibited improvements in the majority of functional fitness tests when examining pre and post intervention data: Chair Stand Test (15.9  $\pm$  3.4 vs 17.3  $\pm$  5.8), Arm Curl Test (21.6  $\pm$  5.7 vs 22.4  $\pm$  7.1), Chair Sit and Reach Test (-0.6  $\pm$  4.6 vs -1.7  $\pm$  4.4), Back Scratch Test (-3.7  $\pm$  3.9 vs -3.0  $\pm$  3.5), 8-Foot Up and Go Test (4.9  $\pm$  1.1 vs 4.8  $\pm$  1.1) and 6-Minute Walk test (553.4  $\pm$  64.8 vs 559.0  $\pm$  97.5).

**CONCLUSIONS:** Participation in an exercise program for the older adult may attenuate the normal age-related declines in functional capacity and maintain or possibly improve the ability of older adults to perform activities of daily living.

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### 2502 Board #147 May 29 9:00 AM - 10:30 AM

#### Impact Of The First Step To Active Aging Exercise Program On Older Adults Functional Fitness, Balance, And Daily Activity

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Advancing age is often accompanied by declines in strength, postural stability, flexibility, and cardiovascular fitness. Such declines negatively impact the functional ability and independence of older adults.

**PURPOSE:** To determine how the First Step to Active Aging (FSAH) program impacts functional fitness (FF), balance, and daily physical activity (DPA) in older adults.

**METHODS:** Eighteen women (X=73 $\pm$ 7 yrs) completed FSAH and all assessments. The FSAH group met at a senior center and completed a 12 wk, 50 min, 2d/wk training program (flexibility training; strength training, using elastic resistance bands; balance training using firm and pliable foam pads; and cardio-respiratory activity using pedometers and goal setting. A control group of 15 women (X=75 $\pm$ 6 yrs) was drawn from a waiting list for a similar program at a second area senior center. Subjects (Ss) were screened using the Exercise Screening for You to determine if they needed a healthcare provider visit before starting the program. Program effectiveness was assessed using the Senior Fitness Test to assess functional fitness (chair stand, arm curl, sit and reach, up & go, scratch test, and 12-min walk), balance (NeuroCom Balance Master Limits of Stability (LOS)): movement velocity (MVL), endpoint excursion (EPE), maximum EPE (MXE), and directional control (DCL) for forward (F), right (R), left (L) and back (B) movements), pedometer (Omron HJ-112) measured DPA, and weight.

**RESULTS:** No baseline difference existed between groups. Repeated measures ANOVAs revealed group x time interactions ( $p<0.05$ ) on all measures except the flexibility measures. After 12 weeks, significant FF improvements were noted in the FSAH group: Chair Stand 35%, Arm Curl 26%; Up-&-Go 8%; 12-min Walk 14%. With respect to LOS, MXE improved in all 4 directions (F 18%, R 14%, B 23%, L 10%) and DCL improved in the F direction 9%. DPA also increased the equivalent of 1 mile, from 3,108 to 5,077 steps (38%) and Ss lost 2.3lbs (2%). The control group did not demonstrate change in any variable. **DISCUSSION:** Participating in a FSAH program improves FF. Improving an older adult's FF, a concept reflecting the ability to perform normal everyday activities safely, independently, and without undue fatigue, may allow individuals to function at a higher level and live independently for a longer period of time.

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### 2503 Board #148 May 29 9:00 AM - 10:30 AM

#### Differences In Functional Fitness And Fear Of Falling Among Older Japanese Women

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**PURPOSE:** Declines in functional ability and the prevalence of falling are problems in older adults. In the elderly, the fear of falling (FOF) may be as limiting as falling itself in terms of restricting daily physical activity. Therefore, measures of functional fitness may be related to FOF.

**METHODS:** A total of 537 women (68.9±5.7 y; range=60-94 y) were recruited from the community and divided into three groups: no fear of falling (NF, n=163), low fear of falling (LF, n=311), and high fear of falling (HF, n=63). FOF was assessed using a single question survey. Functional fitness was assessed by seven measures: 1) Chair Stand (CS); 2) Arm Curl (AC), 3) 8-foot up & go (UPGO); 4) Sit & Reach (SR); 5) Back Scratch (BS), 6) Functional reach, and 7) 12min-walk (12W). Balance was assessed using static postural sway (CTSIB) and limits of stability. Group comparisons were made using analysis of variance.

**RESULTS:** All parameters of functional fitness except BS (upper body flexibility) were significantly lower in HF compared to other groups. Differences in CTSIB with foam-open-eyes were observed between all three groups with HF having lower balance than NF and LF groups.

	NF	LF	HF	Post hoc
AC(times/30sec)	23.2±4.3	22.2±4.2	20.8±4.9	NFvsHF*
CS(times/30sec)	21.9±4.9	20.8±4.9	19.6±5.6	NFvsHF*
UG(sec)	4.6±0.5	4.7±0.8	5.0±0.9	NFvsHF*
SR(cm)	16.0±9.2	15.4±8.8	12.1±7.1	NFvsHF*
BS(cm)	-1.5±9.5	-2.0±10.1	-1.7±9.2	N.S.
FR(cm)	29.4±5.1	28.0±5.1	26.9±6.0	NFvsHF*, LFvsHF*
12W(m)	1061±123	1035±146	1019±119	NFvsHF^

\*p<0.05, ^p<0.10

**CONCLUSIONS:** Results suggest that fear of falling may have negative consequences with respect to older adults' functional fitness and balance. Further study is needed to determine if cause and effect relationships exist. It would also be interesting to examine if an exercise program for persons with FOF would increase functional fitness and balance while reducing FOF.

Supported by the Grants-in-for Scientific Research of MEXT Japan.

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**2504 Board #149 May 29 9:00 AM - 10:30 AM**  
**Differences Between Two Exercise Programs On Measuring Fall Risk In Older Adults**

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The loss of balance and strength are two physiological components of aging that can be detrimental to the functional capacity in older adults. Research shows that increasing leg strength can be a major contributor to the reduction of fall related injuries in older adults. Moderate to high intensity exercise interventions have been successful in strengthening the muscles of the lower extremity, therefore possibly reducing the incidence of falls. Balance training, as well, has been shown to improve dynamic balance in this same age group. However, finding an appropriate exercise intervention that is both stimulating and beneficial for older adults to continue on a regular basis seems to be limited.

**PURPOSE:** To determine whether differences existed between a four week balance training intervention and a four week strength training intervention on measures of postural sway, agility, and dynamic balance in older adults.

**METHODS:** Twelve older adults aged 56-91 participated in the study with mean (± SD) age and body weight at 79 ± 10.84 yr. and 167.17 ± 39.97 pounds. Each participant was randomly assigned to one of three groups (strength, balance, and control). Participants were tested (Week 0) on weight, postural sway, agility, and dynamic balance. Each group participated in their specified training intervention for four weeks (Week 1 to 4) and were then tested again on Week 5.

**RESULTS:** An a-priori multivariate analysis of variance was used to determine if differences existed between the three groups. Three contrast statements were used in the analysis: strength trained and balance trained vs. control, strength trained vs. control, and balance trained vs. control. There were no significant differences between the strength and balance vs. control groups, Wilk's lambda = .54; F (6,17) = 2.01, p = .20; strength vs. control groups, Wilk's lambda = .49; F (6,17) = 2.35, p = .16; and for balance vs. control groups, Wilk's lambda = .71; F (6,17) = .96, p = .46. Based on this information, no further analysis was needed due to the non significant differences between the groups.

**CONCLUSION:** These results indicate that no significant differences existed between the three groups on measures of postural sway, agility, or dynamic balance. This is primarily due to the small sample size in the study and the lack of variability between the groups.

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**2505 Board #150 May 29 9:00 AM - 10:30 AM**  
**Psoas Major Muscle In Elderly Female Rowers**

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(No relationships reported)

The psoas major muscle (PM), which is recruited for hip/lumbar stabilization and during hip joint flexion, plays an important role in maintenance of upright posture and walking. The age-related wasting of PM size is more remarkable than quadriceps femoris muscle. Rowing exercise, which includes hip joint flexion, may be categorized as one of the exercise mode for maintaining PM size and functions. We showed that elderly rowing trained men had larger PM than age-matched untrained men (MSSE, 40(5)suppl.:371, 2008). However, little is known whether rowing exercise can prevent the wasting and weakness of PM in elderly women.

**PURPOSE:** The purpose of this study was to evaluate the effects of regularly performed-rowing exercise on the morphology and function of PM in elderly women.

**METHODS:** Participants were 8 elderly female rowers (ER: age 64.1±4.6 yrs, BMI 20.7±0.8 kg/m<sup>2</sup>, mean±SD), 14 age-matched female walkers as active control group (EC: 62.8±3.8 yrs, 21.6±2.3 kg/m<sup>2</sup>) and 6 young untrained women (YC: 21.5±1.0 yrs, 20.2±0.9 kg/m<sup>2</sup>). Elderly rowers and walkers performed rowing or walking exercise regularly twice a week and each session 60-120 min. Muscle cross-sectional area (CSA) of PM scanned by magnetic resonance imaging and bilateral leg extension power were measured.

**RESULTS:** The CSA of PM in EC was 33% lower than that in YC (p<0.001). ER had 74% higher CSA of PM than EC (p<0.001), which was comparable to that of YC (YC: 9.4±1.3 cm<sup>2</sup>, EC: 6.2±1.0 cm<sup>2</sup>, ER: 8.7±1.7 cm<sup>2</sup>, mean±SD). The leg extension power in EC was 28% lower than that in YC (YC: 853±221 W vs EC: 616±148 W, p<0.05), whereas there was no significant difference between ER and YC (ER: 704±154 W). The CSAs of PM was strongly associated with leg extension power (r=0.914, p<0.001). Furthermore, partial correlation analysis revealed that PM is strong independent predictor of leg extension power (r=0.585, p<0.001).

**CONCLUSIONS:** These results provide the possibility that PM plays an important role in the muscle function of leg extension, and that rowing exercise can prevent age-

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**2506 Board #151 May 29 9:00 AM - 10:30 AM**

**Effect Of Inspiratory Muscle Training On Exercise Capacity And Quality Of Life In Older Adults**

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(No relationships reported)

Older adults (>65 yrs) undergo numerous age-related changes in pulmonary function, resulting in weakened respiratory muscles that promote dyspnea and decrease exercise capacity. Inspiratory muscle training (IMT) strengthens respiratory muscles by creating resistance during inspiration. IMT may enhance respiratory system functioning, diminishing respiratory muscle fatigue. IMT devices create a negative pressure which must be overcome for inspiration, resulting in improved inspiratory muscle strength and endurance.

**PURPOSE:** To examine the effects of IMT on respiratory muscle function, exercise capacity, and quality of life in community dwelling older adults.

**METHODS:** Twelve individuals ( $72 \pm 6$  yrs) participated in a 6-week IMT program. The training group ( $n=6$ ) trained at 85% MIP, known to elicit changes in respiratory muscle function. The placebo group ( $n=6$ ) trained at an ineffective intensity of 15% MIP. Training was 3 sets of 12 breaths, 3 days per week. Measurements of respiratory muscle function, exercise capacity, and quality of life (QOL) was assessed pre and post. A 2-way mixed ANOVA was used.

**RESULTS:** IMT did result in significant differences pre post in both groups (15%MIP group: pre  $0.57 \pm 0.39$  post  $0.90 \pm 0.26$  cmH<sub>2</sub>O; 85%MIP group:  $0.72 \pm 0.30$  post  $1.20 \pm 0.33$ ;  $p < 0.05$ ). MIP between placebo and training groups was not significantly affected (post:  $0.90 \pm 0.26$  vs.  $1.20 \pm 0.33$  cmH<sub>2</sub>O,  $p=0.408$ ). A significant improvement in walking distance (6MWD) was seen pre to post IMT. The interaction between training and placebo groups was not significant (post:  $539 \pm 88$  vs.  $370 \pm 59$  m,  $p=0.175$ ), while the main effect of test was seen ( $p = 0.001$ ). IMT did not significantly affect QOL, measured by the EQ-5D and EQ-VAS ( $p=0.679$ ,  $p=0.509$ ).

**CONCLUSIONS:** Six weeks of IMT did not significantly improve quality of life in community dwelling older adults although improvements in MIP and 6MWD were observed.

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**2507 Board #152 May 29 9:00 AM - 10:30 AM**

**Effects Of Different Intensities And Frequencies Of Resistance Training On Muscle Mass, Strength, And Sarcopenia Classification In Older Men And Women**

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The loss of muscle mass is a normal occurrence of aging. Decreased muscle mass, or sarcopenia, can be determined by calculating the relative skeletal muscle mass index (RSMI) using appendicular skeletal muscle mass divided by height squared. RSMI scores  $< 5.45$  kg/m<sup>2</sup> and  $7.26$  kg/m<sup>2</sup> are classified as sarcopenia for women and men, respectively. Traditional high intensity resistance training is effective for increasing muscle mass and strength in older adults, but it is unknown if varying the intensity or frequency of training would result in similar findings.

**PURPOSE:** The purpose of this study was to investigate the effects of four different resistance training programs on muscle mass, strength, and sarcopenia classification in older men and women.

**METHODS:** Forty-four men ( $65 \pm 0.5$  years) and 77 women ( $63 \pm 0.4$  years) were assigned to one of four training groups for 40 weeks (80% 1RM, 3 sets, 8 reps, either 2X or 3X/week or 40% 1RM, 3 sets, 16 reps, either 2X or 3X/week). Upper body exercises included lat pulls, military press, bicep curls, tricep extension, and low row and lower body exercises included knee extension, knee flexion, leg press, hip flexion, hip extension, hip abduction, and hip adduction. Appendicular skeletal muscle mass was estimated from total body DXA scans (Lunar DPX-IQ).

**RESULTS:** At baseline, 10 men (23%) and 16 women (21%) met the criteria for sarcopenia. Following the intervention, 5 of the men and 6 of the women were no longer considered to be sarcopenic. There were significant ( $p < 0.01$ ) time x gender effects for skeletal muscle mass and upper and lower body strength. Men significantly ( $p < 0.01$ ) increased RSMI while women did not, and training groups exhibited similar improvements in skeletal muscle mass. Average upper and lower body strengths significantly ( $p \leq 0.01$ ) increased for both genders, with men having significantly greater improvements. A significant ( $p < 0.01$ ) time x training group effect was found for lower body strength with the low intensity 2 days/week group showing smaller increases than both high intensity groups.

**CONCLUSION:** Differential effects of training intensity were evident only for average lower body strength and the training programs had minimal effects on sarcopenia re-classification. Although both men and women increased strength, only men demonstrated muscle hypertrophy.

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**2508 Board #153 May 29 9:00 AM - 10:30 AM**

**Differential Anti-aging Effects Of Tai Chi Chuan On Aging Process Of Balance**

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Tai-Chi Chuan (TCC) is a traditional Chinese martial art. Debates had been made about the anti-aging effects of TCC in many researches. However, no previous research studies about the interaction effect of age and TCC in aging process of balance. We conduct a two-factor designed study to evaluate the antiaging effect of TCC on balance.

**PURPOSE:** To determine anti-aging effects and the interaction effects of aging and TCC on balance.

**METHODS:** Four groups (old TCC group,  $n=26$ , age= $68.3 \pm 6.2$ , duration of practice=  $13.3 \pm 9.6$ ; young TCC group,  $n=13$ , age= $21.8 \pm 2.5$ , duration of practice=  $3.0 \pm 1.7$ ; old control group,  $n=14$ , age= $69.1 \pm 3.1$ ; young control group,  $n=19$ , age= $24.8 \pm 3.8$ ) of subjects were tested with The Smart Balance Master (Neuro Com Inc., Clackamas, Oregon, USA) to acquire postural stability measurement. The sensory organization test (SOT) will be conducted to assess the balance control of subjects. During the SOT, subjects will be exposed to 6 combinations of visual and support surface conditions as follows: (1) eyes open and fixed support (EO), (2) eyes closed and fixed support (EC), (3) sway-referenced vision and fixed support (SV), (4) eyes open and sway-referenced support (SS), (5) eyes closed and sway-referenced support (ECSS), and (6) sway-referenced vision and support (SVSS). **RESULT:** TCC effects are significant in all the counter-active conditions (SV,SS, ECSS, SVSS). Age effects are significant in all conditions. Interaction effects are significant in ECSS and SVSS. Main effects of TCC and age are both significant in visual, vestibular and preferential ratios. Interaction effects are not significant in all ratios.

**CONCLUSION:** TCC can improve postural stability and prevent balance deterioration during aging process.

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**2509 Board #154 May 29 9:00 AM - 10:30 AM**

**Influence Of Ankle Strength On Lower-extremity Physical Function In Older Adults**

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(No relationships reported)

Prevention of age-related reductions in physical function is a primary public health concern. Leg muscle strength is related to improved lower-extremity physical function (LEPF); however, the influence of ankle strength in particular is not well known.

**PURPOSE:** To evaluate the association between physical activity, regional leg strength and LEPF in healthy elderly.

**METHODS:** LEPF was assessed in 42 older adults ( $70.1 \pm 6.6$  y, 28 females, 15 males) using a 7-m walk (WALK) and a 7-m walk with an obstacle (OBWALK) at normal walking speed, a timed up-and-go task performed as quickly as possible (UPGO), and a chair stand test with 5 repetitions completed as quickly as possible (CHAIR). Knee extension (K-Ext) and flexion (K-Flex) strength were assessed using an isokinetic dynamometer at 180 deg/sec, whereas ankle plantarflexion (A-PFlex) and dorsiflexion (A-DFlex) strength was assessed at 120 deg/sec. Physical activity was assessed for 7 days step counts via pedometer.

**RESULTS:** Absolute K-Flex and A-PFlex strength were related to performance on all walking tasks ( $r$  range = 0.35 to 0.60, all  $p < 0.05$ ) as were K-Ext and A-DFlex with UPGO ( $r = 0.33$ ,  $p < 0.05$ ). When normalized to body mass correlations improved ( $r$  range = 0.34 to 0.70) and all strength measures were related to all gait function tasks ( $p < 0.05$ ). CHAIR time was inversely related to relative A-PFlex strength ( $r = -0.31$ ). Using stepwise linear regression analysis, A-PFlex strength normalized to body mass was the only independent predictor of WALK and OBWALK, explaining 44% and 47% of the variance, respectively, and was the most significant predictor of UPGO, explaining 41% of the variance. Weekend step count was a significant correlate of UPGO, and total step count was the only independent predictor of CHAIR, explaining 6% and 14% of the variance, respectively.

**CONCLUSIONS:** Leg strength at the knee and ankle joints is related to gait and LEPF in healthy older adults. Ankle plantarflexion appears to have a substantial influence on function in this population. Physical activity, particularly on weekends, appears to impact physical function as well. These findings support the importance of physical activity and maintenance of ankle strength for the preservation of physical function in older adults.

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**2510 Board #155 May 29 9:00 AM - 10:30 AM**  
**Using Measures Of Fatigue To Discriminate Between Levels Of Self-reported Functional Ability.**

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The role of lower limb strength in functional ability is well known. Whether fatigue can be used to dissociate between levels of functional ability remains to be established.

**PURPOSE:** Determine if measures of muscle fatigue and subjective fatigue can discriminate between different levels of functional ability in older women.

**METHODS:** Twenty-eight Caucasian older women were divided into two groups (high and moderate/low functioning) based on self-reported functional ability. Functional ability was assessed with the Composite Physical Function scale. Fourteen women were high functioning ( $72 \pm 5$  yrs) and 14 were of moderate to low functioning ( $75 \pm 3$  yrs). Isometric hand grip strength and fatigue, as well as isometric and isotonic leg extension strength and fatigue were compared between groups. Field-based tests of walking speed, 8ft up-and-go, 30-seconds arm curl, 30-seconds chair stands, and subjective fatigue (mobility-tiredness scale and two items from the WHO Quality of Life Questionnaire) were also compared. Hand grip and leg extension isometric fatigue was defined as the time when force decreased to 50% of maximum. Isotonic leg extension fatigue was a percentage decline in maximum isometric strength following 3 sets of 10 isotonic leg extensions with ankle weights at 70% of 1RM maximum.

**RESULTS:** Leg extension strength ( $p < 0.05$ ), walking speed ( $p < 0.01$ ), and performance for 8ft up-and-go and 30-second chair stands test ( $p < 0.001$ ), were greater in high functioning women compared to the moderate/low functioning women. Subjective fatigue was greater ( $p < 0.05$ ) in the moderate/low functioning women compared to the high functioning group. No significant differences were found between the two groups for hand grip strength ( $p = 0.23$ ), hand grip fatigue ( $p = 0.18$ ), leg extension fatigue ( $p = 0.31$ ), and performance for the 30-seconds arm curl test ( $p = 0.15$ ).

**CONCLUSIONS:** Lower limb tests of muscle strength and mobility were better able to discriminate between functional ability levels compared with upper limb tests. Objective measurements of muscle fatigue, in both upper and lower limbs, did not influence self-reported functional ability scores in these older women, however, measurements of subjective fatigue were related to functional ability.

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**2511 Board #156 May 29 9:00 AM - 10:30 AM**  
**Increased Perceived Quality Of Life Burden With Age-associated Decline In Vascular And Physical Function**

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Impaired vascular function is typically associated with a marked reduction in functional ability and a decline in health-related quality of life (HRQOL) in patients with cardiovascular and metabolic disease. However, the literature is not clear on the quality of life burden associated with age-dependent changes in vascular and physical function, and the potential modifying effects of daily physical activity.

**PURPOSE:** (1) to examine the age-associated changes in vascular and physical function and its relation to HRQOL in older adults; and (2) to determine the possible modifying role of physical activity status, in nonagenarians.

**METHODS:** Participants from the Louisiana Healthy Aging Study ( $n = 168$ ; Age:  $87 \pm 7$ , Range: 61 to 99yrs) were used for these analyses. Physical activity status was assessed using a self-reported physical activity survey (YALE activity index), and the doubly-labeled water technique (physical activity level: PAL=TDEE/RMR). Brachial artery reactivity (BAR) was determined from high-resolution ultrasonography. Physical function (CS-PFP10) was determined from a previously validated instrument used to assess activities of daily living. HRQOL was assessed using the SF-36.

**RESULTS:** From the 7<sup>th</sup> through the 10<sup>th</sup> decade, the average decline in BAR and the total CS-PFP10 score was  $\sim 0.8\%/decade$  ( $BAR = -0.07 \times (Age) + 9.30$ ,  $r = -0.22$ ), and  $\sim 15U/decade$  ( $CS-PFP10 = -1.50 \times (Age) + 169.89$ ,  $r = -0.61$ ). BAR ( $r = 0.43$ ) was strongly associated with the CS-PFP10 scores, and both measures were significantly related to several of the SF-36 scores including the physical component score, vitality, and physical functioning. Prediction models (using BAR and CS-PFP10) accounted for  $\sim 30$  to  $60\%$  of the variance in the physical component score, vitality, and physical functioning of the SF-36. Importantly, in nonagenarian men, a MANOVA revealed those in the highest tertile of the Yale activity index and PAL had greater BAR, and higher scores on the CS-PFP10, and several of the SF-36 component scores ( $p < 0.05$ ).

**CONCLUSION:** These data confirm an age-dependent decline in vascular and physical function. This decline appears to contribute to a greater quality of life burden, particular in men. However, the magnitude of the quality of life burden may be diminished by a high daily physical activity status, in nonagenarians.

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**2512 Board #157 May 29 9:00 AM - 10:30 AM**  
**Optimal Loading For Power In Older Men**

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Power is the most important physical attribute affecting independence and falls in older veterans. Due in part to our published data comparing the knee and ankle, we hypothesized that different loads would be required to maximize power development for different movements/muscle groups.

**PURPOSE:** The purpose of the study was to examine if different resistance training exercises would generate maximal power at different optimal loads due to differences in physiological and/or biomechanical properties.

**METHODS:** Sixteen men, aged  $80.5 \pm 4.4$  yrs, participated in a five-day protocol. There were two days each of maximal strength-testing and power-testing, using six pneumatic machines. Power tests were performed at 20-80% of the patients' maximal load for each machine. This allowed us to determine if particular exercises required different optimal loads to maximize power due to the biomechanical and physiological differences among the joints and muscle groups targeted.

**RESULTS:** Our results showed the optimal loads that elicited peak power varied in specific patterns that were determined by the number of joints involved, the nature of those joints, and the volume of the associated musculature. The lowest loading patterns were for the triceps pushdown (30-50% 1RM) and biceps curls (40% 1RM). Both exercises use joints designed for velocity, rather than strength, due to their longer lever systems and smaller musculature. The long lever system at the knee with its larger muscle groups, developed power at the next highest load of 50% 1RM. This was similar to the optimal loads for the chest press and row, both multi-joint movements, which produced their highest power at 50% 1RM. Finally, heel raise produced it highest power at 60% 1RM, as we expected, given the fact that the ankle joint is a short lever designed for force production rather than speed of movement.

**CONCLUSION:** These results indicate that the "one-size-fits-all" pattern of loading, currently used by most physical therapy and fitness facilities, does not provide optimal loading for power development. When power training is not maximized, its efficiency and effectiveness are reduced and the physical benefits to the patient are proportionally decreased.

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**2513 Board #158 May 29 9:00 AM - 10:30 AM**

#### **Dose-response Relationship For Controlled Aerobic Training On $\text{VO}_{2\text{max}}$ Improvement In Older Adults**

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**PURPOSE:** Although much research has been conducted examining cardiorespiratory fitness ( $\text{VO}_{2\text{max}}$ ) increases with endurance training, little insight and insufficient information is individually provided regarding a quantifiable dose-response relationship for older adults. The purpose of this investigation was to identify a quantitative dose-response relationship for improvement of  $\text{VO}_{2\text{max}}$  in sedentary older adults, resulted from controlled aerobic exercise training.

**METHODS:** We used a systematic meta-analysis approach to synthesize the existing scientific studies regarding the effect of controlled endurance training on aerobic fitness development in older adults. Fifty-one studies were qualified for the final analysis. A total of 2522 older subjects (mean age  $67.45 \pm 5.25$  yrs) were included with 1511 in the exercise group and 1012 in the control. Effect sizes were calculated for training-induced improvements in  $\text{VO}_{2\text{max}}$ .

**RESULTS:** The pooled standardized effect size showed an average effect of  $0.64 \pm 0.05$  (mean  $\pm$  SEM, 95% CI = 0.56 to 0.73;  $p < 0.001$ ) for  $\text{VO}_{2\text{max}}$ . Effect sizes indicated different responses in improvements of  $\text{VO}_{2\text{max}}$  based on the aerobic training regimens. Training with mean intensities of 60%-65% of heart rate reserve (HRR) produced a similar effect as intensities of 75%-80% of HRR in affecting  $\text{VO}_{2\text{max}}$ . A mean exercise duration of approximately 45 minutes per session elicited maximal gains of  $\text{VO}_{2\text{max}}$ . Trained individuals experienced a greater  $\text{VO}_{2\text{max}}$  increase with a mean exercise frequency of 3 to 4 d.wk<sup>-1</sup>. Greater improvement in aerobic fitness was found to be associated with a mean training length of 30 to 40 weeks with the greatest gains in those who trained for approximately 36 weeks.

**CONCLUSIONS:** This study presented a quantifiable dose-response relationship and trends related to controlled endurance training and aerobic fitness changes in older adults. The results provide insight into the magnitude of  $\text{VO}_{2\text{max}}$  alterations as affected by exercise dose, a function of its intensity, duration, frequency, and training length. This information can be useful in the development and prescription of effective and safe exercise programs to benefit cardiovascular healthy aging for older adults.

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**2514 Board #159 May 29 9:00 AM - 10:30 AM**

#### **$\text{VO}_2$ Kinetics Are Slowed In The Upper Compared To Lower Range Of Moderate Exercise In Older Men**

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The adaptation of pulmonary  $\text{O}_2$  uptake ( $\text{VO}_2$  kinetics) is slower and the gain (G,  $\text{DVO}_2/\text{DWR}$ ) greater when exercise is initiated in the upper compared to the lower range of the moderate-intensity exercise domain in younger adults. It remains unclear, however, whether this response persists in older adults who have consistently been shown to have slowed  $\text{VO}_2$  on-kinetics compared to younger adults.

**PURPOSE:** To determine the phase 2  $\text{VO}_2$  kinetics (time constant ( $t\text{VO}_2$ ) and G) in older adults during exercise performed in the upper compared to the lower ranges of the moderate-intensity domain.

**METHODS:** Six males (70 ( $\pm$ SD) (4) yr; 89 (12) kg; 174 (4) cm) each completed 6 repetitions of leg cycling exercise consisting of baseline cycling at 20 W, followed by 2 equal step-transitions (lower step, S1; upper step, S2) to a S2 work rate corresponding to 90% estimated lactate threshold. Expired gases were analyzed breath-by-breath using a volume turbine and mass spectrometer, and the phase 2  $\text{VO}_2$  response was modeled with a mono-exponential function using non-linear regression. The  $t\text{VO}_2$  and G for S1 and S2 were compared using paired sample t-tests.

**RESULTS:** The  $t\text{VO}_2$  was greater ( $p < 0.05$ ) in S2 (52 (15) s) than in S1 (37 (10) s). The  $\text{VO}_2$  gain was not different ( $p = 0.11$ ) between S1 (9.2 (1.2) ml·min<sup>-1</sup>·W<sup>-1</sup>) and S2 (9.9 (0.5) ml·min<sup>-1</sup>·W<sup>-1</sup>).

**CONCLUSION:** Despite already having 'slowed'  $\text{VO}_2$  kinetics in S1 as compared to values reported for younger adults (i.e., ~ 25 s),  $\text{VO}_2$  kinetics were slowed even further in the upper compared to the lower range of the moderate-intensity exercise domain in older men, thereby conferring an even greater  $\text{O}_2$  deficit in this region of the moderate-intensity domain.

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**2515 Board #160 May 29 9:00 AM - 10:30 AM**

#### **The Seated Medicine Ball Throw As A Test Of Upper Body Power In Older Adults**

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While muscle strength is an important fitness component for older adults, muscle power production may be a better indicator of functional ability. Unfortunately, few studies have evaluated the validity and reliability of field tests for upper body power in the older adult population.

**PURPOSE:** This study's aim was to evaluate the validity and reliability of the seated medicine ball throw as a measure of upper body power in older adults.

**METHODS:** Older adults (n=42; Age 72.4±5.2 years) completed 12 trials of a medicine ball (MB) throw over 2 testing days using two weights of MBs (1.5 Kg and 3.0 Kg). For each day and each MB, 3 trials were performed. From a seated position, subjects threw the MB as far as possible using a motion similar to a chest pass in basketball. Additionally, subjects completed 6 trials of an explosive modified push-up on a force plate (Kistler, 9281C) over 2 testing days. Push-up force data were collected at 1250 Hz and maximal vertical force output (Zmax) was recorded. Validity was assessed via a Pearson Product-Moment correlation coefficient (PPM) between MB throws and Zmax. Reliability of the MB throw was determined using PPMs, Intra-class Correlation Coefficients (ICC) and Bland-Altman Plots (BAP).

**RESULTS:** The association between the medicine ball throws and the push-up test revealed a PPM of  $r=0.641$  and  $r=0.614$  for the 1.5 kg and 3.0 kg medicine balls respectively. PPM values for test-retest reliability of the 1.5kg and 3.0kg MB toss was  $r=0.967$  and  $r=0.958$ , respectively. ICC values for test-retest reliability of the 1.5kg and 3.0kg MB toss was,  $R=0.994$  and  $0.989$  for the 1.5 kg and 3.0 kg MB throws, respectively. BAPs revealed >95% of the differences were within  $\pm 2$  standard deviations of the mean difference for both weights of MB throws. The ICC for the push-up test was  $R=0.969$ . For the modified push-up, reliability of Zmax was  $r=0.944$  using PPM and  $R=0.969$  using ICC. BAP showed 90% of the differences were within  $\pm 2$  standard deviations of the mean difference.

**CONCLUSION:** As a field test for upper body power for the older adult, the seated medicine ball throw appears to be highly reliable test. Its validity relative to the maximal force exerted during modified push-up is modest. However, for assessing and tracking upper body power in the older adult the medicine ball throw test is an inexpensive, repeatable measure.

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**2516 Board #161 May 29 9:00 AM - 10:30 AM**  
**Effects Of 12week Aerobic Exercise On Leptin, Tnf-a And Ghrelin On Postmenopausal Women**

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**PURPOSE:** This study determined the effects of 12-week walking/running exercise on plasma leptin, TNF- $\alpha$  and ghrelin on postmenopausal women.

**METHODS:** The 17 postmenopausal women were volunteered for this study (Age; 56.8±1.8 yr, Height; 154.3±2.0 cm, Body Weight; 64.9±3.0 kg). The training protocol was treadmill walking and running for 30-60 min/5-days/12-weeks. The running distance was progressively increased for whole training. Maximal oxygen consumption ( $\text{VO}_{2\text{max}}$ ) was determined by the method of expired gas analysis and body composition (%fat) was measured by method of skinfold thickness. Plasma insulin, and leptin, ghrelin were measured by radioimmunoassay methods. TNF- $\alpha$  was determined by using ELISA kit.

**RESULTS:** After 12-week walking/running exercise, the changes of all variables in the current study are follows;

	PRE	POST	p
$\text{VO}_{2\text{max}}$ (ml/kg/min)	22.7 ± 0.6	25.3 ± 0.7 *	.005
%fat (%)	31.3 ± 1.6	27.6 ± 1.1 *	.006
Insulin ( $\mu\text{IU/mL}$ )	4.3 ± 0.3	3.7 ± 0.2 *	.029
Glucose (mg/dl)	96.9 ± 3.5	95.6 ± 3.1	.312
Leptin (ng/ml)	12.0 ± 1.2	9.1 ± 0.9 *	.004
TNF- $\alpha$ (pg/ml)	45.4 ± 0.1	45.4 ± 0.1	.593
Ghrelin (pg/ml)	26.8 ± 2.2	29.4 ± 2.3 *	.009

Values are Mean ± SE.

\*: Significantly different from PRE,  $p < .05$

**CONCLUSIONS:** The results of this study indicate that 12-week aerobic training significantly reduced % body fat and attenuated insulin resistance with no significant change of TNF- $\alpha$ . In addition, plasma leptin levels were significantly reduced but ghrelin levels were reversely elevated.

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**2517 Board #162 May 29 9:00 AM - 10:30 AM**  
**Effect Of 12 Weeks Of Step Aerobics Training On  $\text{VO}_{2\text{max}}$  Of Older Adult Women**

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Step aerobics (SA) is one of the most popular fitness activities and has been practiced for almost three decades. Several studies have recognized SA as an effective training to improve cardiovascular capacity, determined by maximal aerobic capacity ( $\text{VO}_{2\text{max}}$ ), in young adult population. However, only a few studies were conducted with older adults.

**PURPOSE:** To evaluate the effect of step aerobics training on maximal aerobic capacity of older adult women.

**METHODS:** Fifteen previously sedentary, apparently healthy older women [(mean, SD) age 62.5±1.82yrs; and body mass index 29.1±5.0 kg/m<sup>2</sup>], participated in 36 step aerobics sessions during a 3-month period. Each session was 45-60 min in length. The Bruce treadmill maximal exercise test was used to assess maximal aerobic capacity one week before and after the training period.

**RESULTS:** Mean rate of attendance to the SA sessions was 85%. The  $\text{VO}_{2\text{max}}$  (mL·kg<sup>-1</sup>·min<sup>-1</sup>) increased significantly after SA training [(mean, SD) pre-test 24.5±2.85 and post-test 28.1±4.41;  $p < 0.001$ ], which represent an average increase of 15%. Similarly, maximal heart rate ( $\text{HR}_{\text{max}}$ ) achieved during the maximal test increased after SA training, [(mean, SD) pre-test 145.0bpm±7.46 and post test 157.6bpm±6.42;  $p < 0.001$ ].

**CONCLUSIONS:** Twelve weeks of step aerobics training were effective to improve maximal aerobic capacity in previously sedentary, apparently healthy older women, assessed by the  $\text{VO}_{2\text{max}}$  and  $\text{HR}_{\text{max}}$ . These results are an indicative that older women, as well as young adults, can have fitness benefits when performing bench stepping exercises. Further studies should examine these effects on fitness components as well as adherence after longer periods of training.

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**2518 Board #163 May 29 9:00 AM - 10:30 AM**  
**The Effects Of Resistance-training And Bench-step Aerobics On Bone Density And Sex-hormone In Postmenopausal Women**  
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**PURPOSE:** To explore the effect of either (i) a 6-month resistance training (EX1), or (ii) a 6-month bench-step aerobic training program (EX2), on bone mineral density (BMD) and sex hormone in postmenopausal women (PMW).

**METHODS:** 66 PMW (mean age were  $55.03 \pm 3.86$  year-old) who were sedentary and with no history of hormone replacement therapy were randomly divided into two exercise groups and a sedentary control group (C). EX1 consisted of (13 muscle groups, 1-3 sets, 8-25 repetitions,  $49.82 \pm 2.52$ – $56.10 \pm 8.85\%$  maximal heart rate reserve, MHRr), and EX2 included ( $58.87 \pm 11.15$ – $80.43 \pm 13.46\%$  MHRr), with exercise training 3 times per week, 60 minutes per session for 6 months. BMD was determined using dual-energy x-ray absorptiometry (DEXA) at the lumbar spine and femur neck at baseline, 3-, 6-month, and 3-month follow-up. Estradiol (E2) and testosterone (T) were assessed using chemiluminescence by the ADVIA Centaur® system (BAYER) at baseline, 3-month, and 3-month follow-up. All data were analyzed using Pearson correlations and a two-way ANCOVA. The significance level was  $\alpha=0.05$ .

**RESULTS:** (1) Compared to baseline, there were no sig. difference in BMD of femur neck and lumbar at 3-, 6-month, and 3-month follow-up. (2) Compared to baseline, EX1 were sig. decreased in T at 3-month follow-up; but there were no sig. difference in E2. (3) Compared to baseline, EX2 were significantly increased in T at 3-month. (4) Compared to baseline, E2 were significantly increased in T at 3-month and 3-month follow-up; (5) Compared to 3-month, EX2 showed significant declines in T at 3-month follow-up; (6) EX1 were sig. different from EX2 in T at 3-month follow-up; (7) There were no differences between EX1, EX2, and C in E2 at 3-month and 3-month follow-up; (8) Sex-hormone was not related to BMD.

**CONCLUSION:** 6-month of EX1 and EX2 can maintain BMD in lumbar and femur neck in PMW; 3-month bench-step aerobics increase T in PMW.

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**2519 Board #164 May 29 9:00 AM - 10:30 AM**  
**Indicators Of Physical Activity, Disability, And Quality Of Life: Differences Among Assisted And Independent Living Residents**

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As the population of older adults grows so too does the need and number of residential care facilities such as assisted living (ALF) and independent living (ILF). The degree to which residents in these distinct facility types differ in important aspects of health such as physical activity and functional health is unclear.

**PURPOSE:** To determine whether residents in ALF and ILF significantly differ on assessments of physical and functional health and associated indicators.

**METHODS:** 106 older adults were recruited from ALF ( $n = 68$ ) and ILF ( $n = 38$ ) to complete self-report assessments of physical activity, self-efficacy, functional limitations and disability, and quality of life. Participants also wore an Actigraph accelerometer which provided activity counts and step counts. The Short Physical Performance Battery (SPPB) was used to assess functional performance through tests of balance, gait, and lower body strength. Facility comparisons were made using one-way ANOVA.

**RESULTS:** Self-report physical activity ( $38.5$  vs.  $56.4$ ,  $p < 0.05$ ), self-efficacy ( $48.5$  vs.  $61.8$ ,  $p < 0.05$ ), and quality of life ( $21.8$  vs.  $24.8$ ,  $p < 0.05$ ) were significantly lower in the ALF residents. ALF residents reported greater functional limitations ( $16.0$  vs.  $18.7$ ,  $p < 0.05$ ) and disability ( $26.5$  vs.  $30.6$ ,  $p < 0.05$ ) than ILF residents. However, no significant group differences were observed for activity counts or step counts. Standing balance, gait speed, and lower body strength also did not significantly differ between ALF and ILF residents.

**CONCLUSION:** Although residents in assisted living facilities are understood to have greater difficulty with activities of daily living than residents in independent living, these results suggest that there is in fact no difference in individual capabilities as evidenced by the SPPB and accelerometer. Instead, the individual differences appear to be manifest in individual perceptions of functional limitations and capabilities, ultimately influencing the quality of life of these individuals. This research was

Supported by an ACSM Foundation Research Grant from the American College of Sports Medicine Foundation.

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**2520 Board #165 May 29 9:00 AM - 10:30 AM**  
**Shopping Habits And Physical Activity In Older Adults: The Older People And Active Living Project.**

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(No relationships reported)

**PURPOSE:** To use a mixed-methods approach to explore the shopping habits of UK older adults (70+ years) and their association with levels of physical activity (PA) and body mass index (BMI).

**METHODS:** 240 participants (mean age  $\pm$  SD =  $78.1 \pm 5.7$  yrs, 47.9% female) in the Older People and Active Living (OPAL) project provided quantitative data on physical activity (PA by accelerometry), BMI, and shopping habits (using self-report questionnaires); semi-structured interviews were also conducted with 46 participants (mean age  $\pm$  SD =  $79.7 \pm 6.3$  yrs, 41.3% female) to provide qualitative data on patterns of shopping during a typical week, reasons for shops preferences and perceived importance of shopping to activity levels.

**RESULTS:** BMI data (mean  $\pm$  SD =  $27.2 \pm 4.9$  kg/m<sup>2</sup>) indicated that the majority of participants were overweight (38.8%) or obese (27.9%). More than 79.8% reported doing their own shopping alone or with someone; 68.6% drove or were driven to shops. Participants who drove/were driven to their main food shop had significantly higher BMI values ( $27.8 \pm 4.3$  vs.  $25.9 \pm 4.8$  kg/m<sup>2</sup>,  $p = .021$ ). Those who made most of their journeys by car were significantly less active than those who made most journeys by other forms of transport (walking, cycling, bus;  $3672.4 \pm 2245.0$  vs.  $4935 \pm 2823.7$  steps/day,  $p = .004$ ); and ( $14.5 \pm 13.9$  vs.  $22.8 \pm 22.19$  min/day moderate-to-vigorous PA,  $p = .004$ ). Shopping was reported as the main structured activity for these participants. Participants preferred shopping in supermarkets; they offered variety of choices and competitive prices compared to the limited provision and high prices of local amenities. Shopping malls were an accessible and attractive destination for these older adults, helping them to overcome barriers such as safety concerns and weather conditions and offering opportunities for socialising.

**CONCLUSION:** Shopping and running errands contributed significantly to older adults' PA levels. Opportunities for active trips to shops required the provision of better local amenities. Shopping malls have potential as important health promotion venues for older people but consideration of proximity and attractiveness of local shops and amenities is critical for increasing daily activity.

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**2521 Board #166 May 29 9:00 AM - 10:30 AM**  
**Older Adults' Perceived Physical Activity Enablers And Barriers: A Multicultural Perspective**

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Almost all population groups in the United States need more physical activity (PA). PA programs are particularly needed for groups affected by health disparities; lack of PA contributes to disparities. Identifying perceived PA barriers and enablers among various racial/ethnic groups may help develop effective PA programs.

**PURPOSE:** To identify perceived PA enablers and barriers among a racially/ethnically diverse group of older adults.

**METHODS:** Data were from 42 focus groups (n=396) with United States residents ages 50 and older, including: African Americans, American Indians, Hispanics, Chinese, Vietnamese, and non-Hispanic Whites (hereafter Whites). Grounded theory identified themes. Thematic analysis organized content. Constant comparison methods examined themes by race/ethnicity.

**RESULTS:** Barriers perceived in common among the groups were health problems, fear of falling, and lack of exercise facilities. Enablers perceived in common were positive health outcome expectations, social support, and PA program access, including senior centers. American Indians mentioned the built environment (e.g., lack of suitable areas for walking) and lack of knowledge about PA as barriers; they also described health benefits as an enabler more often than other groups. Whites and American Indians emphasized the importance of PA programs specifically designed for older adults, stressing the need for activities that are easy on joints, such as water aerobics. African Americans mentioned financial cost as a barrier more often than others. There were no differences between barriers and enablers offered in common among the groups and those offered by Chinese and Vietnamese participants, although Vietnamese participants offered fewer barriers and enablers.

**CONCLUSION:** Results suggest several ways to promote PA among older adults, including developing exercise programs for them and health messages promoting existing PA places and programs. Racial/ethnic differences should be considered when designing such programs, and when developing messages and communication campaigns to promote them. Results also suggest that certain groups, such as American Indians, may be particularly affected by barriers in the built environment. Concerted action by communities and governments may be needed to overcome such barriers.

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**2522 Board #167 May 29 9:00 AM - 10:30 AM**  
**Validating The Brfss And Acls Physical Activity Surveys In A Diverse Group Of Older Adults**

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**PURPOSE:** To examine the validity of the Behavioral Risk Factor Surveillance System (BRFSS) physical activity (PA) questions, and the Aerobics Center Longitudinal Study (ACLS) PA short and long surveys in middle-aged and older adults.

**METHODS:** 71 adults > 45 years of age (68% female, 32% male; 74% White [W], 26% African American [AA]) participated in the study. Telephone interviews were used to administer the BRFSS PA questions, and to obtain self-reported height and weight. Each participant was then mailed and asked to wear an Actical accelerometer for 7 consecutive days, to complete a daily PA log, and to complete the ACLS short and long surveys. Two-tailed Spearman correlation coefficients were used to compare moderate, vigorous, and moderate and greater intensity PA (MVPA; min/day) to accelerometer determined PA. We also examined gender and race differences in the validity of the surveys.

**RESULTS:** The participant's were older ( $M$  age =  $57.4 \pm 9.9$  yrs) and overweight ( $M$  BMI =  $27.9 \pm 4.9$  kg/m<sup>2</sup>), but otherwise healthy adults. The Spearman correlations revealed moderate agreement between self-reported PA and accelerometer determined PA. There was moderate agreement between accelerometer determined moderate intensity PA and the ACLS long ( $r = .306, p < .05$ ) determined moderate intensity PA. There was moderate agreement between accelerometer determined vigorous intensity PA and BRFSS ( $r = .330, p < .05$ ), ACLS short ( $r = .455, p < .001$ ), and ACLS long ( $r = .451, p < .001$ ) determined vigorous intensity PA. There was also moderate agreement between accelerometer determined MVPA and BRFSS ( $r = .302, p < .05$ ), ACLS short ( $r = .315, p < .05$ ), and ACLS long ( $r = .472, p < .001$ ) determined MVPA. The mean MVPA for the BRFSS was 66.2 min, 75.6 min for the ACLS short, 39.7 min for the ACLS long, and 27.2 min for accelerometry. The strength of the associations were greater among women than in men, and among Ws than in AAs.

**CONCLUSION:** Few studies have assessed the validity of these PA surveys among diverse middle-aged and older adults. We found moderate correlations with accelerometer data, with results also varying by gender and race. Researchers need to be aware of the limitations associated with self-report PA surveys for this age group, especially among certain subpopulations, and obtain objectively-measured PA data whenever possible.

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**2523 Board #168 May 29 9:00 AM - 10:30 AM**  
**Metabolic Equivalent Intensity Levels Of Household Activities In Elderly Women**

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Metabolic equivalent (MET) intensity levels are used to estimate energy cost of physical activities in individuals and to compare results across epidemiological studies using self-reports of physical activity. There are concerns that there may be differences in MET intensity levels of specific activities between individuals who differ in age, cardiorespiratory fitness levels or mechanical efficiency. Therefore MET intensity levels derived from studies in young healthy adults may not be used to estimate energy cost in surveys assessing self-reported physical activity in elderly people.

**PURPOSE:** To investigate the intensity levels of four different self-paced household activities in older women ( $\geq 70$  years) in comparison to younger women (20-40 years).

**METHODS:** Oxygen uptake was assessed by mobile spirometry in 18 older women (aged  $74.5 \pm 5.0$  (70-89) years; body mass index (BMI)  $25.8 \pm 3.6$  kg•m<sup>-2</sup>; percentage body fat measured by bioimpedance analysis  $32.3 \pm 3.4\%$ ) and in 19 younger women (aged  $27.5 \pm 5.4$  (20-39) years; BMI  $24.6 \pm 5.2$  kg•m<sup>-2</sup>; percentage body fat  $31.0 \pm 5.8\%$ ) during the following self-paced household tasks in the subjects' homes: cleaning the bathroom, preparing a meal, ironing, and vacuuming. The household tasks were conducted in randomized order. MET intensity levels were calculated by dividing oxygen uptake during activity (mL•kg<sup>-1</sup>•min<sup>-1</sup>) by a resting oxygen uptake constant of  $3.5$  mL•kg<sup>-1</sup>•min<sup>-1</sup>. Statistical analysis for differences between the age groups was done with Student's t-test. Level of significance was set at  $p < 0.05$ .

**RESULTS:** The two age groups did not differ significantly in BMI or percentage body fat ( $p > 0.05$ ). MET intensity levels were:  $2.8 \pm 0.8/2.6 \pm 0.5$  for cleaning the bathroom,  $1.9 \pm 0.5/2.0 \pm 0.4$  for preparing a meal,  $1.9 \pm 0.5/2.0 \pm 0.3$  for ironing,  $2.8 \pm 0.7/2.9 \pm 0.4$  for vacuuming (older/younger women respectively). MET intensity levels of the four household tasks did not differ significantly between the two age groups ( $p > 0.05$ ).

**CONCLUSIONS:** These data suggest that MET intensity levels of household tasks that have been derived from studies in younger women may also be used in epidemiological studies on self-reported physical activity in elderly women. Due to high standard deviations, estimation of energy cost in individuals by using predefined MET intensity levels is imprecise.

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**2524 Board #169 May 29 9:00 AM - 10:30 AM**  
**Objectively Measured Patterns Of Physical Activity: The Older People And Active Living (opal) Project.**

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(No relationships reported)



**PURPOSE:** Firstly, to describe objectively measured physical activity patterns of a sample of older adults (70+ years), stratified by index of multiple deprivation and proximity to retail outlets; secondly, to determine the association of journeys away from their residence with physical activity.

**METHODS:** 240 participants (mean age  $\pm$  SD = 78.1 $\pm$ 5.7 yrs, 47.9% female) wore an Actigraph GT1M accelerometer for 7 days. Accelerometers were programmed to record activity counts and steps in 10s epochs. Participants kept a log of when the Actigraph was worn and recorded details of any journeys made from home including purpose and transport mode used. Actigraph data were reduced using MAH/UFFE v.1.9.0.3 software.

**RESULTS:** Males were significantly more active than females (minutes of at least moderate physical activity [MVPA]  $\cdot$  d<sup>-1</sup>: 22.3  $\pm$  20.6 [M] vs. 13.9  $\pm$  12.8 [F], p<.001; steps  $\cdot$  d<sup>-1</sup>: 4584.4  $\pm$  2736.7 [M] vs. 3882.1  $\pm$  2251.6 [F], p=.042) and made more daily journeys (journeys [Jy]  $\cdot$  d<sup>-1</sup>: 1.51  $\pm$  0.79 [M] vs. 1.25  $\pm$  0.56 [F], p=.005). Young participants (70-75y) were significantly more active than older participants (MVPA  $\cdot$  d<sup>-1</sup>: 25.0  $\pm$  20.0 [70-75y] vs. 13.3  $\pm$  14.9, p<.001 [80-85y], 8.2  $\pm$  8.2, p<.001 [85-90y], 1.6  $\pm$  0.4 p<.001 [90+y]; steps  $\cdot$  d<sup>-1</sup>: 5178.7  $\pm$  2681.5 [70-75y] vs. 3749.4  $\pm$  2273.0, p=.006 [80-85y], 2498.4  $\pm$  1730.5, p<.001 [85-90y], 942.5  $\pm$  609.2, p<.001 [90+y]) and made significantly more journeys (Jy  $\cdot$  d<sup>-1</sup>: 1.64  $\pm$  0.76 [70-75y] vs. 1.19  $\pm$  0.50, p=.001 [80-85y], 1.10  $\pm$  0.58, p=.013 [85-90y], 0.44  $\pm$  0.31, p<.001 [90+y]). Those who did most Jy  $\cdot$  d<sup>-1</sup> (>1.67 Jy  $\cdot$  d<sup>-1</sup>) were significantly more active (28.6  $\pm$  21.9 MVPA  $\cdot$  d<sup>-1</sup>, 5689.6  $\pm$  2529.5 steps  $\cdot$  d<sup>-1</sup>) than those who did fewer Jy  $\cdot$  d<sup>-1</sup> (MVPA  $\cdot$  d<sup>-1</sup>: 16.7  $\pm$  13.2, p<.001 [1.00-1.67 Jy  $\cdot$  d<sup>-1</sup>], 8.4  $\pm$  11.0, p<.001 [ $<$ 1.00 Jy  $\cdot$  d<sup>-1</sup>]; steps  $\cdot$  d<sup>-1</sup>: 4334.6  $\pm$  1995.6, p=.001 [1.00-1.67 Jy  $\cdot$  d<sup>-1</sup>], 2538.5  $\pm$  1676.9, p<.001 [ $<$ 1.00 Jy  $\cdot$  d<sup>-1</sup>]). Participants were significantly more active on weekdays (W) than weekend days (WE) (steps  $\cdot$  d<sup>-1</sup>: 4444.7  $\pm$  2650.9 [W] vs. 3741.3  $\pm$  2638.8 [WE], p<.001). Diurnal peaks in activity occurred late morning and mid afternoon.

**CONCLUSIONS:** Getting out of the house makes a significant contribution to PA in older adults. Encouraging older adults to get out more may help reduce age related declines in physical activity.

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**2525 Board #170 May 29 9:00 AM - 10:30 AM**  
**Mobility Performance Tests For Discriminating Frailty In Community-dwelling Older Women**

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(No relationships reported)

Along with the increase in frail older persons, concern about screening for frailty has been increasing as well. Mobility performance measures could be objectively used to identify frailty in older people who are at an increased risk for loss of functional independence. However, little is known about the identification of frailty using mobility performance tests.

**PURPOSE:** To identify frailty using optimal cutoff values with four mobility performance tests in community-dwelling older women.

**METHODS:** A cross-sectional sample of 377 community-dwelling older women, aged 65 years and over, participated in this study. Participants were classified into a frail group (n = 166, 75.0  $\pm$  5.8 years) and a non-frail group (n = 171, 74.1  $\pm$  4.7 years) based on original criteria using questionnaires from the Japanese Ministry of Health Labour and Welfare. The four mobility performance tests were alternate step, timed up-and-go (TUG), timed rapid gait (TRG), and usual gait speed. Receiver operating characteristic curves were obtained for all the scales to assess the optimal cutoff values, and logistic regression analysis was performed.

**RESULTS:** All mobility performance tests showed the largest areas under the curve (AUC) discriminated between non-frail and frail (AUC > 0.80, p < 0.000). The optimal cutoff value of alternate step (4.8 s), TUG (7.1 s), TRG (6.0 s), and usual gait speed (1.24 m/s) were indicated by maximum sensitivity and specificity in the discrimination between non-frail and frail. In the logistic model, adjusted for body mass index and number of diseases, alternate step (odds ratio [OR], 1.72; 95% confidence interval [CI], 1.17-2.53) and usual gait speed (OR, 0.10; 95% CI, 0.22-0.51) were significantly associated with the frail.

**CONCLUSION:** The optimal cutoff values derived from these results can be used as criterion reference points for identifying deterioration or loss of mobility in community-dwelling older women.

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**2526 Board #171 May 29 9:00 AM - 10:30 AM**  
**Lessons Learned Recruiting Senior Masters Athletes As Research Participants**

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(No relationships reported)

**BACKGROUND:** Physical activity throughout the lifespan is essential for promoting and maintaining health. Older athletes have different risk factors for injury and a longer recovery time than younger athletes. Seniors are at higher risk for acute injury during athletic pursuits and such injuries are a frequent cause for emergency room visits. We administered injury surveys to athletes at the Huntsman World Senior Games in 2006, 2007, and 2008 using a variety of recruitment techniques. Each year there are approximately 8,000 athletes participating in the Games, which occurs in early October for a 2-week, and 3-weekend period. The Games are open to athletes older than 50 and include 24 individual and/or team activities ranging from archery to volleyball.

**PURPOSE:** To describe and evaluate effectiveness of methods used to recruit senior athletes into an injury survey study.

**METHODS:** Paper-based surveys were administered to Games athletes in 2006, 2007, and 2008. In 2008, an option for completing an electronic version of the survey online was added. Utah Sports Research Network faculty and staff traveled to the Games each year to distribute surveys and encourage athlete participation. In 2008, surveys were included in the registration packets, and staff distributed postage-paid return envelopes for surveys in addition to collection at the Games.

**RESULTS:** In 2006 and 2007, we collected 124 and 169 completed surveys, respectively, primarily from athletes that completed and returned the surveys during the Games. Each year a few committed participants returned surveys by mail at their own expense. Responses from 2008 are still arriving by mail and online but have already surpassed the previous two years combined. We have received more than 250 paper surveys, approximately half returned by mail, and over 60 online surveys.

**CONCLUSIONS:** Providing multiple means of response achieved a better response rate. Including the survey in the registration packet increased the number distributed and the profile of the study among athletes and possibly encouraged participation. Next year we plan to include the postage-paid return envelopes in the registration packet as well as the survey and encourage more online survey completion.

**ACKNOWLEDGMENTS:** Athletes and staff of the Huntsman World Senior Games; Utah Sports Research Network.

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**2527 Board #172 May 29 9:00 AM - 10:30 AM**  
**Walking Behavior And Maximum Walking Speed In An Elderly Community Population: A Cross-sectional Analysis**

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(No relationships reported)

Previous studies have shown that physical activity plays a role in maintaining functional ability later in life. Walking is the most common physical activity behavior of the elderly. The determinants of walking behavior have been reported to vary with the purposes (e.g., recreation or transport) of walking. However, specific relationships between walking for particular purposes and functional ability have not been clear.



**PURPOSE:** To clarify specific relationships between walking for particular purposes and maximum walking speed (MWS) in the elderly.

**METHODS:** A cross-sectional survey was conducted in 2007 using a sample of community-dwelling elderly people aged 60 and over in Mitoya, Unnan City, Shimane Prefecture, rural Japan. 372 men ( $n=132$ ) and women ( $n=240$ ) responded to questionnaires and face-to-face interviews. MWS was measured by a 10m walking test. Associations with MWS were examined separately for self-reported weekly time of walking for recreation, walking for transport, and total walking time using multiple linear regression analyses. All regression models were adjusted for age, body mass index, a number of chronic conditions, musculoskeletal pain in the hip and lower limb, and depression.

**RESULTS:** The mean MWS were  $2.2\pm0.4$  m/s in men and  $2.0\pm0.4$  m/s in women. The mean walking time for recreation and for transport were  $66\pm101$  min./w. and  $26\pm51$  min./w. in men and  $47\pm87$  min./w. and  $35\pm70$  min./w. in women. Both in men and women, walking for recreation was significantly associated with MWS after controlling for potential confounding factors (men:  $b=0.188$ ;  $p<0.05$ , women:  $b=0.185$ ;  $p<0.01$ ). However, walking for transport was not significantly associated with MWS. Total walking time was significantly associated with MWS only in women ( $b=0.126$ ;  $p<0.05$ ).

**CONCLUSIONS:** Elderly people with longer walking times for recreation had faster MWS. Walking for recreation may contribute to maintaining functional ability in the elderly.

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**2528 Board #173 May 29 9:00 AM - 10:30 AM**  
**The Relation Between Health And Physical Activity In Adults 65 And Older**

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(No relationships reported)

**PURPOSE:** To examine physical activity as it relates to health in a sub group of "The Environmental Correlates of Physical Activity in Older Adults: A Healthy Aging Research Network Collaboration Study". This is a Centers for Disease Control, Prevention Research Center national investigation.

**METHODS:** A sub-sample of 201 individuals aged 65 years and older, were recruited from Allegheny County, Pennsylvania senior centers. During an interview, data were gathered using a questionnaire, physical performance assessments, and cognitive functioning tests.

**RESULTS:** Mean age, 75.24 (SD  $\pm 6.25$  years); 78.6% female; 75.6% White. 51.24% reporting 150 minutes or more of Physical Activity (PA) per week. Differences were observed in groups reporting >150 mins PA vs less than 150 mins: self reported health status, 84.5% reported good-excellent vs 68.4%; mean BMI,  $29.382$  kg/m<sup>2</sup> vs  $29.521$  kg/m<sup>2</sup>; performance in jug lift 74.8% lifting jug over eye level vs 30.3%; and chair stand test, 11.84 seconds for 5 repetitions vs 13.13 seconds.

**CONCLUSIONS:** Older individuals who engage in regular physical activity generally feel healthier and are more physically fit than those who are not physically active.

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**2529 Board #174 May 29 9:00 AM - 10:30 AM**  
**Objective Measurement Of Sedentary And Active Behavior In Older Adults**

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**PURPOSE:** To describe the physical activity (PA) behavior of community dwelling older adults, aged 50 to 87 years.

**METHODS:** Two hundred and eighteen older adults (62 men,  $66.0 \pm 8.5$  y; 156 women,  $63.8 \pm 7.4$ ) participated in this study. Each participant wore a belt-mounted accelerometer (ACC; Actigraph 7164, Fort Walton Beach, FL) for 7 consecutive days. ACC derived PA was categorized into accumulated time spent in sedentary ( $\leq 260$  cts/min), moderate (1952-5725 cts/min), vigorous ( $\geq 5725$  cts/min), moderate + vigorous activity (MVPA;  $>1952$  cts/min), and time spent in  $\geq 10$  min bouts of MVPA. Means  $\pm$  SD are presented for all PA classifications. Overall age and gender comparisons were made using independent t-tests. A multivariate ANOVA was performed to explore gender and age category differences (50-59 y, 60-69 y, and 70+ y).

**RESULTS:** On average participants wore the ACC  $6.92\pm0.32$  days for  $967.29\pm85.8$  min/d. Overall, older adults spent 75.2% of their day in sedentary behavior and 2.9% in MVPA. There were no gender differences in time spent in sedentary or MVPA, but significant differences were noted across age groups. Sedentary behaviors increased significantly with age from 50-59 y to 70+ y ( $719.2\pm86.5$  to  $762.6\pm75.7$  min/d;  $p=0.044$ ) and 60-69 y to 70+ y ( $713.1\pm110.1$  to  $762.6\pm75.7$  min/d;  $p=0.011$ ). MVPA decreased significantly with increasing age, 50-59 y to 60-69 y ( $37.5\pm25.3$  to  $28.0\pm21.9$  min/d;  $p=0.026$ ), 50-59 y to 70+ y ( $37.5\pm25.3$  to  $18.4\pm16.1$  min/d;  $p=0.000$ ), and 60-69 y to 70+ y ( $28.0\pm21.9$  to  $18.4\pm16.1$  min/d;  $p=0.035$ ). Bouts of MVPA also decreased with increasing age, 50-59 y to 70+ y ( $15.6\pm19.0$  to  $7.0\pm10.7$  min/d;  $p=0.010$ ).

**CONCLUSIONS:** These findings present an objective measure of an older adult's daily pattern of sedentary and active behavior. Results indicate that older adults are spending a large portion of their day participating in primarily sedentary behavior, with little time spent in accumulated MVPA. MVPA is further reduced when expressed in bouts lasting  $\geq 10$  min in duration. Collectively, results worsen with advancement in age. Given that time spent in activities requiring low levels of energy expenditure have been associated with increased risk for chronic disease, efforts to reduce the amount of time older adults spend in sedentary activities are warranted.

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**2530 Board #175 May 29 9:00 AM - 10:30 AM**  
**Effectiveness Of Water-based Exercise For Managing Pain Among Frail Elderly Women With Knee Pain**

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(No relationships reported)

Osteoarthritis is one of the most prevalent musculoskeletal disorders in the elderly. Pain and impairment on knee frequently leads to moderate to severe limitations of participation in daily life and decreased quality of life. Water-based exercise (WE) provides several water-specific benefits to reduce pain and improve functional decline.

**PURPOSE:** To evaluate the effectiveness of WE and its sustainability for managing pain among frail elderly women with knee pain at the community-based setting.

**METHODS:** Fifty one elderly women with knee and/or back pain (age=72.1 $\pm$ 4.6 years) were randomly assigned to either a WE group (WEG) or a waiting-list control group (CG). Only participants with knee pain were included for the data analysis (WEG:  $n=19$ ; CG:  $n=16$ ). WEG first participated in a 12-week WE program. CG was provided the same program immediately after the intervention as a cross-over design. The Japanese Knee Osteoarthritis Measure (JKOM) and Japanese short-version of Coping Strategy Questionnaire (CSQ) were assessed at baseline and post-intervention. Both groups completed the same assessments at 3 months after their own WE programs. Mixed factorial and repeated measures ANOVA were utilized for analyses. Effect sizes were calculated.

**RESULTS:** No significant differences at baseline were found between WEG and CG in all variables. WEG significantly improved activity restriction (AR; pre= $29.4\pm20.7$ ; post= $17.9\pm9.4$ ) and reduced pain (PA; pre= $12.2\pm7.4$ ; post= $6.6\pm3.9$ ) on JKOM, and reduced reinterpreting pain sensation (RPS; pre= $2.3\pm1.4$ ; post= $1.7\pm1.8$ ) and enhanced self-efficacy for self-management (SE; pre= $3.0\pm1.2$ ; post= $3.9\pm1.1$ ) on CSQ at post-intervention ( $p<0.05$ ) whereas did not change in CG ( $p>0.05$ ). Improvement of AR, PA, and RPS significantly maintained for 3 months after WE programs ( $p<0.05$ ). Effect sizes of each item for the effectiveness of WE and its sustainability were moderate to large on JKOM and small to moderate on CSQ.

**CONCLUSIONS:** WE would be effectively and safely provided with the frail elderly as a community-based preventive program for knee pain, and could maintain its effectiveness for short-term period. To enhance the effectiveness of exercise program for managing knee pain, it would be important to incorporate the psychological approaches into existing therapeutic exercise intervention.

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**2531 Board #176 May 29 9:00 AM - 10:30 AM**  
**Predictors Of Self-reported And Directly Measured Physical Activity Among Healthy Older Adults Living In Rural Communities.**

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(No relationships reported)

**PURPOSE:** The importance of a physically active lifestyle in chronic disease prevention is well established. Still, inactivity is common among older adults. Identification of factors associated with physical activity would be useful in developing programs to increase physical activity. The purpose of this study was to assess the strength of several variables in predicting self-reported and directly measured physical activity (PA) levels in healthy, independent rural dwelling older adults.

**METHODS:** Subjects were recruited from two rural nutrition program meal sites (42 women and 14 men). Potential predictor variables included BMI, a crude measure of chronic disease status, age, and the 5 subscales of the MOS - Short Form [SF-36] that are related to physical health & function. These include: Physical Functioning (PF), Role-Physical (RP), Bodily Pain (BP), Vitality (VT), and General Health (GH). MOS scores were transformed to a 0-100 scale with high scores indicating minimal to no perceived limitation. The self-reported PA variable was total PASE score (TOT PASE). The accelerometer (CSA) measures were total counts/day (TC/day) and mean counts/ minute (CTS/min).

**RESULTS:** PF was the only significant correlate of TC/day and CTS/min and was a poor predictor of both TC/day ( $r^2=.062$ ,  $p=.038$ ) and CTS/min ( $r^2=.067$ ,  $p=.032$ ). There were no significant predictors for TOT PASE.

**CONCLUSIONS:** PA level was poorly predicted by variables measured in this study. Even though the PF measure was a statistically significant predictor for both direct measures, the total variance accounted for was < 20% in both cases, indicating no practical value as a predictor.

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**2532 Board #177 May 29 9:00 AM - 10:30 AM**  
**"Strictly-ballroom": Can Dance Raise The Amount And Intensity Of Physical Activity In Senior Adults?**

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(No relationships reported)

**PURPOSE:** In the present pilot study, we examined the impact of a 12-week community based ballroom dancing intervention on objectively measured total minutes of physical activity and assessments of intensity within lessons.

**METHODS:** Sedentary senior adults ( $N=27$ , 22 female; aged  $53 \pm 6$  y) with a self-assessed status of being physically inactive, volunteered to participate in a 12-week (1 x 2 hrs per week) instructor-led dance class, which introduced novices to ballroom dancing (e.g., tango). Participants generally lived near ( $3.8 \pm 3.2$  miles) to the community venue situated in North of the UK. Physical activity was assessed using an Actigraph GT1M accelerometer, set at 2-second epochs, with measures taken in weeks 1 or 2 compared to weeks 11 or 12. To identify intervention impact we calculated total lesson step counts and minutes spent in sedentary, light and moderate physical activity based on published cut points.

**RESULTS:** Repeated measures MANOVA, identified that the amount and intensity of activity increased across the 12 week intervention (time  $F(3, 23) = 24.59$ ,  $p<.001$ ,  $L = .238$ ,  $h^2 = .76$ ). No main or interaction effect was identified for any participant characteristics (e.g., gender). Specifically, from initial to latter weeks, the number of total steps per lesson increased by over 500 ( $1321 \pm 296 - 1884 \pm 411$ ;  $F(1, 25) = 52.96$ ,  $p<.001$ ,  $h^2 = .67$ ). Activity intensity also changed, with the time spent in low ( $F(1, 25) = 20.83$ ,  $p<.001$ ,  $h^2 = .45$ ) and moderate intensity increasing ( $F(1, 25) = 4.37$ ,  $p<.005$ ,  $h^2 = .14$ ). Lesson time spent in these intensities increased from 31.4-36.2% (37.5 - 43.25 mins) and 3.1-7% (3.75 - 8.5 mins) respectively, with concomitant reductions in sedentary lesson time.

**CONCLUSIONS:** Among senior adults, beginner dance lessons replaced previously sedentary time, helping them achieve close to 20% (i.e., 2000 steps) of recommended daily steps within a 2-hour period by the end of the intervention. Likewise, activity intensity increased over time, but intensity did not meet recommended moderate daily levels (i.e., 30 mins per day). Nonetheless, considering participant characteristics (e.g., age), replicated at a population level such incremental changes are still beneficial.

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**2533 Board #178 May 29 9:00 AM - 10:30 AM**  
**Dose Response Walking Activity And Physical Function In Older Adults**

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(No relationships reported)

**PURPOSE:** To examine the dose-response relationship between walking activity and physical function in community-dwelling older adults.

**METHODS:** The Wellness Works Program is an ongoing community-academic partnership providing free access to exercise facilities for Milwaukee County seniors. The present study evaluated 836 older adults who underwent an intake assessment including measures for general demographics and anthropometrics, physical activity (PA) and function assessments, prior to joining the program. PA was assessed by pedometer (Yamax SW-200) worn on the mid-thigh line of the right hip for 7 consecutive days. Function was evaluated by the Physical Functioning (PF) scale of the Medical Short-Form Outcomes questionnaire, and from the completion of a 6 minute walk test (6MWT). PA was averaged for the week and categorized into 4 groups (1= $\leq 2500$  [ $n=281$ ], 2=2501-5000 [ $n=326$ ], 3=5001-7500 [ $n=141$ ], and 4= $\geq 7501$  steps/d [ $n=88$ ]). PF and 6MWT distributions among PA groups were summarized with sample means and SD. ANOVA and general linear models were used for unadjusted and adjusted (for age and gender) group comparisons.

**RESULTS:** The average age and body mass index for men was  $68 \pm 9$  yrs ( $n=334$ ) and  $30 \pm 6$  kg/m<sup>2</sup> ( $n=334$ ) and for women was  $67 \pm 8$  yrs ( $n=491$ ) and  $31 \pm 7$  kg/m<sup>2</sup> ( $n=500$ ). Overall, participants walked an average of 4022 step/d, reported a PF score of 71.7 % and walked 1097.5 ft on the 6MWT. Across PA groups, PF mean scores increased from  $66.9 \pm 1.4\%$  to  $73.5 \pm 1.3\%$  to  $78.8 \pm 1.9\%$  to  $81.3 \pm 2.5\%$  and 6MWT distance increased from  $941.7 \pm 15.2$  ft to  $1154.1 \pm 14.0$  ft to  $1260.1 \pm 21.3$  ft to  $1294.0 \pm 26.8$  ft. Both PF and 6MWT scores were statistically different across all PA groups, apart from groups 3 and 4. PA and ranks of PA groups were highly significant predictors ( $p<.0001$ ) for both PF and 6MWT in unadjusted and adjusted for age and gender analyses.

**CONCLUSIONS:** There was a dose-response relationship evident for both PF and 6MWT with increasing levels of PA, with the greatest benefit being seen between PA group 1 ( $\leq 2500$  steps/d) and PA group 2 (2501-5000 step/d). Low levels of PA appear to be an important determinant of physical function in older adults. Efforts to increase walking behavior in this population are warranted to improve function.

*This work was Supported by a Career Development Award from the National Institute on Aging (K01AG025962).*

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**2534 Board #179 May 29 9:00 AM - 10:30 AM**  
**Everyday Physical Activity Patterns In Elderly Men And Women**

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(No relationships reported)

**PURPOSE:** To evaluate gender differences in everyday physical activity patterns and in activity related energy expenditure in elderly people (>70 years).

**METHODS:** The sample was made of 136 community-dwelling older people: 67 men (median age 76; 71-88 years; 49.3%) and 69 women (median age 77; 71-89 years). Subjects were interviewed by telephone on their physical activities of the previous week. Activities were summarized to the following categories: homework, gardening, sporting activities and walking. Hours spent on specific activities were multiplied by predefined metabolic equivalent (MET) levels to estimate activity related energy expenditure (in MET-hours per week=MET-h/w). Statistical analysis for differences between sexes was done with Student's t-test.

**RESULTS:** Total time per day (hh:mm) subjects spent on being active did not differ significantly between sexes (men/women: 10:36±1:51/10:53±2:28; p=0.468). However, women (58.1±21.9 MET-h/w) had a higher (p<0.001) total activity related energy expenditure than men (40.3±19.4 MET-h/w). Energy expenditure (MET-h/w) of men/women within the four categories was: homework 19.9±14.3/48.1±19.3 (p<0.001), gardening 2.3±3.6/1.1±1.5 (p=0.024), sporting activities 11.3±16.3/8.6±11.4 (p=0.272), walking 3.5±2.4/2.7±2.1 (p=0.036). Relating energy expenditure within the respective category to the subjects' total energy expenditure revealed that homework made up 80.9±13.6% of women's and 51.0±27.7% of men's total energy expenditure (p<0.001). Sporting activities accounted for 24.7±27.8/11.1±13.5% (p=0.002), gardening for 6.4±12.2/1.6±2.4% (p=0.007) and walking for 11.7±11.1/4.5±4.1% (p<0.001) of elderly men's/women's total energy expenditure.

**CONCLUSION:** Homework accounted for the greatest portion of total energy expenditure in elderly men and women. A higher amount of homework led to a much higher total energy expenditure in women compared to men. The effects of everyday physical activity on health and functioning should be subject of further studies as they are poorly understood yet.

*The study has been conducted within the research cooperation PRISCUS ("Prerequisites for a new health care model for elderly people with multimorbidity"), which is funded by the German Federal Ministry of Education and Research (01ET0720).*

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**2535 Board #180 May 29 9:00 AM - 10:30 AM**

**Functional Fitness Differences In Japanese Older Women Who Walk 10,000 At Different Intensities.**

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(No relationships reported)

Regular physical activity (PA) plays an important role in maintaining and promoting health, physical fitness, and functional independence in older adults. However, research is less clear when examining the impact of recommended levels of PA accumulation versus PA intensity on health, fitness and functional independence.

**PURPOSE:** To determine if functional fitness (FF) differences exist between community-dwelling older women who accumulate 10,000 steps/day and engage in 30 minutes/day or more of MI versus those who accumulate 10,000 steps/day and engage in less than 30 minutes/day of MI.

**METHOD:** Subjects (Ss) underwent a FF test and received a Lifecorder (Suzuken Co, Japan) accelerometer (LC) to record 2 consecutive weeks of steps and PA intensity (0=low intensity to 9=high intensity). PA intensity was defined as MI corresponding to LC levels 4-6 (3-6 METS). FF was assessed using Arm Curl, Chair Stand, Up & Go, Sit and Reach, Back Scratch, Functional Reach, and 12-min Walk. 603 Ss completed PA and FF assessments; of those 132 Ss (age: 68 ± 5, daily average step: 12370 ± 2087) accumulated 10,000+ steps/day and were selected for analysis. Ss were assigned to one of two groups: 30 or more minutes/day of MI PA (30MMI) or less than 30 minutes (30LMI).

**RESULTS:** in table.

	30LMI (n= 43)	30MMI (n=89)	t-test
Age	68 ± 5	67 ± 5	N.S.
Arm Curl (times/30sec)	22 ± 4	24 ± 4	N.S.
Chair Stand (times/30sec)	20 ± 4	23 ± 5	*p< 0.05
Up&Go (sec)	4.8 ± 0.5	4.5 ± 0.6	*p< 0.05
Sit&Reach (cm)	16.8 ± 9.7	16.2 ± 8.8	N.S.
Back Scratch (cm)	-2.4 ± 11.1	-2.2 ± 11.9	N.S.
Functional Reach (cm)	28 ± 5	30 ± 5	N.S.
12-min Walk (m)	1055 ± 140	1107 ± 97	*p< 0.05

**CONCLUSION:** There appears to be a relationship between MI and FF even for individuals *accumulating* the recommended PA levels. Individuals who accumulate 10,000 steps/day and engage in 30 minutes/day or more of MI appear to have greater lower body strength, mobility, and cardio-respiratory fitness compared to those who accumulate 10,000 steps/day and engage in less than 30 minutes/day of MI. Future research should examine the impact of increasing MI to recommended levels on FF.

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**2536 Board #181 May 29 9:00 AM - 10:30 AM**

**The Effects Of Home Based Nutrition And Exercise Interventions In Improving Functional Capacity And Reducing Falls Among The Elderly**

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(No relationships reported)

Unintentional falls are one of the leading causes of mortality and morbidity among frail older adults. The higher incidence of falls coupled with a higher number of individuals at risk for poor nutrition and physical function among this group make it critical to explore this issue within the proposed context.

**PURPOSE:** The purpose of the study was to examine the synergistic role of functional capacity and nutrition on falls as well as the impact of combined, home-based nutrition and exercise interventions.

**MEASURES:** For the purpose of the study, 80 individuals over 65 years of age were recruited through Continuing Care and other community-based organizations. The participants were placed in one of four groups: exercise only, nutrition only, exercise and nutrition group, and no intervention comparison group. The exercise and nutrition interventions were the Home Support Exercise Program and consumptions of liquid adult nutritional supplement (Ensure ®) daily for six months. The participants' demographic information, status on health, function, nutrition, and falls were assessed at baseline and again at 6 months.

**RESULTS:** The participants' age ranged from 61-98 (ave=81). Of the participants, 83% were female, 50% lived alone, and 65% required personal assistance to leave their home. The 6 months follow-up showed improvement in improvement in functional capacity in the intervention groups.

**CONCLUSION:** Working with frail elderly providers unique opportunities and challenges.

*Supported by Nova Scotia Health Research Foundation and the Canadian Institutes of Health Research*

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## E-34 Free Communication/Poster - Respiratory

MAY 29, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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### 2537 Board #182 May 29 8:00 AM - 9:30 AM

#### Dynamics Of Muscle Deoxygenation And Hemoglobin Supply In Active And Non-active Muscles During Heavy Exercise

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(No relationships reported)

As compared to rest, during exercise, blood flow is redistributed and considerable amount of blood is supplied to active muscles. However, the dynamics of respiration and circulation at the muscle tissue level during exercise remains unclear.

**PORPOSE:** We evaluated the dynamics of muscle deoxygenation and hemoglobin supply to active and inactive muscles during repeated bouts of heavy cycling exercise by using near-infrared spectroscopy (NIRS).

**METHODS:** Six healthy subjects (25.1 ± 5.2 yrs) performed 2 bouts (6 min each) of cycling exercise at 80% peak of the pulmonary oxygen uptake; the 2 bouts were separated by 6 min of exercise at 10 W. The rate of gas exchange and heart rate were measured throughout the experiment. Further, oxyhemoglobin and deoxyhemoglobin concentrations ([O<sub>2</sub>Hb] and [HHb], respectively) in the vastus lateralis muscles (VLMs) or the flexor digitorum superficialis muscles (FDSMs) were measured using NIRS.

**RESULTS:** The total hemoglobin concentration (total-[Hb]) in the VLMs increased exponentially after heavy exercise, while it decreased in the FDSMs and was not restored to the baseline. The baseline total-[Hb] in the second bout of heavy exercise increased as compared to that in the first bout. [HHb] showed a rapid exponential increase in the VLMs, while it showed a gradual increase in the FDSMs after starting the heavy exercise. As compared to the baseline [HHb] in the first bout, it increased in the FDSMs and dropped in the VLMs in the second bout of heavy exercise.

**CONCLUSION:** More hemoglobin was supplied to the active muscles, while its supply was reduced to the inactive muscles after heavy exercise. However, deoxyhemoglobin level increased in both the active and inactive muscles, although the dynamics were different between the 2 types of muscles. This suggested the presence of oxidative activity in the inactive muscles during heavy exercise, although there flow no increase in the blood supply.

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### 2538 Board #183 May 29 8:00 AM - 9:30 AM

#### Changes In VO<sub>2</sub> And Muscle Deoxygenation Kinetics With Training In Old And Young Adults

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(No relationships reported)

Phase II pulmonary VO<sub>2</sub> (VO<sub>2p</sub>) kinetics are slower in older (O) than in younger (Y) adults. Training results in a faster VO<sub>2p</sub> kinetics in both O and Y, however, the time-course and mechanisms underlying this faster adaptation are unknown.

**PURPOSE:** To determine the time-course and mechanisms of adaptation for phase II VO<sub>2p</sub> time constant (tVO<sub>2p</sub>) in O and Y men in response to a 12-week endurance training program.

**METHODS:** VO<sub>2p</sub> and muscle deoxygenation kinetics were examined during step transitions from 20 W to moderate-intensity cycling (90% of estimated lactate threshold) in 8 O (68 (7) yr; mean (±SD)) and 8 Y (23 (5) yr) men pre-training, and at 3, 6, 9, and 12 weeks of training. VO<sub>2p</sub> was measured breath-by-breath using a volume turbine and a mass spectrometer. Changes in deoxygenated-hemoglobin concentration ([HHb]) of the vastus lateralis muscle were measured by near-infrared spectroscopy. VO<sub>2p</sub> and [HHb] were modeled with a mono-exponential using non-linear regression. Training was performed on a cycle-ergometer three times per week for 45 min at ~70% of VO<sub>2peak</sub>; training intensity was adjusted at 3 week intervals to reflect changes in fitness level.

**RESULTS:** Pre-training tVO<sub>2p</sub> was greater (p<0.05) in O (43 (11) s) than Y (34 (8) s). The tVO<sub>2p</sub> decreased (p<0.05) by 3 weeks training in both O (35 (9) s) and Y (22 (8) s) with no further changes seen with continued training: tVO<sub>2p</sub> at 12 weeks was 32 (7) s (O) and 20 (7) s (Y). Pre-training, [HHb] adaptation (MRT=TD+t) was faster than tVO<sub>2p</sub> in both O and Y, which resulted in the [HHb]/VO<sub>2</sub> displaying a transient "overshoot" relative to the subsequent steady state level. After 3 weeks training the [HHb]/VO<sub>2</sub> "overshoot" was attenuated in both O and Y. With further training, the "overshoot" persisted in O but was eliminated in Y.

**CONCLUSION:** The training-induced speeding of VO<sub>2p</sub> kinetics in O and Y at 3 weeks of training (i.e., reduced tVO<sub>2p</sub>) appeared to be the result of an improved (microvascular) blood flow distribution (as represented by a lower [HHb]/VO<sub>2</sub>). The continued "overshoot" in the [HHb]/VO<sub>2</sub> in O, but not Y, may reflect a reduced vasodilatory responsiveness that may limit muscle blood flow distribution (and O<sub>2</sub> delivery) at exercise onset and thus limit further speeding of VO<sub>2</sub> in O.

Supported by: CIHR, NSERC, Standard Life Assurance Company of Canada.

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### 2539 Board #184 May 29 8:00 AM - 9:30 AM

#### Severity Of Expiratory Muscle Fatigue Is Greater After Whole-body Exercise Versus Maximal Voluntary Hyperpnea

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(No relationships reported)

The severity of diaphragm fatigue is greater after exhaustive whole-body exercise compared to maximal voluntary isocapnic hyperpnea (VIH) during which diaphragm pressure is in excess of that generated during exercise; whether this occurs in the expiratory muscles is unknown.

**PURPOSE:** To compare the severity of expiratory muscle fatigue in response to high-intensity whole-body exercise and VIH.

**METHODS:** Five healthy male subjects participated in the study [mean ± SD peak oxygen uptake (V<sub>O2peak</sub>) = 47.6 ± 2.3 ml·kg<sup>-1</sup>·min<sup>-1</sup>]. On separate occasions, the subjects cycled at >90% V<sub>O2peak</sub> to the limit of tolerance (11.4 ± 2.1 min) and performed 2 min of VIH. Expiratory muscle fatigue was assessed following both conditions by measuring the reduction from baseline of the magnetically evoked gastric pressure (P<sub>ga</sub>) response to stimuli at 1, 5, 10, 15, 20 and 25 Hz.

**RESULTS:** At all frequencies of stimulation, P<sub>ga</sub> was lower than baseline immediately after whole-body exercise and VIH [-25 ± 6% and -17 ± 4%, respectively (mean for all frequencies); P < 0.01]. The severity of expiratory muscle fatigue was greater after exercise versus VIH (P = 0.041). Maximum ventilation during exercise (153 ± 23 l·min<sup>-1</sup>) was lower (P < 0.05) than ventilation during the first and the last 10 s of VIH (198 ± 22 and 156 ± 15 l·min<sup>-1</sup>, respectively). The product of the tidal integral of gastric pressure and breathing frequency (P<sub>ga</sub> × f<sub>R</sub>) was lower (P < 0.01) during the first and last 10 breaths of exercise (452 ± 104 and 525 ± 96 cmH<sub>2</sub>O·s·min<sup>-1</sup>) compared to the first and last 10 breaths of VIH (1724 ± 719 and 822 ± 337 cmH<sub>2</sub>O·s·min<sup>-1</sup>). The cumulative ∫P<sub>ga</sub>, however, was not different for exercise vs. VIH (6505 ± 982 vs. 8124 ± 1051 cmH<sub>2</sub>O·s<sup>-1</sup>, P = 0.14).

**CONCLUSION:** Although the cumulative pressure output of the expiratory muscles was similar between trials, high-intensity whole-body exercise elicited a greater degree of



expiratory muscle fatigue compared with 2 min of VIH. We postulate that a greater competition for blood flow between different vascular beds during exercise compared to VIH may have accounted for the additional expiratory muscle fatigue after exercise.

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**2540 Board #185 May 29 8:00 AM - 9:30 AM**  
**Inspiratory Muscle Function In Elite Male Field Hockey Players**

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(No relationships reported)

Inspiratory Muscle Function has been studied in many sports however there are few studies that investigate the phenomenon in team based game such as Field Hockey.

**PURPOSE:** To determine whether inspiratory muscle fatigue is induced via a regulation field hockey match and what affect a 5 week inspiratory muscle training programme will have on inspiratory muscle function in elite male field hockey players.

**METHOD:** Baseline pulmonary function (FVC, FEV<sub>1.0</sub>) and maximal inspiratory pressure (MIP) were measured for all players (n=16). MIP was then measured at three separate time points (pre-game[Pre], at half-time [HT] and post-game [Post]) relating to a standard regulation league match (English National Hockey League Premier Division). The sixteen players were then split randomly into training (n=8) and placebo groups (n=8). Each group underwent a 5 week training programme, the intervention group (IMT) training consisted of 30 inspiratory efforts, twice a day at approximately 50% of MIP while the placebo group (PG) performed 60 inspiratory efforts one day at approximately 15% of MIP. The players were informed that each protocol was measuring Inspiratory Muscle function and that the two protocols were going to be compared. All players took part with full informed consent and all procedures were as accepted by the institutional ethics committee.

**RESULTS:** There was a significant drop in inspiratory muscle function, as shown by a reduce MIP when comparing the Pre results to the Post results (p<0.05) which indicates a level of fatigue occurs throughout a match. With training a 25% increase in MIP occurred for the IMT group while a there was no change in the PG. However upon re-testing there was no significant difference between the two training groups when inspiratory muscle fatigue was looked at throughout a second competitive match. **CONCLUSIONS:** An elite level male field hockey match can induce inspiratory muscle fatigue and these same players can increase their MIP with training. Many studies have looked at various forms of inspiratory muscle training in different sports however this is one of the very few studies to show that games based sports also induce inspiratory muscle fatigue.

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**2541 Board #186 May 29 8:00 AM - 9:30 AM**  
**The Influence Of Two Weeks Use Of A Respiratory Protective Device Upon Airway Function In London Cycle Couriers**

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(No relationships reported)

Exposure to the particulate matter (PM) emitted by vehicle exhausts has been linked to a range of negative health effects, including acute inflammation and decrements in lung function in people with asthma (McCreanor et al, 2007). By virtue of their proximity to traffic, the duration of exposure, and the elevated breathing demands of exercise, cycle couriers are subjected to the highest levels of exposure of any city dweller. We wished to examine whether this group exhibited any evidence of impaired of lung function due to PM by assessing the influence of 2-wk use of a respiratory protective device (RPD) that removed PM.

**PURPOSE:** To determine whether protection from PM improved lung function in cycle couriers.

**METHODS:** 7 healthy male cycle couriers with no history of asthma were assessed prior to, immediately after, and two weeks after using a RPD for 2-wk. Outcome variables included peak expiratory flow rate (PEFR), forced expiratory volume in 1 sec (FEV<sub>1</sub>), forced vital capacity (FVC), and instantaneous flow rates 1, 2 and 3 litres below total lung capacity (IFR<sub>1, 2 or 3</sub>). Individual exposure indices (amount of PM inhaled) were calculated for each participant using local PM monitoring stations, work logs, and an assumed minute ventilation of 30 l.min<sup>-1</sup>. Measurements were made on a Friday evening, immediately following the working day. Statistical comparisons were made using repeated measures ANOVA.

**RESULTS:** Average PM concentration did not exceed the WHO threshold of 50 µg.m<sup>-3</sup> at any point in the study, but did fluctuate, as did individual exposures to PM. Relative to baseline, PEFR increased significantly immediately following the intervention and decreased 2-wk later (9.27±1.92 vs. 9.72±1.93 vs. 9.14±2.16 l.sec<sup>-1</sup>, respectively; P<0.05). A similar pattern was observed for IFR<sub>1</sub> (P<0.05), and FVC (P<0.05), but there were no changes in IFR<sub>2</sub>, IFR<sub>3</sub>, or FEV<sub>1</sub>.

**CONCLUSION:** Healthy cycle couriers exhibit signs of large airway inflammation, which is diminished following a 2-wk period during which PM exposure is reduced by using a RPD.

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**2542 Board #187 May 29 8:00 AM - 9:30 AM**  
**Exhaled Nitric Oxide Is Correlated With Changes In Small And Large Airway Obstruction**

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(No relationships reported)

**PURPOSE:** Previous research has shown that pre-exercise fraction of exhaled nitric oxide (FENO) levels, a marker of airway inflammation, are elevated in people who exhibit exercise-induced bronchoconstriction (EIB). It has previously been shown that a positive relationship exists between pre-exercise FENO levels and post-exercise large airway closure as documented by changes in FEV<sub>1</sub>. Therefore, the purpose of this study was to determine if pre-exercise FENO levels demonstrated the same positive relationship with changes in FEF<sub>25-75%</sub> (indicative of small airway closure).

**METHODS:** Twelve EIB subjects, as determined by a post-EVH drop of ≥ 10% in FEV<sub>1</sub>, and 6 control (non-EIB) subjects completed 3 expiratory maneuvers in order to measure the FENO using an online measurement restricted exhaled breath protocol (NOA 280i, Sievers Instruments Boulder, CO). Subsequently subjects underwent a eucapnic voluntary hyperventilation (EVH) challenge. The EVH challenge required each subject to hyperventilate for 6 min at a ventilation calculated as 30 x the volume of baseline FEV<sub>1</sub>, while breathing a gas mixture containing 5% CO<sub>2</sub>, 21% O<sub>2</sub>, and balance N<sub>2</sub>. Pulmonary function was measured pre- and post-EVH at 5, 10, 15, and 20 min.

**RESULTS:** Significant (P<0.05) positive correlations were observed between pre-EVH FENO and post-EVH drops in FEV<sub>1</sub> (r=0.730, P=0.007) and FEF<sub>25-75%</sub> (r=0.798, P=0.002). Pre-EVH FENO levels were also significantly (P<0.05) higher in subjects who exhibited EIB (41.0±25.4ppb) as compared to control subjects (17.8±10.3ppb).

**CONCLUSION:** This study has demonstrated that FENO is associated with drops in post-EVH FEV<sub>1</sub> and FEF<sub>25-75%</sub>, indicating that FENO is correlated with both changes in the large and small airways. Since FENO is a marker of airway inflammation, these data indicate that subjects who exhibit EIB have underlying inflammation at rest. The data also indicate that subjects with higher levels of inflammation at rest may have a greater degree of airway hyperresponsiveness when challenged. Furthermore, these data indicate that exhaled nitric oxide may be a useful tool in the prediction of EIB and of the magnitude of both large and small airway changes as a result of exercise or other bronchial hyperresponsiveness challenges.

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**2543 Board #188 May 29 8:00 AM - 9:30 AM**  
**Exhaled Breath Condensate Ph Is Correlated With Post-exercise Small Airway Obstruction**



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(No relationships reported)

**PURPOSE:** It has been shown that individuals with asthma and exercise-induced bronchoconstriction (EIB) exhibit lower exhaled breath condensate (EBC) pH values than healthy individuals. The purpose of this study was to determine if EBC pH was correlated with the degree of airway obstruction following a bronchial hyperresponsiveness challenge.

**METHODS:** Twenty three subjects [15 asthmatics subjects with EIB, as determined by a post-EVH drop of  $\geq 10\%$  in  $FEV_1$ ; 8 control subjects (no-asthma/no EIB)] were asked to breathe normally at rest for 10 min wearing a nose clip while their exhaled breath was collected (EcoScreen, Jager, Hoechberg, Germany). The pH of the condensate was measured immediately following collection. Subsequently subjects underwent a eucapnic voluntary hyperventilation (EVH) challenge. The EVH challenge required each subject to hyperventilate for 6 min at a ventilation calculated as  $30 \times$  the volume of baseline  $FEV_1$ , while breathing a gas mixture containing 5%  $CO_2$ , 21%  $O_2$ , and balance  $N_2$ . Pulmonary function was measured pre-EVH and post-EVH at 5, 10, 15, and 20 min.

**RESULTS:** The EBC pH was significantly ( $p < 0.05$ ) lower in the subjects that exhibited EIB ( $6.83 \pm 0.43$ ) as compared to those who did not ( $7.37 \pm 0.32$ ). The EBC pH was not significantly correlated to the post-EVH drop in  $FEV_1$  ( $r = 0.048$ ,  $p = 0.827$ ). However, EBC pH was found to be significantly inversely correlated to post challenge drop in  $FEF_{25-75}$  ( $r = 0.579$ ,  $p = 0.004$ ).

**CONCLUSION:** Exhaled breath condensate pH was significantly lower in subjects who exhibit EIB than in healthy control individuals, which may indicate acidification of the airways in individuals with airway hyperresponsiveness. The pH was also inversely related with the post-EVH drop in  $FEF_{25-75}$  indicating that the lower EBC pH in the airways may be indicative of heightened reactivity in the small airways.

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**2544 Board #189 May 29 8:00 AM - 9:30 AM**  
**Comparative And Synergistic Effects Of Caffeine And Albuterol On The Severity Of Exercise-induced Bronchoconstriction.**

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**PURPOSE:** Previous research has demonstrated a beneficial effect of caffeine on preventing exercise-induced bronchoconstriction (EIB). Therefore, the main aim of this study was to extend previous published findings that have demonstrated a beneficial effect of caffeine on EIB by evaluating the comparative and synergistic effects of caffeine and albuterol ( $\beta_2$ -agonist) on the severity of EIB.

**METHODS:** Ten asthmatic subjects with EIB participated in a randomized, double-blind double-dummy crossover study. One hour before an exercise challenge, each subject was given 0, 3, 6, or 9mg/kg of caffeine or placebo mixed in a flavored sugar drink. Fifteen minutes before the exercise bout, an inhaler containing either albuterol (180 $\mu$ g) or placebo was administered to each subject. Pulmonary function tests were conducted pre- and post-exercise (1, 5, 10, 15 and 30 min). The exercise challenge comprised of each subject running on a motorized treadmill to volitional exhaustion while breathing dry air from a gas tank.

**RESULTS:** Caffeine significantly reduced ( $P < 0.05$ ) the mean maximum % fall in post-exercise  $FEV_1$  at 6 and 9mg/kg ( $-9.0 \pm 9.2\%$  and  $-6.8 \pm 6.5\%$ ) as compared to the double-dummy (placebo;  $-14.3 \pm 11.1\%$ ) and baseline ( $-18.4 \pm 7.2\%$ ). There was no significant difference ( $P > 0.05$ ) in the post-exercise % fall in  $FEV_1$  between albuterol (without caffeine) ( $-4.0 \pm 5.2\%$ ) and the 9mg/kg dose of caffeine ( $-6.8 \pm 6.5\%$ ). Interestingly, there was no significant difference ( $P > 0.05$ ) in the post-exercise % fall in  $FEV_1$  between albuterol (without caffeine) ( $-4.0 \pm 5.2\%$ ) and albuterol with 3, 6 or 9mg/kg of caffeine ( $-4.4 \pm 3.8$ ,  $-6.8 \pm 5.6$ ,  $-4.4 \pm 6.0\%$  respectively). Similar changes noted for the post-exercise % fall in  $FEV_1$  were also observed for FVC,  $FEF_{25-75}$  and PEF. In addition, it was determined that a dose-response relationship existed between the %fall in post-exercise  $FEV_1$  and caffeine dose administered (0, 3, 6 and 9 mg/kg) for all dependent variables.

**DISCUSSION:** These data indicate that moderate (6 mg/kg) to high doses (9 mg/kg) of caffeine can reduce the severity of EIB in a dose-response manner. These data also indicate that no significant difference exists between high doses of caffeine and albuterol which suggests that caffeine may represent an alternative to albuterol reducing the severity of EIB.

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**2545 Board #190 May 29 8:00 AM - 9:30 AM**  
**Concordance Of Two Methods For Airway Hyperresponsiveness In Obese Adolescents**

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**PURPOSE:** To evaluate the concordance of two methods airway hyperresponsiveness of the saline hypertonic solution and exercise in obese adolescents.

**METHODS:** This study was realized with 16 obese individuals (mean age  $12.93 \pm 2.04$ ), 10 female (mean age  $13.30 \pm 2.11$ ) and 6 male (mean age  $12.33 \pm 1.96$ ). The pulmonary function was measured for spirometer (Spirosift 3000) and were evaluated the forced expiratory volume ( $FEV_1$ ) in baseline and during the tests. Inhalation of 4.5% hypertonic saline was obtained by large volume ultrasonic nebulizer (DeVilbiss), continuously through 0.5, 1, 2, 4, 8 minutes until a  $FEV_1$  fall of  $> 15\%$  in relation to baseline. The physical exercise test was realized as American Thoracic Society protocol and the  $FEV_1$  was measured in 3, 5, 10, 15 and 30 minutes after the exercise, considered the bronchial o exercise the reduction of  $> 15\%$  in relation to baseline. The statistical analysis used was Shapiro-Wilk's test for the normality of data, index of concordance of kappa, Bland-Altman plots and intraclass correlation ( $P < 0.05$ ).

**RESULTS:** Normality of data was confirmed ( $P = 0.606$ ). The provocation test with hypertonic saline was positive in 12.5% of subjects and the exercise test was positive in 6.25% of the group, with a high concordance between the methods ( $k = 0.87$ ;  $P = 0.007$ ). The intraclass correlation coefficient was strong ( $r = 0.883$ ;  $P < 0.001$ ). Bland-Altman graphs confirmed the absence of bias in the intermethod comparison.

**CONCLUSION:** Our data supported that the two methods for the detection of airway hyperresponsiveness probably have the same trigger point, that is to say, both promoted the bronchial hyperosmolarity and therefore possess a degree of agreement.

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**2546 Board #191 May 29 8:00 AM - 9:30 AM**  
**Breathe Right® External Nasal Dilator Strips As An Ergogenic Aid To Exercise**

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**PURPOSE:** Having the ability to breathe easily through the nose is an important part of exercising. The nose effectively warms and humidifies incoming air to better suit the bodies needs. It is known that having difficulty breathing through the nose can negatively affect exercise performance.

**METHODS:** The purpose of this study is to investigate the effects of the Breathe Right® external nasal dilator strip on exercise performance at 80% of an individual's  $VO_2$

max. Eighteen people participated in the study. Subjects signed an informed consent, PAR-Q, additional questionnaire, and rated their ease of breathing through their nose on a 1 to 10 scale prior to testing. Testing was performed in the Human Performance Laboratory at the University of Louisiana at Monroe. Subjects VO<sub>2</sub> max was measured using open spirometry on a treadmill ergometer. On two separate occasions participants returned to the laboratory for a treadmill run at 80% of the subjects predetermined VO<sub>2</sub> max; once with the nasal dilator strip and once with a placebo. Heart rate (HR), Borg's Rate of Perceived Exertion (RPE), and time to exhaustion were measured. Statistical analysis was conducted using SPSS 14.0. Significance level was preset at p<.05.

**RESULTS:** A significant difference was found in the time to exhaustion between runs with the Breathe Right® strip vs. runs with the placebo strip. No significant difference in HR or RPE was found between runs with the Breathe Right® strip vs. runs with the placebo strip.

**CONCLUSIONS:** Prior data shows mixed results when testing at a high percentage of VO<sub>2</sub> max. This study provides further support that Breath Right® strips may have an ergogenic effect on aerobic exercise performance.

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**2547 Board #192 May 29 8:00 AM - 9:30 AM**  
**Increased Ventilatory Response To Submaximal Exercise After 5 Weeks Of Head-down Bed Rest**

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(No relationships reported)

Previously, ventilation (V<sup>E</sup>) during incremental exercise was found to be elevated after 7 days of horizontal bed rest (FASEB J 1991, 5:A1477). We investigated the effects of 5 weeks of head-down bed rest (HDBR) on the exercise ventilatory response (EVR), defined as the slope of the relationship between V<sup>E</sup> and CO<sub>2</sub> production (VCO<sub>2</sub>), to submaximal constant load exercise. To further explore the effects of HDBR, we examined short-term modulation (STM) of the EVR before and after HDBR. STM is defined as a neural mechanism where EVR is augmented in the presence of increased respiratory dead space (DS; J Appl Physiol 2008, 104: 244-252).

**PURPOSE:** To examine the effects of 5 weeks of HDBR on EVR and the capacity for STM.

**METHODS:** 25 subjects (3 female) spent 5 weeks in HDBR. As part of a larger study, subjects were assigned to 3 groups, 2 of which undertook exercise training during HDBR (semi-recumbent rowing 3 days/wk and horizontal strength training 2 days/wk) while the third remained inactive. The EVR was measured at rest and during upright cycle exercise (30W) without (Control) and with 400ml added external DS, before and after HDBR. The main effects of group and HDBR were analyzed with a two-way repeated measures ANOVA.

**RESULTS:** The main effect of group was not significant for any of the variables tested. The physical characteristics for the 25 subjects were: age 33±11 yr, height 175±10 cm, weight 74±12 kg and BMI 24±2 kg/m<sup>2</sup>. EVR both with and without added DS was elevated post HDBR (Control: 27.9±4.5 and 30.3±5.6; DS: 31.4±7.2 and 36.0±8.1; pre and post HDBR, respectively; p<0.05). EVR was significantly augmented with DS vs. Control both pre and post (p<0.05), indicating STM of the EVR, and this capacity to augment the EVR was unaffected by HDBR. The increase in EVR was due to a significant decrease in VCO<sub>2</sub> (Control: 0.79±0.15 and 0.73±0.11; DS: 0.75±0.11 and 0.70±0.10 l/min; at 30W pre and post HDBR, respectively; p<0.05), with no affect of HDBR on V<sup>E</sup> during exercise.

**CONCLUSION:** HDBR appears to alter the EVR mainly by a reduction in VCO<sub>2</sub>, which we speculate might be associated with a change in substrate metabolism. However, HDBR does not appear to affect the capacity for STM to augment the EVR with added DS.

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**2548 Board #193 May 29 8:00 AM - 9:30 AM**  
**Pulmonary Ventilation During Incremental Ramp Exercise Under Acute Acetazolamide Administration**

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(No relationships reported)

The relative contribution of the chemoreflex drive to the exercise hyperpnoea is largely uncertain. Carbon dioxide rebreathing protocols clearly demonstrate chemoreflex driven respiration resulting from alterations in P<sub>a</sub>CO<sub>2</sub>, however, the stimuli for exercise ventilation remain controversial, particularly as arterial CO<sub>2</sub> content is well constrained during exercise.

**PURPOSE:** This study aimed to examine ventilation during incremental ramp exercise under acute acetazolamide (Acz) administration, which is known to result in impaired CO<sub>2</sub> elimination via inhibition of carbonic anhydrase.

**METHODS:** Nine healthy volunteers (mean ± SD age = 28 ± 7 yr; height = 183 ± 13 cm; mass = 83.6 ± 19.1 kg; VO<sub>2peak</sub> 4.48 ± 0.74 l min<sup>-1</sup>) completed two incremental ramp exercise tests (8 W min<sup>-1</sup>) at sea level (~755 mmHg) on an electromagnetically-braked cycle ergometer after either placebo or Acz administration (500 mg orally, 2.5 hr prior to exercise). Arterialized capillary blood samples (P<sub>a</sub>O<sub>2</sub> > 70 mmHg) were taken at rest and every 4 min during the incremental ramp protocol for blood gas, [La<sup>-</sup>], and pH measurements. Pulmonary ventilation (V<sub>E</sub>, V<sub>T</sub>, f<sub>R</sub>) was measured breath-by-breath via hot-wire anemometer.

**RESULTS:** Peak work rate was lower (291 vs. 300 W; CI<sub>Diff</sub> 3, 16; P < 0.05) in the Acz trial as compared to placebo, however, no differences were observed for VO<sub>2peak</sub> (CI<sub>Diff</sub> -0.17, 0.43 l min<sup>-1</sup>; P > 0.340). At exhaustion, P<sub>a</sub>CO<sub>2</sub> was higher during the Acz trial, as compared with placebo (33.2 vs. 27.4 mmHg; CI<sub>Diff</sub> 2.8, 8.8; P < 0.05). Blood pH was similar at exhaustion, but lower in the Acz trial at baseline and all other work rates (n=7; F[1, 12] = 37.662; P < 0.05; h<sup>2</sup> = 0.758). No interactions (work rate x trial) were observed for any of the ventilatory variables (V<sub>E</sub>: F[5, 80] = 1.113; P > 0.360; h<sup>2</sup> = 0.065; V<sub>T</sub>: F[2.591, 41.463] = 0.597; P > 0.597; h<sup>2</sup> = 0.036; f<sub>R</sub>: F[2.823, 45.168] = 0.536; P > 0.649; h<sup>2</sup> = 0.032). Despite the substantially smaller reduction in P<sub>a</sub>CO<sub>2</sub> and lower pH during the Acz trial, ventilation was similar at all work rates between the Acz and placebo trial (P > 0.05).

**CONCLUSION:** These data indicated that the modulation in P<sub>a</sub>CO<sub>2</sub> and pH from an acute dose of Acz did not affect ventilation during maximal graded exercise at sea level.

This investigation was Supported by the Frederick W. Kasch Endowment for Graduate Study.

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**2549 Board #194 May 29 8:00 AM - 9:30 AM**  
**Cerebral Oxygenation During Incremental Ramp Exercise Under Acute Acetazolamide Administration**

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(No relationships reported)

Recently, near-infrared spectroscopy (NIRS) has been employed for monitoring cerebral oxygenation during exhaustive and maximal exercise. While the implications of cortex oxygenation/perfusion for exercise tolerance are unclear, it is likely that the changes seen in the NIRS signal represent the balance of oxygen consumption and availability, the latter modulated by local vascular tone and perfusion pressure. It has been suggested that hypocapnic hyperventilation and cerebrovascular reactivity are probable mechanisms for cerebral deoxygenation during maximal exercise.

**PURPOSE:** The aim of this study was to examine cerebral oxygenation and perfusion under acute acetazolamide (Acz) administration. Acute Acz therapy has been shown to impair CO<sub>2</sub> elimination via inhibition of carbonic anhydrase and to reduce the severity of hypocapnia during graded exercise.

**METHODS:** Nine healthy volunteers (28 ± 7 yr; VO<sub>2peak</sub> 4.48 ± 0.74 l min<sup>-1</sup>) completed two incremental ramp exercise tests (8 W min<sup>-1</sup>) at sea level (~755 mmHg) on an electromagnetically-braked cycle ergometer after either placebo or Acz administration (500 mg orally, 2.5 hr prior to exercise). Arterialized capillary blood samples (P<sub>a</sub>O<sub>2</sub> > 70 mm Hg) were taken at rest and every 4 min during exercise for blood gas measurements. Cerebral oxygenation was measured using NIRS with the emission/detection optodes

placed over the left prefrontal cortex.

**RESULTS:** At exhaustion,  $P_aCO_2$  was elevated during the Acz trial, resulting in relative isocapnia throughout exercise, as compared with placebo (33.2 vs. 27.4 mmHg;  $CI_{diff}$  2.8, 8.8;  $P < 0.05$ ). No interactions (work rate  $\times$  trial) were present for the NIRS signals ( $DO_2Hb$ :  $F[1.383, 22.126] = 0.062$ ;  $P > 0.878$ ;  $h^2 = 0.004$ ;  $DHHb$ :  $F[1.296, 20.736] = 0.476$ ;  $P > 0.546$ ;  $h^2 = 0.029$ ;  $DTHb$ :  $F[1.632, 26.110] = 0.100$ ;  $P > 0.866$ ;  $h^2 = 0.006$ ). Despite the elevated  $P_aCO_2$  in the Acz trial, no differences were observed for  $DO_2Hb$ ,  $DHHb$ , or  $DTHb$  between trials ( $P > 0.05$ ).

**CONCLUSION:** These data indicated that cerebrovascular reactivity resulting from a reduction in  $P_aCO_2$  did not, alone, account for the increase in cerebral deoxygenation or the blunted perfusion response occurring near exhaustion during incremental exercise.

*This investigation was Supported by the Frederick W. Kasch Endowment for Graduate Study.*

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**2550 Board #195 May 29 8:00 AM - 9:30 AM**  
**Exercise Characteristics Of Patients With Exercise-induced Arteriovenous Fistula In Pulmonary Circulation And Unexplained Exertional Dyspnea.**

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Dynamic appearance of arteriovenous fistula in pulmonary circulation (AVF) during exercise can be diagnosed with an agitated saline microbubble injection study of supine bicycle exercise echocardiography. Using this technique, we have reported that AVF can be observed in one in five outpatients who presented with unexplained exertional dyspnea (UED). However, an effect of AVF on exercise performance in patients with UED has been poorly understood.

**PURPOSE:** To determine exercise characteristics to patients with AVF who presented with UED.

**METHODS:** Forty-one outpatients (age;  $53 \pm 13$ , 35 females) who underwent supine bicycle exercise echocardiography to evaluate a cause of UED were analyzed to compare exercise characteristics in the presence or absence of AVF in this population. Symptom-limited 15 watts 3-minute incremental protocol was used. The delayed microbubble appearance in the left atrium at more than 5 beats after the right atrial opacification was defined as AVF. All exercise data were collected non-invasively.

**RESULTS:** Ten patients (24%) were diagnosed to have exercise-induced AVF. Both patients with AVF and without AVF showed similar peak exercise heart rate, systolic blood pressure, and rate-pressure product ( $136 \pm 16$  vs.  $134 \pm 25$  bpm,  $167 \pm 36$  vs.  $170 \pm 30$  mmHg,  $22.4 \pm 4.2$  vs.  $22.9 \pm 6.3$  bpm-mmHg  $\cdot 10^3$  respectively,  $P = N.S.$  for all, data are mean  $\pm$  SD). Estimated peak systolic pulmonary artery pressure measured with echocardiography at peak exercise was also comparable between two groups ( $54 \pm 15$  vs.  $57 \pm 13$  mmHg). However, peak exercise oxygen saturation tended to be lower in patients with AVF compared with those without AVF ( $95.6 \pm 2.8$  vs.  $97.2 \pm 2.8\%$ ,  $P = 0.12$ ) and only patients with AVF showed a significant drop of oxygen saturation from baseline ( $97.2 \pm 2.5\%$ ,  $P < 0.05$ ).

**CONCLUSION:** Exercise-induced AVF may have a physiological significance in patients with UED by lowering oxygen saturation at exercise. Further investigation to characterize exercise-induced AVF is warranted.

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**2551 Board #196 May 29 8:00 AM - 9:30 AM**  
**Altered GABAergic Modulation Of Ventilatory Response To Hypoxia In Diabetic Rats**

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**PURPOSE:** Diabetes mellitus (DM) patients exhibit blunted ventilatory responses to acute hypoxia whereas the underlying mechanism is unknown. The purpose of the study is to determine whether altered gamma-aminobutyric acid (GABA)ergic mechanisms acting in GABAA receptors contribute to the abnormal ventilatory response to hypoxia in diabetes mellitus.

**METHODS:** Sixteen male Wistar rats at 8 weeks of age were randomly divided into control group (non-DM), streptozotocin-induced DM (65 mg/kg i.v., DM). Eight non-DM Wistar rats and 8 Type 1-like diabetic rats were studied at 12 weeks of age. Respiratory function in conscious rats was assessed using a whole body plethysmograph (Buxco System) where the rat body was not restricted. Ventilation (VE), tidal volume (VT), and breathing frequency (f) during room air breathing and in response to acute hypoxic (10%  $O_2$ ), sustained (30 min) hypoxic (10%  $O_2$ ) challenges were measured on two separate occasions following the randomized blinded administration of equal volumes of DMSO (vehicle), bicuculline (0.5 mg/kg, GABAA receptor antagonist).

**RESULTS:** Ventilatory response to acute (not sustained) hypoxia in DM group was significantly ( $P < 0.05$ ) blunted compared to non-DM group. Bicuculline administration in non-DM Wistar rats had no effect on ventilation either during room air breathing, or acute and sustained exposure to hypoxia. In contrast, bicuculline administration in DM group significantly increased ventilatory response to acute hypoxia. However, bicuculline administration in DM Wistar rats had no effect on ventilation either during room air breathing or sustained hypoxia.

**CONCLUSIONS:** Blunted ventilatory responses to acute hypoxia in diabetes mellitus appeared to be suppressed by endogenous GABA by acting specifically on GABAA receptors. Altered GABAergic modulation in diabetes might potentially impact acute hypoxia related ventilatory compensation.

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**2552 Board #197 May 29 8:00 AM - 9:30 AM**  
**The Correlation Between Triaxial Accelerometer And Indirect Calorimetry Measurements During Forehand Table-tennis Trial**

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(No relationships reported)

Triaxial accelerometer was often used to measure energy expenditure in whole body and lower limbs activities, including running, walking and stepping exercise. However, the application of triaxial accelerometer in high percentage upper limbs exercise, such as table tennis, badminton, and volleyball was not so clear.

**PURPOSE:** The purpose of this study was to examine the validity of RT3 triaxial accelerometer in assessing energy expenditure (EE) during table-tennis exercise in recreational athletes.

**METHODS:** Ten recreational athletes healthy male (mean age  $23.19 \pm 3.11$  years, height  $173.85 \pm 3.51$  cm, weight  $69.65 \pm 4.84$  kg) participated in this study. The triaxial accelerometer (RT3, Stayhealthy, Inc.) and indirect calorimetry (SensorMedics, Vmax 29) were used simultaneously to measure the energy expenditure and oxygen consumption during exercise. Four accelerometers were attached at lower back (L3), dominant side of wrist, elbow, and shoulder. All accelerometers were attached without limiting the movement process. Each subject was required to strike forehand successively for 5 minutes at 75 balls per minutes, determined by table tennis robot (SMARTPONG). The average data of RT3 and oxygen consumption was calculated between the second to fourth minutes of each trial. Pearson correlation coefficient was used to examine the correlation between the RT3 and indirect calorimetry measurements.

**RESULTS:** The lower back RT3 energy consumption and vector magnitude were both highly correlated with indirect calorimetry ( $r = .843$ ,  $p < 0.01$ ;  $r = .832$ ,  $p < 0.01$ ).

Vector magnitude of RT3 at elbow and wrist was significantly correlated with indirect calorimetry ( $r = .413$ ;  $r = .412$ ,  $p < 0.05$ ). No significant correlation was found between RT3 at shoulder (energy consumption, vector magnitude) and oxygen consumption.

**CONCLUSIONS:** RT3 triaxial accelerometer attached at lower back is a valid way to measure the energy expenditure during continuous table-tennis forehand trial. The RT3 attached at upper limb may over estimate the energy consumption during upper limb exercise without any correction of the internal formula.

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**2553 Board #198 May 29 8:00 AM - 9:30 AM**

**Cross Validation And Reliability Of The 20mst For Predicting Of Cardiorespiratory Fitness In Korean**

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**PURPOSE:** Cardiorespiratory fitness is related to an individual's ability to use the large muscles for prolonged periods of dynamic, moderate-to-high intensity exercise. Level of cardiorespiratory fitness is dependent on the condition of the respiratory, cardiovascular and skeletal muscle systems. Analysis of cardiorespiratory fitness is important because of its relationship to health and wellness. Poor cardiorespiratory fitness is related to a marked increase in risk of premature death from all causes. There are many kinds of method to measure cardiorespiratory fitness.

The purpose of this study is to develop an equation to predict a cardiorespiratory fitness of Korean and to evaluate cross validation and reliability of 20MST.

**METHODS:** One hundred-sixteen male volunteers participated in this study (develop equation group,  $n=71$ : Age= $22.04 \pm 2.91$  year, Height= $174.6 \pm 5.25$  cm, Weight= $73.71 \pm 10.73$  kg; cross validation group,  $n=45$ : Age= $22.2 \pm 2.79$  year, Height= $174.34 \pm 5.25$  cm, Weight= $73.08 \pm 11.83$  kg; retest group,  $n=90$ : Age= $22.11 \pm 2.18$  year, Height= $174.54 \pm 5.16$  cm, Weight= $72.06 \pm 9.56$  kg). The peak oxygen uptake (VO<sub>2</sub>peak) was measured by graded exercise test (Bruce protocol) and 20M-Shuttle Run Test was administered on a nonslip surface indoor track in accordance with the procedures described by leger et al (1988), in which running velocity was increased by 0.5 km/hr after every 1-minute stage.

**RESULTS:** An equation was developed through 20M-shuttle run test influenced by running speed and BMI. It was  $Y = -32.046 + (7.086 \times \text{speed}) + (-.490 \times \text{BMI})$  that its R-square was .652. Cross validity using forty-five targets was R-square .618. There was no significant difference between measured and predicted values ( $t = -1.353$   $r = .794$ ,  $p = .179$ ). The relationship between measured and predicted VO<sub>2</sub>peak was  $r = .87$  with an SEE of 1.77 counts.

**CONCLUSIONS:** In conclusion for this research a validation and reliability, 20MST was developed and can be used to evaluate cardiorespiratory fitness for Korean.

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**2554 Board #199 May 29 8:00 AM - 9:30 AM**

**Effect Of Breath Retention On The Development Of Swimming Skills In Preschool Children**

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(No relationships reported)

Little research has examined breathing strategies for preschool aged swimmers. The standard Canadian learn-to-swim program focuses on exhaling while performing swimming skills. In pre-school aged children, the attention demands of exhalation combined with the attention demands of coordinating the arms, legs and body position to execute a swimming skill may exceed a preschooler's attentional capacity. Alternate private programs teach children to hold their breath for the first number of skill levels guided by the belief that breath retention makes children more buoyant and feel safer in the water atmosphere.

**PURPOSE:** To examine the effect of exhalation and breath retention breathing strategies on the development of swimming skills and perceived comfort in the water in preschool aged children.

**METHODS:** Skill development and overall comfort in the water were examined in four level 2 swim classes ( $N = 16$ ,  $M = 4.8$  years,  $SD = 1.52$  years); two classes were randomly assigned to be taught to exhale while performing front glides, back glides, front floats, and back floats, and two classes were taught to hold their breath. Each skill was rated by three swim instructors on the first and last week of an eight week program; the Modified Erbaugh Rating Scale was used to rate the front glide, rating scales were developed for the front float, back float and back glide. Inter-rater reliability for all but the pretest back glide (0.68) ranged between 0.89 and 1.00. Change scores from pretest to posttest were compared across groups by independent t-tests.

**RESULTS:** The classes utilizing the breath retention strategy showed significantly greater improvement for the front ( $p < .01$ ) and back ( $p = .03$ ) glides and back float ( $p = .05$ ), and a trend towards greater improvement for the front float ( $p = .07$ ). The groups did not differ substantially on overall comfort in the water.

**CONCLUSIONS:** The results show that there is an overall increase in skill development when preschool children were taught to hold their breath rather than exhaling while performing front floats, back floats, front glides and back glides. Thus, the coordination components of the skills should be learned before the skills are made more complex by adding the breathing components.

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**E-35 Free Communication/Poster - Sports Biomechanics I**

MAY 29, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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**2555 Board #200 May 29 9:00 AM - 10:30 AM**

**Little League Elbow Related Factors In Throwing Pattern And Physical Characteristics**

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(No relationships reported)

Little league elbow related factors have not been thoroughly explored.

**PURPOSE:** To compare the differences in throwing kinematics and physical characteristics between youth baseball players with and without medial elbow pain (MEP).

**METHODS:** Fifteen players with previous MEP and 15 healthy players were matched by age, height, and weight. Practice hours per week and years of playing organized baseball games were similar between the two groups. Throwing kinematics were recorded by an electromagnetic motion analysis system. Ball speed was recorded with a sports radar gun. Isometric strength of trunk, hip, and shoulder was measured using a torque sensor attached to a custom device. Elbow, shoulder, and hip flexibility were measured with a goniometer and a tape measure. Single leg standing balance was assessed with a force plate. Paired-t tests were performed to compare the differences between the two groups.



**RESULTS:** MEP group demonstrated less elbow flexion angle at maximum shoulder external rotation ( $91.2 \pm 17.0^\circ$  vs.  $101.3 \pm 10.4^\circ$ ,  $p=0.004$ ), more trunk lateral tilt to the non-dominant side at ball release ( $29.3 \pm 9.9^\circ$  vs.  $23.4 \pm 9.0^\circ$ ,  $p=0.035$ ), greater maximum upper torso rotational velocity ( $1065.8 \pm 66.8$  vs.  $931.1 \pm 104.2^\circ/s$ ,  $p=0.0002$ ), greater maximum pelvic rotational velocity ( $727.7 \pm 88.2$  vs.  $622.1 \pm 84.2^\circ/s$ ,  $p=0.001$ ), and greater ball speed ( $89.2 \pm 9.7$  vs.  $82.7 \pm 9.7$  km/hr,  $p=0.006$ ) compared to the healthy group. MEP group had less PROM in shoulder external rotation of the throwing arm compared to the healthy group ( $109.3 \pm 6.9^\circ$  vs.  $115.9 \pm 9.8^\circ$ ,  $p=0.01$ ). In the MEP group, total elbow ROM ( $146.7 \pm 6.7^\circ$  vs.  $150.4 \pm 6.4^\circ$ ,  $p=0.047$ ) and hip flexibility measured from the lateral epicondyle of knee to the table during Patrick test ( $11.2 \pm 2.2$  vs.  $10.3 \pm 1.3$  cm,  $p=0.048$ ) were less in the non-dominant side when compared to their dominant side. No significant differences were found in isometric muscle strength and single leg standing balance between the two groups.

**CONCLUSION:** Differences in throwing kinematics and flexibility were found between youth baseball players with and without previous MEP. Clinicians and baseball coaches should pay attention to these factors in addition to age, height, weight, and overuse that were mentioned to be related to youth players' injury rate for protecting them.

**2556 Board #201 May 29 9:00 AM - 10:30 AM**  
**Comparison Of Swim Starts Using Side Handle And Front Handle Grip Techniques**

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FINA rule FR 2.7 provides for, but does not require, the inclusion of starting blocks equipped with side grip handles for the hands. These side handles were available at the 2003, 2005, and 2007 World Championships but not at the 2004 and 2008 Olympic Games. While a number of studies have documented effects of various starting techniques, none has examined the efficacy of a side handle grip technique.

**PURPOSE:** To quantify differences in swim start performances using side handle and front handle grip techniques.

**METHODS:** A custom-built, instrumented starting block system was designed using two force plates and two 3D force transducers attached to handles which were configurable to allow front grip and side grip starting techniques. Thirty male and 18 female swimmers participating in USA Swimming junior elite and national select camps completed three maximum effort starts each using front and side handle grip techniques. Force data were collected at 600 Hz and used to quantify parameters related to starting performance.

**RESULTS:** Two-way MANOVA with repeated measures on grip revealed a number of significant differences between gender and starting technique.

	Sig.	Front Handle Grip		Side Handle Grip	
		Males	Females	Males	Females
Propulsion time (s)	*†	0.60 ± 0.04	0.65 ± 0.08	0.64 ± 0.07	0.69 ± 0.09
H. takeoff velocity (m/s)	*†‡	4.01 ± 0.36	3.77 ± 0.17	4.85 ± 0.52	4.29 ± 0.24
Takeoff angle (deg)	*†	-1.44 ± 6.64	-6.93 ± 6.80	2.66 ± 5.48	-3.95 ± 6.40
H. peak power (watts/kg)	*†‡	31.08 ± 6.47	27.75 ± 3.92	41.28 ± 7.94	33.54 ± 4.61
Hand/Total impulse (%)	* ‡	11.14 ± 8.18	14.58 ± 9.91	24.74 ± 10.28	22.75 ± 11.77
*Side handle significantly different than front handle ( $p < .001$ ). †Male significantly different than female ( $p < .05$ ). ‡Significant two-way interaction ( $p < .05$ ).					

Males had significantly shorter propulsion times but produced faster and more horizontal takeoffs than females. They also produced more power per unit of body mass. Across all swimmers, starts performed with a side handle grip technique were characterized by significantly longer propulsion times with faster and more horizontal velocities, and greater power.

**CONCLUSION:** Improved starting performance when using the side grip handles was likely attributable to longer propulsion times and significantly greater relative force contribution from the arms.

**2557 Board #202 May 29 9:00 AM - 10:30 AM**  
**Efficacy Of Digital Video Techniques To Estimate Knee Alignment Of Females During A Drop Jump**

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 (No relationships reported)

Female athletes in cutting, jumping and pivoting sports have increased risk for ACL injury compared to their male counterparts. One injury risk factor is landing from a jump with a large knee abduction (ABD) angle and moment. While 3D motion analysis is the gold standard for determining joint kinematics and kinetics, there is a need for affordable and clinically efficacious alternatives. The frontal plane projection angle (FPPA) of the thigh in relation to the shank and the ratio of knee-to-ankle separation are 2D measurements proposed to estimate knee ABD angle. There is little data on the reliability of these 2D measures and their comparison with 3D frontal plane knee kinematics and kinetics.

**PURPOSE:** To determine: 1) inter- and intra-rater reliability of FPPA and knee-to-ankle separation ratio measures; and 2) the correlation of both 2D measures with 3D frontal plane knee angle and moment from the landing phase of a drop vertical jump (DVJ).

**METHODS:** Female collegiate athletes ( $n = 36$ , age =  $20 \pm 1$  yrs) competing in IKDC level I and II sports performed a DVJ while data were collected with a 7 camera motion capture system (250 Hz) and 2 force plates (1500 Hz). Simultaneous digital video was captured with a digital video camera (30 Hz) positioned 3 m away at a height of 0.6 m. Intra and inter-rater reliability of the 2D measures were assessed with ICC's with two blinded evaluators of digital images at peak knee flexion during the land. Pearson Correlation Coefficients were calculated between 2D and 3D measures.

**RESULTS:** Both 2D analysis methods showed excellent reliability (FPPA: intra-rater ICC = 0.95, inter-rater = 0.89; knee-to-ankle separation ratio: intra-rater = 0.97, inter-rater = 0.92). Poor to moderate correlations were found between the FPPA and knee ABD angle ( $r = 0.381$ ;  $p = 0.022$ ) and abduction moment ( $r = 0.504$ ;  $p = 0.002$ ). Moderate to strong correlations were found between the knee-to-ankle separation ratio and knee ABD angle ( $r = 0.592$ ;  $p < 0.001$ ) and ABD moment ( $r = 0.628$ ;  $p < 0.001$ ).

**CONCLUSIONS:** The 2D analysis methods had good consistency and moderate validity with known 3D measures of ACL injury risk. The knee-to-ankle ratio showed better validity compared to the FPPA. 2D analysis has potential to be an inexpensive, reliable and effective means of estimating frontal plane knee position and moment as part of ACL injury screening.

**2558 Board #203 May 29 9:00 AM - 10:30 AM**



## Contribution Of Form Drag And Skin Friction Drag During The Swimming Gliding

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(No relationships reported)

In human swimming, the total drag comprises the skin friction drag, form drag and wave drag. The relative contribution of each component to the overall hydrodynamic drag is controversy issue.

**PURPOSE:** To analyse the relative contribution of the skin friction drag and the form drag for the total drag during the gliding, using computational fluid dynamics.

**METHODS:** A 3-D domain was created to simulate the fluid flow around a swimmer model. The numerical simulation analysis consisted of the use of a three-dimensional mesh of cells that simulates the flow around the human body. Computational fluid dynamics methodology uses the finite volume approach, where the equations are integrated over each control volume. The k-epsilon turbulent model was applied to the flow around a three-dimensional model of a male adult swimmer in two gliding positions: in ventral position with the arms extended at the front and in ventral position with the arms aside the trunk. The swimmer model middle line was placed at a water depth of 0.90 m, equidistant from the top and bottom surfaces of the 3-D domain. The coefficient of drag (CD) was computed using a steady flow velocity of 2 m/s for both gliding situations. The CD was decomposed into form and skin friction drag.

**RESULTS:** The position with the arms extended at the front presented a CD value of 0.43 whereas the position with the arms aside the trunk presented a CD value of 0.74. In the position with the arms extended at the front, form drag and skin friction drag represented, approximately, 87% (CD = 0.37) and 13% (CD = 0.06) of the total drag, respectively. In the position with the arms aside the trunk, form drag and skin friction drag represented, approximately, 92% (CD = 0.68) and 8% (CD = 0.06) of the total drag, respectively.

**CONCLUSIONS:** The gliding position with the arms extended at the front produced lower drag coefficients than with the arms placed aside the trunk. Although form drag was dominant, skin friction drag was by no means negligible during the swimming gliding.

Supported by FCT (SFRH/BD/25241/2005; POCTI/DES/58872/2004).

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## 2559 Board #204 May 29 9:00 AM - 10:30 AM Does Hip Abductor Fatigue Affect Frontal Plane Pelvic Drop In Running?

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(No relationships reported)

**PURPOSE:** To investigate the relationship between unilateral hip abductor muscle fatigue and frontal plane pelvic drop while running.

**METHODS:** Five healthy, female subjects (mean age  $24.2 \pm 3.6$ ) were obtained from a sample of convenience. Subjects were recreational runners who ran  $\geq 10$  miles per week (mean 18.0 miles  $\pm 4.5$ ) and had no known cardiopulmonary or neuromuscular impairments. After a 5-minute warm-up, subjects were asked to run 3 minutes on a treadmill at a speed 10% greater than their self-selected speed ( $6.94 \text{ mph} \pm 0.31$ ) prior to and after an imposed fatiguing protocol. Fatigue was induced by asking subjects to perform a paced (72Hz) standing hip abduction activity using a black TheraBand® for resistance. The activity was halted when the subject could not continue with good form. A kinetic measure of hip abduction torque was used to verify a minimum decrease of 10% between the baseline run and the fatigued run. During each run, kinematic measurements of pelvic position were taken using a 6DOF electromagnetic tracking system (Polhemus Fastrak®). Data were sampled at 60Hz with sensors secured over the posterior superior iliac spines (PSIS) bilaterally. Pelvic drop was calculated as the angle between left and right PSIS relative to a horizontal plane using custom software (MATLAB). A nonparametric t-test was calculated using JMP v 7.0; statistical significance was defined as  $p < 0.05$ .

**RESULTS:** Mean differences between pre to post fatigue pelvic drop were  $0.59 \pm 3.05^\circ$ ,  $1.66 \pm 2.94^\circ$ , and  $1.15 \pm 3.90^\circ$ , for minutes 1, 2, and 3, respectively. These differences were not significant. Pelvic drop tended to increase pre to post fatigue, with the greatest increase seen at minute 2. Torque production showed a mean decrease of  $23.77 \pm 12.35\%$ .

**CONCLUSION:** While these findings were not statistically significant, there appears to be a relationship between fatigue and pelvic drop. From an injury prevention or clinical perspective, kinematics following fatigue may provide useful information in addition to baseline data. The small sample size is a limitation of this study. Data collection is ongoing.

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## 2560 Board #205 May 29 9:00 AM - 10:30 AM Influence Of The Rear Arm On The Biomechanics Of The Lunge In Classically-trained Fencers

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(No relationships reported)

**BACKGROUND:** A fast lunge and rapid return to *en garde* (*EnG*) is critical for success in competitive fencing (Cronin *et al* 2003). Full extension of the rear leg from  $45^\circ$  flexion (typical of the classical *EnG* position) has been shown to achieve a faster lunge in trained fencers (Adrian M and Klinger A 1976) when compared with the modern upright *EnG* posture (where both legs are flexed  $<30^\circ$  from full extension). Unlike the modern technique, classically trained fencers demonstrate rapid extension of the rear arm when performing the lunge and rapid flexion of the rear arm during recovery to *EnG*.

**PURPOSE:** To compare performance of the fencing lunge and recovery to *EnG* with v without the use of the rear arm.

**METHOD:** Six classically trained, male fencers (mean [1SD]) age  $25.3$  [ $4.4$ ] years; body mass  $70.8$  [ $2.9$ ] kg; lunge distance  $0.76$  [ $0.01$ ] m) participated in this ethics approved study. Having practiced the lunge and recovery to *EnG* (the trial) for both conditions (C1: Rear arm tethered to the torso; C2: Classical rear arm technique) participants (in competitive fencing attire) conducted 5 best-effort time trials for each condition. Randomised order of trials (standardised for *EnG* posture, foot position, lunge distance and recovery) were conducted on a level, non-slip indoor surface. Ground reaction forces at the rear and lead legs in the horizontal ( $F_y$ ) and vertical ( $F_z$ ) axes were recorded during each trial using two force platforms. Video analysis of each trial identified correct completion of the lunge (lead foot's toe-lift at *EnG* to initial contact of the same foot) and recovery (loading response of the lead foot at the lunge to initial contact on return to the original *EnG* position). Data were analysed by repeated measures ANOVA ( $\alpha = 0.05$ ).

**RESULTS:** C2 produced a faster lunge (C2  $0.90$  [ $0.05$ ]  $\text{m.s}^{-1}$  v C1  $0.75$  [ $0.04$ ]  $\text{m.s}^{-1}$ ,  $p < 0.05$ ) and faster recovery to *EnG* (C2  $0.46$  [ $0.03$ ]  $\text{m.s}^{-1}$  v C1  $0.39$  [ $0.03$ ]  $\text{m.s}^{-1}$ ,  $p < 0.05$ ) than C1. Differences ( $p < 0.05$ ) in rear leg kinetics were evident between conditions during the lunge ( $F_y$ : C2  $5.12$  [ $0.07$ ]  $\text{N.kg}^{-1}$  v C1  $4.83$  [ $0.14$ ]  $\text{N.kg}^{-1}$ ; *peak horizontal power*: C2  $5.58$  [ $0.33$ ]  $\text{W.kg}^{-1}$  v C1  $4.50$  [ $0.35$ ]  $\text{W.kg}^{-1}$ ) and recovery to *EnG* ( $F_y$ : C2  $3.39$  [ $0.08$ ]  $\text{N.kg}^{-1}$  v C1  $3.15$  [ $0.09$ ]  $\text{N.kg}^{-1}$ ). No differences were observed in lead leg kinetics.

**CONCLUSION:** The fastest lunge and recovery to *EnG* was achieved when classically trained fencers used the rear arm.

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## 2561 Board #206 May 29 9:00 AM - 10:30 AM Added Mass Of Human Swimmers: A Comparison Of Computational And Experimental Results

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(No relationships reported)

Added mass is the amount of water a swimmer has to accelerate in addition to his body during changes in velocity. It is an important concept in determining the total body drag of swimmers during unsteady motion, as well as propulsive forces acting from accelerating hands and feet.

**PURPOSE:** The aim of this study was to find added mass of a human body using experimental and computational methods, and to compare the two methods.

**METHODS:** For one male adult subject, added mass was found experimentally using vertical oscillations. The subject were connected to a 2.8m long bar with handles, attached with springs (stiffness  $k=318\text{N/m}$ ) and a force cell. By oscillating this system vertically and registering the time period of oscillations it is possible to find the added mass of the swimmer, given the known masses of the bar and swimmer. Additionally the added mass was found using computational fluid dynamics (CFD) calculations. The body surface and volumes of the subject was determined using a computer tomography scan technique. The 3D body- and water model was created using the Gambit software (Fluent®, Inc. Hannover, USA) producing a hybrid mesh of 900 million cells for use in the CFD calculations. A finite volume model including a standard k-epsilon turbulence model was used to solve the Navier-Stokes equations of fluid flow using the Fluent Software (Fluent®, Inc. Hannover, USA). The acceleration of the water flow was set to  $a=0.4\text{ m}\cdot\text{s}^{-2}$ , and the inlet velocities were 0.1, 0.5, 1.0, 1.5, 2.0, 2.5  $\text{m}\cdot\text{s}^{-2}$ .

**RESULTS:** For the male swimmer, with a body mass (BM) of 81.6 kg, and a characteristic length of 2.39m (reaching height) the added mass was found experimentally to be 21.6kg, and using CFD to be 26.6 $\pm$ 4.3 kg.

**CONCLUSIONS:** The added mass of male humans seems to be in the proximity of 26.5 or 32.5% of BM using oscillation or CFD measurements respectively. There is a relatively close agreement between AM found using experimental and CFD methods. The different AM values found using these two methods is most probably due to the subject's experimental conditions during oscillations involve small body posture movements, whereas with the CFD model the body are completely stiff. The results indicate that CFD can be used to estimate the added mass of human swimmers. For the future, unsteady effects of human swimming hydrodynamics should be investigated.

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**2562 Board #207 May 29 9:00 AM - 10:30 AM**  
**Front Crawl Intracyclic Velocity Variation Of The Hip In Swimmers With Down Syndrome**

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Intracyclic velocity variations (IVV) are considered an inverse indicator of swimming efficiency and have been widely used to evaluate high swimming performances. However, there is a lack of kinematical studies with disable competitive swimmers, which do not allow coaches to have more objective data to help their training process.

**PURPOSE:** To determine the front crawl IVV of the hip in swimmers with Down syndrome, comparing their IVV when breathing to their preferred and non preferred side.

**METHODS:** 6 swimmers (20 $\pm$ 5 yrs, 58 $\pm$ 14 kg, 154 $\pm$ 12 cm and 16 $\pm$ 12 %fat mass) from the Down Syndrome National Portuguese Team performed 2 repetitions of 20 m all-out in front crawl, one time using their preferred side breathing and other time breathing to their non preferred side. Swimmers were monitored while passing through a pre-calibrated space. Two stationary and synchronized below and above the water cameras recorded the tests at 50 Hz, being analyzed one complete stroke cycle. After digitizing and 2D reconstruction of the hip, IVV of horizontal velocity (v) was assessed through the calculation of the variation coefficient and was also expressed as a percentage of the horizontal v (%IVV). Mann-Whitney test was used to compare the different types of breathing for stroke length (SL), stroke rate (SR), v, IVV and %IVV.

**RESULTS:** Table 1 presents the values of the referred parameters during one complete stroke cycle when breathing to the subject's preferred and non preferred sides, being observed no differences.

**CONCLUSIONS:** As expected the IVV were higher than in swimmers without disability. Additionally, it seems that swimmers need to adapt their SR to maintain IVV. So, the obtained %IVV values allow to state that if the sample was higher differences may occurred.

Table 1. Mean  $\pm$  SD values of v, SL, SR, IVV and %IVV when breathing to non and preferred sides

	Preferred side	Non preferred side
v (m/s)	0.89 $\pm$ 0.13	0.85 $\pm$ 0.18
SL (m/cycle)	1.35 $\pm$ 0.10	1.37 $\pm$ 0.13
SR (cycles/min)	39.37 $\pm$ 3.98	36.98 $\pm$ 5.59
IVV	0.23 $\pm$ 0.05	0.25 $\pm$ 0.06
%IVV	26.89 $\pm$ 6.79	33.22 $\pm$ 1.29

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**2563 Board #208 May 29 9:00 AM - 10:30 AM**  
**Influence Of Foot Posture On Ground Reaction Forces**

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(No relationships reported)

Most running injuries are related to compounded stresses that occur at the lower extremities (LE). Previous literature has indicated runners with extremes in arch height (pes planus or pes cavus) are more susceptible to injuries than those with average arch structure. Although the relationship of LE stress and injury is well documented, little research describing attenuation of vertical ground reaction forces (vGRF) related to arch height exists in the current literature.

**PURPOSE:** To examine the relationship between vGRF and the change in arch height in load bearing conditions, during running bouts.

**METHODS:** Eighteen healthy female college aged Division I cross country runners (mean age = 20  $\pm$  1.7 yrs; ht = 164.4 cm  $\pm$  6.7 wt = 54.4 kg  $\pm$  5.4) participated in 5 - 7 running trials on a force plate (AMTI, OR-6, Watertown, MA) instrumented runway sampling vGRF data in body weights (BW) at 960 Hz. Measurement of navicular height and truncated foot length were taken in non-weight bearing (NWB) and weight bearing (WB) conditions prior to the running bouts to determine the calculated arch index (CAI). CAI was compared to vGRF using pearson's correlation (SPSS, IL;  $\alpha=.05$ ). Linear regression was constructed to predict peak vGRF based on CAI ( $\alpha=.05$ ). Participants were also surveyed regarding history of LE pain and injury.

**RESULTS:** A significant negative correlation ( $r=-.567$ ,  $p=.012$ ) was reported when comparing CAI to vGRF. Linear regression indicated 33.2% of the variance observed in vGRF was explained by the decrease in CAI in the NWB and WB conditions.

**CONCLUSIONS:** The comparative negative correlation between CAI and vGRF indicates that individuals with a greater residual arch height in the NWB and WB conditions (greater

CAI) tend to exhibit lower vGRF during self paced running bouts. Anecdotally, those with low CAI, with less than 10% change in NWB to WB arch height, tended to have history of knee pain. These individuals also exhibited the highest amount of vGRF during running bouts. These data indicate that the calculation of CAI may predict a runner's ability to attenuate vGRF and lend insight into causation of LE injury.

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**2564 Board #209 May 29 9:00 AM - 10:30 AM**

**Comparison Of EMG Activity In Trunk Training Exercises And Baseball Pitching And Hitting**

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(No relationships reported)

Trunk training exercises are foundational for baseball strength and conditioning programs. While previous EMG research has documented the role of trunk musculature in various trunk exercises, no research has examined the relationship between EMG levels in trunk training exercises and baseball pitching and batting performance.

**PURPOSE:** To examine EMG activity of select trunk musculature during specific trunk training exercises and compare it to the EMG activity during baseball batting and pitching.

**METHODS:** Ten male subjects from a mid-western University Club baseball team participated in this study. Bilateral EMG data was sampled from four superficial trunk muscles (upper rectus abdominus and external obliques) during four trunk exercises and five to seven pitching and or batting trials. The pitching motion was divided into four phases (Phase 1 - initiation of pitch to maximum stride knee kick height, Phase 2 - maximum stride leg knee height to stride foot contact (SFC), Phase 3 - SFC to ball release, and Phase 4 - ball release to .5 seconds after ball release). The batting motion was divided into two phases. Phase 1 was defined as the loading phase (initiation of backwards movement of the bat to initiation of forward movement of the bat). Phase 2 was defined from the initiation of forward movement until .5 seconds after forward movement. Mean EMG data from each muscle during each trunk exercise were presented as percentage EMG during each pitching and batting phases. Percentages less than 100 indicated the mean EMG elicited during the trunk exercises was less than what was elicited during pitching and batting phases.

**RESULTS:** Mean EMG levels during trunk exercises were lower than the mean EMG levels in phases 3 and 4 of the pitching motion and phase 2 of batting. Mean EMG of the trunk exercises was substantially higher than mean EMG in phases 1 and 2 of pitching and phase 1 of batting.

**CONCLUSIONS:** Phases 3 and 4 of the pitching motion and phase 2 of batting are the most explosive phases of each motion respectively. Thus, the trunk training exercises did not elicit EMG levels that would be sufficient to provide an appropriate training effect for strength and/or explosiveness in pitching and batting.

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**2565 Board #210 May 29 9:00 AM - 10:30 AM**

**Comparison Of Peak Forces Associated With Six Common Martial Arts Striking Techniques**

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(No relationships reported)

One of the primary purposes of strikes in martial arts is to impart maximal force to a target, thus harming the target or recipient of the strike. Although various strikes, such as the standard forefist punch, have been investigated from a force-producing perspective, no studies have directly compared the six upper-limb strikes included in this study.

**PURPOSE:** To compare peak forces associated with six common martial arts striking techniques - knife-hand, reverse knife-hand, elbow, reverse elbow, back-fist and fore-fist.

**METHODS:** Nineteen healthy adult participants (12 men and 7 women; age  $32.9 \pm 11.9$  yrs; body mass  $77.1 \pm 19.8$  kg) with current expertise and competence in martial arts were recruited. In random and repeated design, each participant executed fifteen strikes per arm per technique (90 strikes total each arm, rest periods allowed). The peak force (N) of each style of strike was assessed utilizing a pad-covered force transducer interfaced with a computerized data acquisition system.

**RESULTS:** One-way repeated measures ANOVA revealed significant differences amongst the six strikes ( $F_{5,18} = 34.56$ ,  $p < 0.01$ ). The ranking of strikes from the greatest peak force to least is; reverse elbow ( $1490.0 \pm 537.7$  N), elbow ( $1401.0 \pm 462.6$  N), fore-fist ( $1087.6 \pm 371.5$  N), back-fist ( $969.7 \pm 335.3$  N), knife-hand ( $906.4 \pm 324.6$  N), and reverse knife-hand ( $904.0 \pm 312.7$  N). Post-hoc tests showed no differences between the two elbow striking techniques; however, both elbow techniques had higher peak forces than any of the other four striking techniques. There were no differences between the other four strikes (back-fist, fore-fist, knife-hand, or reverse knife-hand).

**CONCLUSION:** With regard to peak force, elbow strikes are superior to the hand strikes compared in this study (back-fist, fore-fist, knife-hand, reverse knife-hand). However, peak force is only one variable to be considered when comparing strikes. Additional factors dictating the effectiveness of a particular strike technique include range, accuracy, applicable targets, and timing considerations.

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**2566 Board #211 May 29 9:00 AM - 10:30 AM**

**Timing Of Upper Body Segmental And Joint Velocities In Skilled Male And Female Golfers**

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(No relationships reported)

It is generally accepted that a precisely timed pattern of proximal-to-distal upper body motion facilitates large clubhead speeds. Furthermore, males and females exhibit different amplitudes of segmental motion during the golf swing. However, it is unknown if gender differences exist in the timing of upper body movements during the swing.

**PURPOSE:** To examine the timing of upper body segmental and joint velocities during the swing of skilled male and female golfers.

**METHODS:** Driver data for 19 M ( $26 \pm 7$  yr) and 19 F ( $25 \pm 7$  yr) golfers with handicaps under 4 were collected using a motion analysis system. 3D peak angular velocities were calculated for the pelvis and thorax segments, and the elbow and wrist joints. From this data, the angular velocity which was greatest (i.e. flex-extension, abd-adduction, or axial rotation angular velocity) was determined and then the timing of this peak velocity was calculated. The maximum differential and timing of the maximum differential, between pelvis and thorax axial rotation angles projected onto the transverse plane (i.e. X-Factor) was also calculated. For all data, the timing of kinematic events was determined as a percentage of the downswing cycle (top of backswing to ball contact).

**RESULTS:** Clubhead speed was significantly greater for males,  $48 \pm 2$  m.s<sup>-1</sup>, compared to females,  $40 \pm 2$  m.s<sup>-1</sup> ( $p < .01$ ). No gender differences were identified for the timing of upper body segmental and joint velocities (Table 1), peak X-factor (M  $54 \pm 10^\circ$ , F  $55 \pm 9^\circ$ ) or the period in the downswing cycle where peak X-factor occurred (M  $51 \pm 6\%$ , F  $54 \pm 7\%$ ).

**CONCLUSIONS:** There was no gender difference in timing. Furthermore, the sequencing of events for males and females was not in an explicit proximal-to-distal pattern.

Table 1. Timing of upper body and clubhead peak velocities (% of downswing)

	Male	Female	Movement
Pelvis	71 $\pm$ 5	70 $\pm$ 8	Axial rot
Thorax	85 $\pm$ 18	81 $\pm$ 15	Axial rot
Right elbow	95 $\pm$ 4	97 $\pm$ 4	Ext
Left elbow	72 $\pm$ 20	78 $\pm$ 21	Ext

Right wrist	84 ± 7	83 ± 10	Flex
Left wrist	89 ± 2	86 ± 5	Ext
Clubhead	98 ± 3	97 ± 3	-

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**2567 Board #212 May 29 9:00 AM - 10:30 AM**  
**Kinematic And Kinetic Comparison Of Overhand And Underhand Pitching: Implications To Proximal-to-distal Sequencing**

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(No relationships reported)

Currently there is a wealth of information on the kinetics and kinematics of the overhand baseball pitch, but surprisingly little on the underhand softball pitch. Even more surprising is that these two pitching motions have received no direct study to analyze and compare the proximal-to-distal sequencing of both pitches.

**PURPOSE:** The purpose of this study was to investigate the interaction between adjacent segments in relation of the competing theories of proximal-to-distal sequencing as they function in an overhand baseball and underhand softball pitch.

**METHODS:** 5 Collegiate Varsity Softball Pitchers (ht: 1.73 + .06 m, mass: 69.99 + 13.95 kg) and 5 Collegiate Varsity Baseball Pitchers (ht: 1.83 + .07 m, mass: 87.27 + 6.09 kg) who signed an institutionally approved consent document were asked to throw 5 pitches at game speed from a simulated mound. The motions were captured using an integrated Motion Reality Inc. (Marietta, GA) motion capture and Noraxon (Scottsdale, AZ) EMG system. EMG sensors were placed on the area of greatest bulk of the proximal biceps brachii and proximal triceps brachii in order to analyze the activity of the musculature during each pitch. All pitches were captured, and the pitch with the highest ball velocity was used for analysis.

**RESULTS:** Velocity and acceleration (both linear and angular) followed the expected pattern of a proximal-to-distal sequence where the distal segment's (upper arm) maximum velocity is achieved at a point near the proximal segment's (lower arm and wrist) minimum velocity with concurrent appropriate changes in acceleration. The electromyographic results revealed analogous muscle activation, suggesting that both throwing techniques use the same mechanical system to maximize the velocity of the more distal segment: an external stopping force on the proximal segment causing an inertial acceleration of the distal segment.

**CONCLUSIONS:** The results of this study confirmed the existence of proximal-to-distal sequencing in both throwing types and illustrated that both types can be theoretically categorized as an inertial acceleration of the distal segment. Additionally, the biceps activation in the underhand pitch is analogous to the triceps activation during the overhand pitch further supporting the inertial acceleration mechanism for both pitches.

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**2568 Board #213 May 29 9:00 AM - 10:30 AM**  
**A Portable Instrumentation System To Evaluate Lower Extremity Athletic Performance And Injury Risk**

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(No relationships reported)

There is considerable interest in identifying the physical performance potential and injury susceptibility of athletes. However, performance screening and injury prevention guidelines are lacking due to a limited understanding of the interaction between biomechanical quantities, performance, and injury risk. Quantitative biomechanical assessments of athletes in-the-field is needed to test various theories regarding factors affecting performance and injury mechanisms.

**PURPOSE:** To develop a portable instrumentation system that can be used in-the-field to record biomechanical quantities believed to affect lower extremity athletic performance and injury risk.

**METHODS:** Biomechanical quantities of interest were selected from careful inspection of clinical and research literature and discussion with athletic trainers and coaches. The system to collect these quantities was developed using commercial and custom components. The design criteria for the system were that it: (1) sample the quantities of interest with sufficient speed and accuracy to allow useful biomechanical evaluation, (2) is portable, (3) have minimal learning curve for new researchers, and (4) allow an athlete to be tested within one hour. Bench and in-the-field tests were conducted to evaluate the system components and overall system performance.

**RESULTS:** Quantities of interest include: anthropometric measures, flexibility, absolute strengths and strength ratio of knee and ankle flexor/extensor muscles, movement kinematics, ground reaction forces, muscle activation, and reaction timing. The system consists of: a laptop computer, an analog to digital converter, a custom isometric strength testing fixture, a 60 Hz digital video camera, a force plate with portable ramp, a telemetered EMG system, and a cart. The accuracy of locating contrast markers was 1±1.8 mm for the camera positioned 3 m from the plane of motion. Ground reaction forces were accurate to within 1.1% of dynamic forces. System performance in the field included a ½ hour setup time and 2 testing stations, requiring 1 hour of testing per subject.

**CONCLUSIONS:** The portable system increases athlete accessibility and provides a unique tool for accurately collecting data relevant to athletic performance and injury risk.

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**2569 Board #214 May 29 9:00 AM - 10:30 AM**  
**Relationship Between Crossbar Height Cleared And Approach Run Velocity For Non-elite And Elite Pole Vaulters**

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(No relationships reported)

Research has shown a positive correlation between approach velocity ( $v_a$ ) and crossbar height cleared ( $h_c$ ) for elite (E) pole vaulters; and that the relationship between  $v_a$  and  $h_c$  for female (F) vaulters has shifted over the years - decreasing the contribution of  $v_a$  to  $h_c$  - approaching the relationship for males (M) (McGinnis, 2004). Little is known about this relationship for non-elite (NE) vaulters.

**PURPOSE:** To determine the relationship between  $v_a$  on  $h_c$  for NCAA Division II (Northern Sun Intercollegiate Conference - NSIC) vaulters; to determine if M-NE and F-NE vaulters show similar relationships; to compare the findings of this study to data of M-E and F-E vaulters by McGinnis (2004).

**METHODS:** The last 5 m of the approach run was recorded for vaulters in the 2005 NSIC Championships (9 F, 8 M). The best legal trial per subject was analyzed. Correlation and linear regression analysis determined the relationship between  $v_a$  and  $h_c$ . Stepwise multiple linear regression compared the relationships for the different groups.

**RESULTS:** The table summarizes the results. They show that a positive correlation between  $v_a$  and  $h_c$  also exists for NE vaulters. The regression lines for all groups but the F-NE were parallel to each other but not coincident. The F-NE line was not parallel to the F-E 1997-2003 and M-E lines but was not shown to differ from the lines of the other two groups.

**CONCLUSIONS:** For E and NE,  $h_c$  is significantly related to  $v_a$ . As the vaulters become technically more refined, the contribution of  $v_a$  to  $h_c$  decreases -same  $v_a$  leads to higher  $h_c$ . In contrast, for F-NE,  $v_a$  seems to play overall a lesser role -same increases in  $v_a$  lead to smaller increases in  $h_c$ .

	NSIC 2005	Elite (McGinnis, 2004)
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	F	M	F	F	M
	1995-1997	1995-1997	1997-2003	1997-2003	1986-2003
r	.911*	.840*	.836*	.747*	.781*
Slope	0.507a	0.654ab	0.644ab	0.652b	0.627b
Intercept	-0.277abcd	-1.141a	-1.262b	-0.975c	-0.282d

Note. Values for slope/intercept with no subscripts in common are significantly different,  $p < .05$ ; \* $p < .01$

## 2570 Board #215 May 29 9:00 AM - 10:30 AM Effect of Segmental Velocity Increments On Maximum Wheelchair Racing Speed

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(No relationships reported)

**PURPOSE:** Biomechanical characteristics in wheelchair propulsion such as range of motions, segment velocities and accelerations, and pushrim forces and moments have been broadly documented; however, the effect of segmental velocities on wheelchair racing have not been investigated. This study was to determine the effect of linear segmental velocity increments of the upper extremity on the maximum wheel speed (MWS) in wheelchair racing.

**METHODS:** Seventeen elite international wheelchair racers with the mean age of  $30.3 \pm 7.0$  yrs, body mass  $57.5 \pm 10.2$  kg and wheelchair racing training  $8.9 \pm 6.6$  yrs served as participants. Reflective markers were placed on right 5th metacarpal head (hand), lateral styloid process (wrist), lateral epicondyle of the humerus (elbow) and acromion (shoulder), as well as the right wheel. Participants were filmed at 100Hz by a three-dimensional motion system while propelling their own racing wheelchairs on a training roller at their maximum speeds. After shoulder, elbow, wrist and hand linear velocities in the drive phase were calculated, linear segmental velocity increments were derived based on the difference of peak linear velocities between two adjacent joints, including shoulder-to-elbow (SE), elbow-to-wrist (EW) and wrist-to-hand (WH) velocity increments. A multiple linear regression was employed to determine the effect of each increment on the MWS.

**RESULTS:** Mean peak linear velocities were  $2.04 \pm 0.38$  m/s for the shoulder,  $5.14 \pm 0.83$  m/s for the elbow,  $6.26 \pm 1.15$  m/s for the wrist and  $7.53 \pm 1.03$  m/s for the hand. The mean MWS was  $9.14 \pm 1.72$  m/s. Peak linear velocities increased from proximal to distal joints, specifically from shoulder to the elbow (from 2.04 to 5.14 m/s). It was shown 87% of the variance of the MWS was accounted for by segmental velocity increments ( $P < 0.01$ ) with the greatest contribution from WH and the least contribution from EW ( $MWS = -21.92 + 1.67SE + 1.42EW + 2.02WH$ ).

**CONCLUSIONS:** It is speculated that increasing wrist linear velocity by performing more abduction/addition in the drive phase may improve the wheelchair racing speed.

Supported by the Roosevelt Warm Springs Institute for Rehabilitation, Warm Springs, GA

## 2571 Board #216 May 29 9:00 AM - 10:30 AM Intra-cyclic Stroke Parameter Changes Associated With Increased Speed In Competitive Front-crawl Swimming

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(No relationships reported)

Studies of stroke parameter relationships in swimming have shown that the basic strategy used by elite swimmers to increase speed is to increase stroke rate (SR) while attempting to maintain stroke length (SL). Recently, it has been shown that non-linear changes in SR and SL occur immediately after a swimmer reaches critical speed. The specific intra-cyclic mechanisms responsible for producing these changes, namely the duration of the propulsive and recovery phases of the stroke cycle, have not been investigated.

**PURPOSE:** To determine temporal changes in the propulsion and recovery time associated with increased SR in front-crawl swimming.

**METHODS:** Eight elite competitive swimmers (6 female, 2 male;  $17.9 \pm 0.86$  yrs) performed a 4 x 200 m interval training set (60 s rest) in a 25 m pool according to target times that were based on a critical speed test (1 = submax. intensity, 2 = max. lactate steady state, 3 = critical speed, 4 = VO2 max.). Velocity, SR, SL, propulsion time and recovery time were recorded for each 25 m length of each 200 m repetition. The data were normalized (1st length %) to compare the relative stroke parameter changes between the 4 x 200s using repeated measures ANOVA.

**RESULTS:** As speed increased, SR increased significantly ( $p < 0.05$ ) for each repetition ( $+26.5 \pm 7.8\%$  from 1st to last repetition), whereas SL decreased significantly ( $p < 0.05$ ) for the 3rd and 4th repetitions ( $-2.6 \pm 1.6\%$  &  $-4.8 \pm 2.8\%$ , respectively). In addition, SR increased markedly during the 3rd (critical speed) 200 ( $+12.0\%$  vs. the previous increase of  $+3.4\%$ ). Changes in SR were associated with significant decreases ( $p < 0.01$ ) in the propulsion time for each repetition ( $-25.6 \pm 8.1\%$  from the 1st to 4th repetition) as well as the recovery time ( $p < 0.05$ ) for the 3rd and 4th repetitions ( $-6.9 \pm 4.9\%$  &  $-13.2 \pm 5.7\%$ , respectively). An asymmetric change in the stroke cycle was shown by a significant drop ( $p < 0.05$ ) in the propulsion/recovery ratio from the 1st to 4th repetition ( $-9.3 \pm 11.2\%$ ).

**CONCLUSION:** Progressive speed related increases in SR are associated with simultaneous decreases in the duration of the propulsion and recovery phases of the stroke cycle, such that propulsion time decreases more than recovery time. This suggests that pulling/pushing the arm through the water faster contributes more to the elevation of SR than increasing the tempo of the recovery.

## 2572 Board #217 May 29 9:00 AM - 10:30 AM Kinematic And Kinetic Comparison Of Running In A Neutral Cushioned Shoe And A Minimal Shoe

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(No relationships reported)

Minimal shoes have been promoted as a means to reduce injury risk by mimicking barefoot running. Barefoot treadmill running has been associated with a reduced rearfoot strike pattern and decreased associated impact forces. Therefore, running in minimal shoes should result in a reduction in these variables compared to a standard running shoe.

**PURPOSE:** The purpose of this study was to determine if a minimal shoe reduces ground reaction forces and strike pattern compared to a standard running shoe.

**METHODS:** This is an ongoing study with 5 subjects examined so far. Subjects were male recreational runners, 24.4 years old  $\pm 2.7$ , running at least 7 miles per week ( $18.4 \pm 10.6$ ). Minimal shoe running was novel for these subjects. Nike Pegasus shoes (Beaverton, Ore) served as the neutral cushioned shoe (NS). Nike Free 3.0 shoes were utilized for the minimal shoe condition (MS). A triaxial accelerometer (PCB Piezotronics, Depew, NY) measured tibial shock. Subjects were tested while running 3.35 m/s on an instrumented treadmill (AMTI, Watertown, Mass). Data were collected after 10 minutes for each shoe condition. Forceplate and accelerometry data were sampled at 1000 Hz. Kinematic data (Vicon, Oxford, UK) were collected at 200 Hz. Variables of interest were average vertical load rate (AVLR), tibial shock (TS), leg stiffness, ankle dorsiflexion at heel strike (DF), and horizontal angle of the foot at



heelstrike in the lab coordinate system (FLAB).

**RESULTS:** All variables of interest were surprisingly greater in the MS condition.

Variable	NS	MS	Difference	Percent Difference (%)
TS (g's)	4.5 (0.6)	5.8(1.5)	+1.3	+28.9%
AVLR(BW/S)	53.7(14.9)	85.6(24.0)	+31.9	+59.4%
Stiffness(kN/m)	11.3(1.3)	11.9(1.4)	+0.6	+5.3%
DF(deg)	2.2(4.3)	6.4(3.3)	+4.2	+190.9%
FLAB(deg)	9.6(6.6)	12.0(3.8)	+2.4	+25.0%

**CONCLUSIONS:** Novel minimal shoe running appeared to have a detrimental effect on the loading variables. Adaptation to minimal shoe running may occur with time. A study of runners who habitually run in minimal shoes is underway.

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**2573 Board #218 May 29 9:00 AM - 10:30 AM**  
**Influence Of Ankle Taping On The Kinetics Of A Lateral Jump**

Adam C. Knight<sup>1</sup>, Justin F. Shroyer<sup>2</sup>, Andrea M. Sumner<sup>2</sup>, Joanna E. Booker<sup>2</sup>, Wendi H. Weimar<sup>2</sup>. <sup>1</sup>Mississippi State University, Mississippi State, MS. <sup>2</sup>Auburn University, Auburn, AL. (Sponsor: David Pascoe, FACSM)  
(No relationships reported)

The lateral ankle sprain is the most frequently occurring injury in athletics and often occurs during foot placement when landing from a jump. Ankle taping is frequently used to prevent ankle sprains but limited research has been conducted to determine the difference between different brands of tape.

**PURPOSE:** The purpose of this study was to investigate the influence of four different types of athletic tape on the medial/lateral component of the ground reaction force during a lateral jump. The tapes tested included two new types of adhesive tape developed by Cramer (Cramer Tape A and B), Coach Tape by Johnson and Johnson, and PowerTape by Andover.

**METHODS:** Thirty Three (19 F, 14 M) healthy participants (age=21.45, +1.57 years; mass 72.94 + 13.94 kg) were tested on four separate days. The peak medial/lateral component of the ground reaction force was recorded during the lateral jump using an AMTI force platform. The participants were randomly assigned to one of the 4 tape conditions each day until receiving each taping condition. A Certified Athletic Trainer (lead author) applied a closed basketweave tape procedure to both ankles. Foam prewrap was used as the underwrap, except when using the PowerTape, in which PowerFlex was used. The participants performed a lateral jump (to replicate a cutting maneuver) of 40 cm onto and off of the force platform, initiating the jump with the left leg, landing on the force platform on the right foot, and then jumping off the force platform with the right leg. The test was performed before ankle taping (pre-test), immediately after ankle taping (acute test), and after 30 minutes of walking (post-test). The data was analyzed with a 4 (ankle tape) x 3 (test number) ANOVA.

**RESULTS:** There was no significant interaction ( $p=.258$ ), and no significant main effects for the type of tape ( $p=.546$ ) or the test number ( $p=.643$ ).

**CONCLUSION:** Ankle taping should prevent ranges of motion that may lead to an ankle sprain without changing the kinetics of the activity. These results revealed that all four types of tape produced a similar medial/lateral force during the lateral jump. There was no change in this force after 30 minutes of physical activity for all four tape types. Future research should continue to measure the effects of these tapes on the kinetics and kinematics of other athletic maneuvers.

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**2574 Board #219 May 29 9:00 AM - 10:30 AM**  
**Relationship Between Eccentric Knee Strength And Impact Force Attenuation In Drop Landing**

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Skeletal muscle is a major active mechanism of impact force attenuation in human movement. During the landing phase impact attenuation is achieved through eccentric contraction of the muscles of the lower extremity. However, few studies have investigated the effects of knee strength, especially eccentric strength, on impact attenuation during landing.

**PURPOSE:** To examine effects of knee eccentric strength on impact force attenuation during drop landing.

**METHODS:** Seven NCAA DI football athletes (TRAINED) and 7 recreationally active students (REC) with limited sports training participated in this study. Isokinetic testing of the knee extensor and flexor torques was performed concentrically at 60 and 180°·sec<sup>-1</sup> and eccentrically at 60°·sec<sup>-1</sup>. Each subject performed 5 drop landings from each of 3 heights of 40, 60cm and 100% of each individual's maximum jump height (100%MJH) with simultaneous recording of 3D kinematics and ground reaction force (GRF) sampled at 240 Hz and 1200 Hz, respectively. The peak torque variables were evaluated using a mixed-design 2 x 2 (group x speed). Selected peak GRF and kinematic variables were examined using a 2 x 2 (group x height) ANOVA for 40 and 60 cm height conditions and an independent samples t-test for 100%MJH ( $p < 0.05$ ).

**RESULTS:** The TRAINED had greater concentric strength, vertical jump height, but no significant differences existed in the eccentric strength (336 vs 340 N.m/kg) between the groups. The TRAINED had marginally greater peak GRFs (2.7 & 3.5 BW vs 2.0 & 2.7 BW for 40 and 60 cm,  $p=0.051$ ) and significantly less time to the peak (0.048 & 0.043 s vs 0.060 & 0.053 compared to the REC in drop landing. The TRAINED used less but non-significant knee flexion range of motion (-60.7 & -54.1 ° vs -62.7 & -69.6 °) during drop landing than the REC. There were high, positive and significant correlations between the peak eccentric knee extensor torque and time to the first and second peak GRF.

**CONCLUSION:** Despite training the results did not find any significant differences in eccentric strength of the TRAINED subjects in comparison to their REC counterparts. They adopted a stiffer landing strategy to effectively deal with high impact loading during landing. Future research is warranted in investigating impact attenuation in landing of participants with significantly different eccentric strength.

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**2575 Board #220 May 29 9:00 AM - 10:30 AM**  
**Kinematics Differences Among Elite, Subelite And Amateur Sprinters**

Giorgos Paradis<sup>1</sup>, Carlton Cooke<sup>2</sup>, Athanasios Bissas<sup>2</sup>, Elias Zacharogiannis<sup>1</sup>, Athanasia Smirniotou<sup>1</sup>. <sup>1</sup>University of Athens, Athens, Greece. <sup>2</sup>Leeds Metropolitan University, Leeds, United Kingdom.  
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Sprinting ability is an important parameter affecting primarily the outcome in many different sports. However, there are different views in the literature regarding the main factor which affect the maximum running velocity. In order to understand the kinematics of sprint running, a comparison of different levels of sprinting performance is required.

**PURPOSE:** Aim of this study was to compare the kinematic characteristics among elite, subelite and amateur sprinters.

**METHODS:** Thirty males participated in this study (age  $24.5 \pm 3.55$  years, mass  $74.8 \pm 6.20$  kg, height  $1.78 \pm 0.02$  m), where all subjects were active sprinters and their mean maximum running speed was  $8.82 \pm 0.64$  m·s<sup>-1</sup>. Testing was employed to evaluate the differences among the three levels of sprinters on the kinematic characteristics of 35 m maximal sprint running. A Kodak EktaPro 1000 high speed video camera was used to collect video recordings of the sagittal plane of a full stride (two consecutive steps) of all three maximal sprint runs, sampling at 250 Hz. Filming was performed with the camera placed at the 35 m distance and 10 m from the performance plane such that its optical axis was approximately horizontal, forming an angle of 90° with the horizontal plane of running. Contact time, flight time, and maximal running speed were calculated according to methods reported previously (Paradisi & Cooke, 2006).

**RESULTS:** The maximum running velocity the step length and step rate for elite sprinters were  $9.67 \pm 0.25$  m s<sup>-1</sup>,  $2.19 \pm 0.06$  m and  $4.42 \pm 0.04$  Hz respectively, for subelite sprinters were  $9.07 \pm 0.10$  m s<sup>-1</sup>,  $2.08 \pm 0.10$  m and  $4.39 \pm 0.20$  Hz respectively and for amateur sprinters were  $8.52 \pm 0.42$  m s<sup>-1</sup>,  $2.08 \pm 0.10$  m and  $4.11 \pm 0.33$  Hz respectively. The maximum running velocity for elite sprinters was significantly different ( $F = 21.765$ ,  $P < 0.05$ ) from that of subelite (6.2%) and amateur (11.6%) sprinters, the step length for elite sprinters was significantly different ( $F = 6.538$ ,  $P < 0.05$ ) from that of subelite (5.3%) sprinters and the step rate for elite sprinters was significantly different ( $F = 8.620$ ,  $P < 0.05$ ) from that of amateur (6.9%) sprinters.

**DISCUSSION:** These data indicate that the step rate distinguishes the elite from the subelite sprinters where as the main difference between the elite and the amateur sprinters was the step length.

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## **E-36 Free Communication/Poster - Stress, Overreaching and Injury in Athletes**

MAY 29, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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### **2576 Board #221 May 29 8:00 AM - 9:30 AM**

#### **Effect Of Stress On Salivary Cortisol Levels Of Top Ranking Brazilian Wrestlers.**

Birgit Keller, Ricardo W. Coelho, Flávia B. Justus, Rubens Tempiski. *Federal University of Paraná State, Curitiba, Brazil.*

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(No relationships reported)

**PURPOSE:** The aim of this study was two fold, first to investigate the effect of basal, pre competitive and post competitive stress on salivary cortisol levels of top ranking adult Brazilian wrestlers. Second, investigate the correlations power among three different stress measures (Perceived Stress, salivary cortisol and Physiological Stress Reaction).

**METHODS:** The investigation followed the quasi-experimental design with repetitive measures. The subjects (n=16) were top ranked male wrestlers, age ranging from 18 to 30 years old (M= 23.58, SD=3.20). All of them represent the Brazilian team in international competitions. Salivary cortisol was collected in three different situations (basal, pre and post-competition). The physiological stress reaction and perceived stress scores were collected prior competition just before warm up. The data was analyzed by ANOVA with repetitive measures by Pearson and Spearman's Rho correlation at a significant level of  $p < .05$ .

**RESULTS:** The ANOVA for salivary cortisol concentration demonstrated significant main effect on basal, pre and pos competition  $F(1, 16) = 160.46$ ,  $p < .001$  and the Post Hoc results indicated that the salivary cortisol concentration was much greater in the post-competitive than pre-competitive and basal measures. The findings of Spearman's Rho and Pearson correlation demonstrated that there was no significant correlation at  $p < .05$  level among all measure.

**CONCLUSIONS:** Salivary cortisol concentration increase according to exercise intensity because the higher is the mental and physiological effort higher would be the glucogenesis. The validity of using Perceived Stress Inventory and Physiological Stress Reaction Inventory in a competitive setting is questionable. They probably are measuring different constructs but not competitive stress. This suggests that they were stressed but did not perceive as it is. The wrestlers possess a great deal of cortisol concentration resistance in stress situation. This means that even when they are in a situation of stress they don't perceived or feel the physiological effects of it or they can control very well even in high stressful situation.

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### **2577 Board #222 May 29 8:00 AM - 9:30 AM**

#### **Effect Of Multi-modal Imagery Intervention On Pre-competitive Anxiety And Stress Levels In Elite Tennis Players**

Ricardo W. Coelho, Birgit Keller, Flávia B. Justus, Rubens Tempiski. *Federal University of Parana State, Curitiba, Brazil.*

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(No relationships reported)

**PURPOSE:** Effect of multi-modal imagery on anxiety and perceived stress levels in tennis players.

**METHODS:** The quasi-experimental design included pre- and post-treatment test subjects and a control group. Male tennis players (n=49) ranging in age from 16 to 18 years old (M=16.96, SD= 0.82) were divided into two groups: (1) a treatment multi-modal imagery group and (2) a placebo imagery group used as the control group. The 27-item Competitive State Anxiety Inventory (CSAI-2) was used to assess anxiety and the Perceived Stress Scale (PSS10) to assess stress. The treatment involved a multi-modal (relaxation, imagery and behavior modeling video) intervention conducted three times per week for 25 minutes after ordinary technical and physical practice for a period of 9 weeks between tournaments. A 2x2 multifactor analysis of variance (MANOVA; pre- and post-treatment, control and experimental groups) was used to analyze the main effect among variables at a significance level of  $p < .05$ .

**RESULTS:** Multifactor analysis of variance testing of perceived stress and anxiety subscales showed a main effect for control vs. experimental, Wilks'  $\lambda = 1.63$ ,  $F(4, 91) = 37.051$ ,  $p < .01$ , pre- vs. post-treatment, Wilks'  $\lambda = 1.26$ ,  $F(4, 91) = 28.65$ ,  $p < .01$ , and interaction between control vs. experimental and pre- vs. post-treatment groups Wilks'  $\lambda = 1.44$ ,  $F(4, 91) = 32.68$ ,  $p < .01$ . Univariate analysis revealed a significant main effect for perceived stress, cognitive anxiety and self-confidence at  $p < .05$ . There was no significant effect for somatic. ANOVA also revealed significant interaction effects for perceived stress  $F(1, 94) = 6.87$ ,  $p < .05$ , cognitive anxiety  $F(1, 94) = 4.42$ ,  $p < .05$ , and self-confidence  $F(1, 94) = 5.07$ ,  $p < .05$ . However, the interaction was not significant for somatic anxiety  $F(1, 94) = 0.78$ ,  $p > .05$ .

**CONCLUSIONS:** The results for stress and two anxiety subscales (cognitive anxiety and self-confidence) indicate that multi-modal imagery intervention represents a useful tool to build self-confidence and to lower cognitive anxiety and perceived stress levels in tennis players. These findings are in accordance with previous studies in the area of physiotherapy and medicine that concluded that imagery is an efficient psychological intervention to control anxiety and stress in many disturbing situations.

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### **2578 Board #223 May 29 8:00 AM - 9:30 AM**

#### **Link Between Psychological Resilience And Dehydroepiandrosterone Sulfate Against Competition Outcome In Golfers**

Shu-Man Chen<sup>1</sup>, Mei-Chih Chen<sup>2</sup>, Kun-Ning Chen<sup>2</sup>, Chia-Hua Kuo<sup>2</sup>, John L. Ivy, FACSM<sup>3</sup>. <sup>1</sup>Committee for General Studies, Shih Hsin University, Taipei, Taiwan. <sup>2</sup>Taipei Physical Education College, Taipei, Taiwan. <sup>3</sup>Univeristy of Texas at Austin, Austin, TX. (Sponsor: John L Ivy, FACSM)

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The neurosteroid dehydroepiandrosterone sulfate (DHEA-S) has been implicated to play a role in stress coping and recovery. The role of DHEA-S in the mood adjustment against

negative outcome for athletic competition has not previously been investigated in athletes.

**PURPOSE:** To determine the link between mood adjustment and circulating DHEA-S level following a competition for elite golfers.

**METHODS:** 14 elite golfers participated in a major national golf tournament, were subsequently divided into two groups according to their competition outcomes: made the cut (N= 8) and failed (N=6) groups. Profile of Mood States (POMS) inventory and plasma concentrations of DHEA-S and cortisol were measured 1 day before beginning of competition (baseline) and 1, 3, 5 days after their final competitions, in the morning (0800-0830) under fasted condition.

**RESULTS:** Total mood disturbance scores and DHEA-S were not changed for the made the cut group throughout the entire observation period. DHEA-S for the failed group was significantly dropped below baseline on day 1 and remained lower for 5 days. Depression subscale of POMS for the failed group was increased only on day 1 post-competition, reflecting a situational reaction on the event. Cortisol for the made the cut group was significantly dropped only on day 1 after competition and no change was observed for the failed group.

**CONCLUSIONS:** Although the post-competition overall mood state was well-maintained for those golfers who received negative competition outcome, plasma DHEA-S concentration was declined for 5 days, suggesting its role in the coping mechanism against psychological challenge.

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**2579 Board #224 May 29 8:00 AM - 9:30 AM**

**The Effect Of A Competitive Collegiate Basketball Season On Recovery-stress Scores**

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(No relationships reported)

Heavy training and competition requires adequate rest and recovery to ensure optimal performance and training. Recovery-stress scores have been suggested as a possible tool to assess recovery from training and competition.

**PURPOSE:** The aim of the present study was to observe the influence of a competitive season on Recovery-Stress for Athletics (RESTQ-Sport 76) scores in college women basketball players.

**METHODS:** RESTQ-Sport 76 scores were collected approximately monthly (T1 - T3) during the competitive season from twelve NCAA Division I women varsity basketball players. Subjects were instructed on the proper technique for answering the questionnaire at each collection time point. Additionally athletes were asked to give a RPE score (1-10 scale) at the conclusion of each conditioning session, practice, and game. This RPE score was multiplied times the number of minutes each athlete participated to yield an estimate of accumulative physical exertion (RPE-minutes). RPE-minutes were averaged for all athletes for the three days prior to each data point (to support the directions for taking the RestQ, i.e. in the past three days).

**RESULTS:** Repeated measures ANOVA failed to reveal significant differences ( $p > 0.05$ ) in mean scores of five scales: physical recovery, general stress, general well-being, emotional exhaustion, and being in shape.

**CONCLUSIONS:** Analysis of RestQ-Sport 76 scores failed to reveal any significant differences among the five scales examined. The scores were relatively stable for each scale with no more than a 0.5 unit change across the three time periods. The average RPE-minutes for the three days prior to each data collection point supported the changes in the scales examined. The results of this study support the use of the RESTQ-Sport 76 to monitor athletes during a competitive season.

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**2580 Board #225 May 29 8:00 AM - 9:30 AM**

**Psychomotor Speed As Marker For Overreaching In Young Elite Soccer Players**

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(No relationships reported)

Psychomotor slowness has recently been introduced as marker for functional and nonfunctional overreaching in sport. Since overreaching is characterized by sport-specific performance decrement (PD), research is needed that relates psychomotor speed to PD. Furthermore, the effect of exercise should be known to verify if such a tool would be suitable for sport practice. Up to now, research has focused on individual sports. However, it can be argued that ball team sport athletes differ in terms of information processing and motor action.

**PURPOSE:** To investigate if psychomotor speed before and after maximal exercise is a useful tool to classify young elite soccer players with and without PD.

**METHODS:** Eleven soccer players with PD of four up to eight weeks and eight controls (mean  $\pm$  SD: Age (years)  $16 \pm 1$ , Height (cm)  $177.3 \pm 5.64$ , Weight (kg)  $69.9 \pm 5.96$ ) were invited to the laboratory. These players were selected out of 94 players who performed monthly submaximal Interval Shuttle Run Tests. Subjects with a heart rate increase  $> 4 \text{ b} \cdot \text{min}^{-1}$  were classified as players with PD. Prior to participation, a sports physician screened all subjects to exclude well-known causes of PD. Subsequently, all players executed the Finger Precuing Task before and after a maximal exercise test on a treadmill.

**RESULTS:** No significant differences were found in mean time to exhaustion and maximal heart rate during the maximal exercise test in the PD group ( $18:01 \pm 2:22 \text{ (min)}$ ),  $190 \pm 11 \text{ b} \cdot \text{min}^{-1}$ ) and the control group ( $17:31 \pm 2:22 \text{ (min)}$ ,  $198 \pm 6 \text{ b} \cdot \text{min}^{-1}$ ). An ANOVA for repeated measures revealed shorter reaction time post compared to pre exercise (Reaction time (ms)  $444.18 \pm 13.27$  vs.  $406.68 \pm 12.32$ ,  $p < .05$ ). No between-subject effect was found (PD group:  $424.91 \pm 15.32$  vs. control:  $421.39 \pm 17.97$ ).

**CONCLUSIONS:** The results demonstrate no differences in reaction time before and after maximal exercise between soccer players with and without PD. This makes psychomotor speed as marker for overreaching in soccer players questionable. It might be that a more sport-specific reaction time task is required. Since in this study soccer players had relatively short-term PD, further research is needed that relates psychomotor speed to long-term PD.

Supported by ZonMw grant 7502.0006.

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**2581 Board #226 May 29 8:00 AM - 9:30 AM**

**Psychosocial And Lifestyle Influences On Sport Injuries: Widening The Lens Of An Injury Model**

Diane L. Elliot, FACSM<sup>1</sup>, Linn Goldberg, FACSM<sup>1</sup>, Krista L. Ranby<sup>2</sup>, Carol A. DeFrancesco<sup>1</sup>, Kristen N. Dulacki<sup>1</sup>, Esther L. Moe<sup>1</sup>, Kerry S. Kuehl<sup>1</sup>. <sup>1</sup>Oregon Health & Science University, Portland, OR. <sup>2</sup>Arizona State University, Tempe, AZ.

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Each year high school athletes experience 2 million injuries, associated with half a million doctor visits and 30,000 hospitalizations. In general female athletes experience more injuries than males, when balanced for playing time and conditions. Reducing injuries primarily relies on pre-participation screening and avoiding harmful training and playing practices. Other existing strategies to reduce injuries involve specific neuromuscular training. Injury reduction efforts fail to incorporate upstream lifestyle habits and psychological dimensions that might impact injury rate. Previously, we found a high school sport team-based curriculum that deterred disordered eating among female athletes also reduced self-reported injuries ( $p < 0.05$ ) (Arch Pediatr Adolesc Med 2004;158:1043-9). That curriculum focused on lifestyle, psychological and social influences, which suggested relationships among those factors and injury rates.

**PURPOSE:** Examine correlates of self-reported injuries to establish lifestyle and psychological dimensions of a comprehensive model of sport injuries among female high

school athletes.

**METHODS:** 1668 female high school athletes began the described intervention study (mean age 15 years primarily [90.5%] White), and reported data are from the baseline survey assessment of intervention and control participants. At baseline 70% reported no injuries preventing training in the preceding 2 months, 29% 1 or 2 injuries and 1% 3 or more injuries. Self-reported injuries were related to lifestyle and psychological survey constructs.

**RESULTS:** Those reporting injuries had stronger intentions to engage in unhealthy weight loss behaviors ( $p < 0.05$ ), had greater alcohol use in the last 3-months ( $p < 0.05$ ), were more likely to be risk takers ( $p < 0.05$ ) and had greater desire to do things perfectly ( $p < 0.001$ ).

**CONCLUSIONS:** When assessed as single factors, other investigators have reported that psychological and lifestyle dimensions are correlates of sport injury. Our findings support a broader injury model and suggest that a sport team-based health promotion program to impact lifestyle and psychological constructs could reduce sport-related injuries among young female athletes.

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**2582 Board #227 May 29 8:00 AM - 9:30 AM**  
**Athletes' Adherence To Injury Rehabilitation: A Test Of Self-determination Theory**

Shauna M. Hoff, James R. Whitehead, FACSM, Ronald H. Brinkert, Sandra E. Short. *University of ND, Grand Forks, ND.*  
(No relationships reported)

Athletes' recovery from injury largely depends on their adherence to the rehabilitation programs provided by athletic trainers.

**PURPOSE:** This study examined adherence versus non-adherence of collegiate athletes to musculoskeletal injury rehabilitation based on their motivational orientation and social motivational climate. Specifically, Self-Determination Theory (SDT) was used as a Meta-theory to guide an investigation of how athletes' perceptions of autonomy support and needs satisfaction predict their completion of rehabilitation following an injury.

**METHODS:** A total of 89 inter-collegiate NCAA Div. I/II athletes representing 15 teams provided data. The participants were classified *a priori* as adherent or non-adherent in completing rehabilitation (based on an operational definition) by the Certified Athletic Trainers working with their individual sports. Those identified as adherers or non-adherers were then invited to complete questionnaires designed to examine their perceptions of trainer competence, autonomy support, and basic needs satisfaction (autonomy, relatedness, and competence), as they relate to motivation to complete rehabilitation for injuries.

**RESULTS:** Discriminant analysis failed to distinguish between adherers and non-adherers on the basis of the motivational variables. However, hierarchical regression showed that when their athletic trainer satisfied their basic psychological needs, and when their perception of autonomy was Supported by their coaches and team peers, they felt more willing to complete rehabilitation ( $R^2 = .41$ ).

**CONCLUSIONS:** While the profile of SDT variables did not statistically discriminate between adherers vs. non-adherers, the findings partially supported SDT in that participants were more willing to seek treatment when their basic psychological needs were satisfied, and when they received autonomy support from coaches and team mates.

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**2583 Board #228 May 29 8:00 AM - 9:30 AM**  
**Illness Perceptions Of Injured Athletes: Useful In Therapy?**

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(No relationships reported)

The prevalence of injuries in sports is high. The duration of the injury and their impact is not only determined by the injury itself, but also by cognitive and behavioral influences. In this study Leventhal's Common Sense Model was used as theoretical framework.

**PURPOSE:** To examine illness perceptions in athletes with sports injuries, and their relationship with mood states.

**METHODS:** Respondents were selected from a University outpatient Center for Sports Medicine, and several physiotherapy practices. From the recruited athletes socio-demographic characteristics, history of injury, and sports characteristics were assessed, together with the Illness Perception Questionnaire-Revised-Sports (IPQ-R-S), the Profile Of Mood States (POMS), and social support.

**RESULTS:** 151 questionnaires were distributed, 101 (67%) were returned by injured athletes of which 95 were included in the study. All Athletes were under medical care. Internal consistency of the IPQ-R-S was good (10 of 12 domains Cronbach's alpha  $> .75$ ). Injured athletes appeared to have a weak illness identity, associated with a high controllability; they perceived their injury as not chronic, with minor consequences. They reported understanding the nature of their injury according to the high illness coherence score and did not have a very emotional representation. Athletes, however, whose injury lasted for at least 6 months experienced their injury to be more chronic, expected less from treatments and experienced significantly less psychological attributions. Athletes with strong emotional representations had a worse psychological mood state. The experienced social support was high, and negatively related to an emotional representation.

**CONCLUSIONS:** The findings of this study suggest that the Common Sense Model is a useful framework to understand the beliefs and emotions regarding injured athletes. The model has to be adapted for sport-specific use to contribute to clinical consequences; clinicians can incorporate patients' views into their medical management in order to increase the concordance between patient's and clinician's perceptions of the injuries, thereby increasing chances of quick and uneventful recovery.

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**2584 Board #229 May 29 8:00 AM - 9:30 AM**  
**Emotional Affects Following Sport Injury**

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It's now recognised fully that the contribution of physical activity to health and well-being is potentially significant.<sup>1</sup> In high level sports the health of an athlete is occasionally at threat. Physical injury can lead struggling athletes to a high level of anxiety or depression.

**PURPOSE:** To determine after a one year follow up the emotional state of an athlete during the injury and during the year following the injury.

**METHOD:** The athletes of Luxembourg elite divisions' teams were invited to participate in a research project concerning psychological adjustment to physical injuries. Data were gathered using self-report questionnaires. Of the questionnaires distributed ( $n = 750$ ) a total of 310 were returned, of which 262 contain sufficient data for analysis. Inclusion criteria is the athlete missing more than a week of practice;<sup>2</sup> were moderate or major injuries

**MEASURES:** The symptoms of anxiety and depression were assessed by using Hospital Anxiety and Depression Scale, HADS<sup>3</sup>. This 14 items scale is intended as a brief screening instrument for both anxiety and depression in non-psychiatric population.<sup>4</sup> Data analysis: A total of 262 athletes answered our questionnaire. Male,  $N = 198$ ; age  $24.2 \pm 6.5$ ; female  $N = 64$  age  $19.79 \pm 2.2$  From those athletes: 40.8% are uninjured; 42.4% had an injury last year, 16.5% are actually injured

**RESULTS:** More generally, uninjured athletes face a depressive episodes  $t = 1.82$ ;  $p < 0.05$ . Uninjured athlete show depressive affect, comparatively to those with recent injuries ( $t = 1.71$ ;  $p < 0.05$ ). The anxiety level is not significant whatever the time of the injury or gender of the athlete

**CONCLUSION:** In the early stage of rehabilitation, injured athletes may be cut-off from day-to-day coaching activities. Rehabilitation will often be repetitive separated from normal training. In the literature authors says that this isolation from other athletes could lead to depressive affects<sup>5</sup>. Competitive athletes are under the stress of a result, the stress of a potential

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## **E-37 Free Communication/Poster - Supplements and Doping**

MAY 29, 2009 7:30 AM - 12:30 PM

ROOM: Hall 4F

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### **2585 Board #230 May 29 8:00 AM - 9:30 AM**

#### **Lipolytic Agent Increases Plasma Norepinephrine And Metabolic Rate With Minimal Increase In Hemodynamics**

Kelsey H. Fisher-Wellman, Kelley G. Hammond, Adrianna A. Weber, Bradford J. Cole, Brian K. Schilling, Richard J. Bloomer. *University of Memphis, Memphis, TN.* (Sponsor: Larry Weiss, FACSM, FACSM)

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( K.H. Fisher-Wellman, Vital Pharmaceuticals, Contracted Research.)

**PURPOSE:** Dietary supplements targeting fat loss and increased thermogenesis are prevalent within the sport nutrition market, often with little or no objective evidence for the claims being purported. Moreover, many such products act as stimulants, leading to increased hemodynamic responses. The purpose of this investigation was to determine the effects of a novel yohimbine containing dietary supplement on plasma catecholamine concentration, metabolic rate, and hemodynamics.

**METHODS:** Ten resistance trained men (age =  $27 \pm 4$  yrs; BMI =  $25 \pm 3$  kg  $\cdot$  m $^{-2}$ ; body fat =  $9 \pm 3\%$ ; mean  $\pm$  SD) were provided a lipolytic agent and a placebo, in a random order, double blind cross-over design, with one week separating conditions. Heart rate and blood pressure were recorded, and fasting blood samples were collected before, and at 30, 60, and 90 minutes post ingestion. Blood samples were assayed for epinephrine (EPI) and norepinephrine (NE) concentration following extraction using an ELISA procedure. For a measurement of metabolic rate using indirect calorimetry, gas samples were collected from subjects from 30-60 minutes post ingestion.

**RESULTS:** A condition main effect was noted for systolic blood pressure ( $p=0.04$ ), with values increasing from  $117 \pm 2$  mmHg to  $123 \pm 2$  mmHg with the lipolytic agent, while remaining unchanged for placebo. No other hemodynamic changes were noted ( $p>0.05$ ). Area under the curve for NE was 32.8% greater ( $p=0.03$ ) for the lipolytic agent ( $1332 \pm 128$  pg  $\cdot$  mL $^{-1}$   $\cdot$  90min $^{-1}$ ) compared to placebo ( $1003 \pm 133$  pg  $\cdot$  mL $^{-1}$   $\cdot$  90min $^{-1}$ ), and values peaked at 90 minutes post ingestion. No difference between conditions was noted for EPI ( $p>0.05$ ). Total kilocalorie expenditure during the 30 minute collection period was 29.6% greater ( $p=0.02$ ) for the lipolytic agent ( $35 \pm 3$  kcal) compared to placebo ( $27 \pm 2$  kcal).

**CONCLUSION:** The lipolytic agent can increase plasma NE and metabolic rate, without altering hemodynamic variables in a clinically relevant manner within a sample of resistance trained men.

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### **2586 Board #231 May 29 8:00 AM - 9:30 AM**

#### **The Effect Of Energy Patches On Substrate Utilization In College Female Cross Country Runners**

Lee Everett, Doug Smith, Ryan Fiddler, Bert Jacobson, FACSM, Joanna Fedick, Creshel Kline, Mandy Andrews, Aric Warren, Matt O'Brien, Ali Boolani. *Oklahoma State University, Stillwater, OK.*

(No relationships reported)

Energy patches have been recently developed to give users significant improvements in performance by utilizing bioelectric stimulation produced by electrical frequencies in the body's magnetic field. These energy patches incorporate organic nanoscale biomolecular antennas into two separate patches that resonate at frequencies in unison with biomolecules in the cells and signal specific metabolic pathways to beta oxidation, using fat as a primary fuel source. Substrate utilization is an important factor for endurance athletes. Utilizing lipids for longer periods of time can improve performance by sparing carbohydrate during endurance activities.

**PURPOSE:** The purpose of the study was to examine the effects of energy patches on substrate utilization during graded exercise testing.

**METHODS:** Twelve Division I female collegiate cross country runners participated in this study. Age, height, body weight and respiratory exchange ratio (RER) were recorded during a pre-test (without patch) and then in a post-test (with patch). The post-test included a placebo patch group consisting of 5 subjects and an active patch group consisting of 7 subjects. The Bruce Protocol was used to achieve maximal exertion, while RER was recorded using a TrueMax 2400 Metabolic Measurement System. Statistical analysis was conducted using dependent t-tests with an alpha level of 0.05 denoting significant mean differences.

**RESULTS:** The results of the present study indicated no significant ( $p>0.05$ ) change in RER between the baseline RER measures and the placebo patch RER measures at any stage (1-5) and at max. There was a significant ( $p<0.05$ ) increase in RER at stage 1 vs. the baseline data for the active patch group; however, there were no other differences in RER at any of the remaining stages (2-5) and at max.

**CONCLUSION:** The results indicated no increase ( $p>0.05$ ) in lipid metabolism when wearing the active patch vs. wearing the placebo patch. In fact, the one stage that exhibited any significant difference in RER while wearing the active patch indicated a decrease in lipid metabolism. It is possible that the energy patch may increase beta oxidation with a larger sample size or by using a different testing protocol; however, in the present study the runners had no significant ( $p>0.05$ ) shift toward fat utilization in subjects wearing the active patch.

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### **2587 Board #232 May 29 8:00 AM - 9:30 AM**

#### **The Ergogenic And Clinical Effects Of Nutritional Supplement, Mass Fx<sup>TM</sup> In Resistance Trained Adult Males**

Patrick S. Dib, M.S., Corey J. Ellis, M.D., Roberta L. Pohlman, Ph.D.. *Wright State University, Dayton, OH.*

(No relationships reported)

**PURPOSE:** The purpose of this study was to determine the effects of a nutritional supplement, Mass FX<sup>TM</sup>, on muscular strength, body composition, and blood chemistries in resistance-trained adult males.

**METHODS:** Eight subjects, mean age  $25 \pm 3.02$  years, were randomly assigned to two groups ( $n=4$ ). Each group was given either Mass FX or a Placebo in a double-blind manner to be taken orally for six weeks (4 caps/day regardless of body weight). For the duration of the study, both groups followed the same training program and a diet customized to each subject's body weight in conjunction to the supplementation. Data were analyzed using Analysis of Covariance (ANCOVA) with a Bonferroni correction resulting in a family-wise level of significance of  $\alpha=0.05$ , to avoid inflation of the Type I error. To confirm results, an independent samples t-test using a Bonferroni correction with a family-wise level of significance of  $\alpha=0.05$  was performed.

**RESULTS:** Using ANCOVA, the groups were significantly different for the Bench Press outcome; whereas using the independent samples t-test, the two groups were significantly different for Bench Press and Free Testosterone ( $p=0.001$ ). The strength improvements for Mass FX compared to the placebo were the following: Bench Press ( $+14.28 \pm 7.36$  vs.  $+1.70 \pm 2.16$  kg;  $p=0.019$ ), Leg Press ( $+48.08 \pm 28.10$  vs.  $+13.58 \pm 16.11$  kg;  $p>0.05$ ), and Dead Lift ( $+15.84 \pm 5.84$  vs.  $+7.92 \pm 9.32$  kg;  $p>0.05$ ). Body composition changes were not statistically significant ( $p>0.05$ ). Group and pretreatment measures were insufficient to explain the variance for total ( $p=0.619$ ) and free testosterone ( $p=0.076$ ). No adverse effects on selected clinical health markers for complete blood count with differential, hepatic (AST, ALP, ALT), lipids (TC, TGs, LDL, VLDL), and renal (creatinine, BUN) were observed from Mass FX supplementation (Group significance  $p>0.05$ ).

**CONCLUSIONS:** The results of this study suggest that short term supplementation with Mass FX may exert ergogenic benefits without adverse clinical effects using a



controlled training program and diet. Due to limitations in terms of sample representation and size, this study should be considered a pilot study. Future studies need to investigate these parameters using larger sample sizes and longer supplementation duration.

*Supported by Anabolic Xtreme Grant.*

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**2588 Board #233 May 29 8:00 AM - 9:30 AM**  
**Acute Effect Of Lact-away Supplementation On High-intensity Kayak Performance**

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*(No relationships reported)*

Lact-Away is a new orally administered sports supplement claimed by the manufacturer to attenuate blood lactate concentration during exercise and improve performance, but there is limited research on its efficacy.

**PURPOSE:** To determine the acute effect of Lact-Away supplementation on kayak performance and related physiological measures.

**METHODS:** Twelve highly-trained kayakers were randomized in a single-blind, crossover fashion to consume either a Lact-Away or a placebo drink prior to performing a maximal incremental exercise test on a wind-braked kayak ergometer, followed 20 min later by a maximal 60-s test. The trials were performed twice in balanced order to improve precision of estimation. Performance measures were peak incremental power, lactate threshold power, heart rate threshold power and mean 60-s power. A 5-point Likert scale was used to obtain measures of gut comfort, wellness and perceived ratings of central and peripheral fatigue. Data were analyzed with mixed modeling. Clinical inferences were based on a smallest important change in performance of 1%; an effect was deemed indecisive if benefit was possible (>25% chance) but risk of harm was unacceptable (odds ratio for harm/benefit >1/66).

**RESULTS:** Effects of Lact-Away vs placebo were indecisive for measures of peak incremental power (-0.3%; 90% confidence limits,  $\pm 1.8\%$ ), mean 60-s power (0.8%;  $\pm 2.4\%$ ), heart-rate profile power (1.0%;  $\pm 1.5\%$ ) and for ratings of central and peripheral fatigue. Peak lactate concentration was substantially higher after consumption of Lact-Away following the incremental test (5.3%;  $\pm 9.4\%$ ) and the 60-s test (5.3%;  $\pm 9.7\%$ ), while lactate-profile power (-1.5%;  $\pm 1.9\%$ ) and ratings of gut comfort and wellness were decisively lower after consumption of Lact-Away.

**CONCLUSION:** The blood lactate response to exercise did not support the manufacturer's claim of a reduction following consumption of Lact-Away. Although some performance outcomes were indecisive, our findings are consistent with no worthwhile enhancement in performance. We do not recommend use of this supplement.

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**2589 Board #234 May 29 8:00 AM - 9:30 AM**  
**Effects Of Short-term Albuterol Administration On Oral Glucose Tolerance In The Elderly**

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We have previously shown that albuterol administered at a dose of 16mg/24 h over 12 weeks increased muscle mass by ~5% without the addition of exercise (Uc et al. Clin. Neuropharmacol. 26(4):207-212, 2003).  $\beta_2$  adrenergic agonists such as albuterol act to increase calpastatin activity which inhibits the calpains. Calpain inhibition has previously been shown to impair insulin stimulated glucose disposal (Sreenan et al. Diabetes 50:2013-2020, 2001). Albuterol administration could lead to impaired insulin sensitivity. Therefore, the present study was undertaken to determine the effects of 7 days of albuterol administration (16mg/24h) on the glucose and the insulin responses to a 75 g oral glucose tolerance test (OGTT). Six elderly individuals (4 men and 2 women) age: 69.3 $\pm$ 4.3 yrs, ht: 172.5 $\pm$ 10.7 cm, wt: 79.1 $\pm$ 20.6 kg, and BMI: 26.2 $\pm$ 4.3 kg/m<sup>2</sup> participated in this investigation. OGTTs were performed before and after albuterol administration with blood sampled immediately prior to and at 30,60,90, and 120 min post-ingestion of the glucose load. Glucose and insulin responses were compared utilizing a 2 way repeated measures ANOVA. Pre and post glucose and insulin areas under the curve were calculated and compared utilizing a paired t-test. No significant visit by time interaction was observed for the glucose response to the OGTT (p=0.540) or the insulin response to the OGTT (p=0.216). No significant difference between pre and post values was observed for the glucose area under the curve (12966 $\pm$ 2413 and 15124 $\pm$ 781(mg/dL) X min mean $\pm$ SE for pre and post albuterol administration, respectively; p=0.427) or the insulin area under the curve (7871 $\pm$ 1951 and 7470 $\pm$ 1603 ( $\mu$ U/ml) X min for pre and post albuterol administration, respectively; p=0.672). In conclusion, short term albuterol administration at a dose of 16 mg/24 h did not significantly alter glucose tolerance or insulin concentrations. Therefore, the administration of albuterol, at least in the short term, would not appear to have the negative effect of impairing glucose tolerance. As a result, albuterol administration should not be contraindicated for this reason.

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**2590 Board #235 May 29 8:00 AM - 9:30 AM**  
**Dietary Supplement Use Among Endurance Athletes**

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*(No relationships reported)*

Existing surveys of dietary supplement use among the general population suggest that 50-75% of adult Americans are "regular users" of dietary supplements, primarily multivitamin/mineral supplements. Supplement usage among athletes is less clear, with some reports indicating 100% usage of dietary supplement among bodybuilders, and other estimates indicating 30-50% usage among elite and non-elite endurance athletes.

**PURPOSE:** The objective of the present study was to gain a greater understanding of the awareness, perceptions, and extent of usage of dietary supplements among endurance athletes.

**METHODS:** We examined dietary supplement usage among a sample of 326 triathletes - 176 "Ironman" distance (IM, 71 females and 103 male) and 152 "Olympic" distance (OD, 63 females and 89 male) from events in 3 states. Athletes were asked 50 questions about dietary supplement usage.

**RESULTS:** Results showed that triathletes at both OD and IM distances are avid users of dietary supplements (d/wk usage = 6.1d IM / 4.5 OD), with IM tending to take more supplements for "recovery" (+20%) and "endurance" (+22%) and also tending to report greater supplement usage "after" exercise (+35%), as compared to OD. Primary sources of information about supplements comes from Friends and Training partners (89% IM/83% OD), the Internet (92% IM/95% OD), and Coaches/Trainers (65% IM/53% OD). A very high percentage of triathletes indicated difficulty finding accurate information (88-90%) and wanting more information (89-90%) about dietary supplements.

**CONCLUSION:** These data clearly show a high usage of dietary supplements among competitive triathletes, as well as a clear desire on the part of those users for additional information regarding the proper use of these products. Future research is warranted to elucidate how to best educate endurance athletes about the pros and cons of dietary supplements usage.

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**2591 Board #236 May 29 8:00 AM - 9:30 AM**  
**Further Considerations For The Diagnostic Evaluation Of Anabolic Androgenic Steroid (AAS) Associated Hepatotoxicity.**

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**PURPOSE:** The present experiment examined the potential hepatotoxic effects resulting from long term (>20years) of AAS use. This study also examined the potential link between creatine kinase (CK) and the liver aminotransferases; alanine aminotransferase (ALT), aspartate aminotransferase (AST), which were also be markedly elevated as a result of bodybuilding exercises.

**METHODS:** Subjects were divided into four distinct groups; AAS users (n=10) who were still using AAS at time of testing results: AAS users (n=10) who had been abstinent for a period greater than three months [mean + Standard Deviation (S.D): 5 + 2.3 months] (SA), bodybuilding controls (n=10) who did not use any pharmacological ergogenic aids (BC), and (n=9) sedentary male controls. Creatine kinase (CK), alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), gamma glutamyltransferase (γGT), albumin (ALB), bilirubin (BIL) and total protein (TOT-P) were analysed by dry slide technology on an Ortho Vitros 950 analyser (Ortho Clinical Diagnostics, Amersham, Bucks, UK). Data were analysed using the SPSS 10.0 for Windows statistical package. Data are presented as means + standard deviations (S.D.) Group differences were analysed using a one way ANOVA followed by a post-hoc Tukey test. Pearson product bivariate procedure was used to examine correlations between variables. Statistical significance was accepted at the P<0.05 level.

**RESULTS:** Bilirubin (BIL) was significantly higher in both AAS using groups (P<0.05) compared with the BC and SC groups. CK, AST and ALT concentrations were not significantly different between SU, SA or BC, but were significantly lower (P<0.05) in the SC group. Furthermore, there were no differences between groups for gamma glutamyl transpeptidase (γGT). Linear regression indicated relationships between CK and AST (r = 0.821; P<0.01), and with CK and ALT (r = 0.557; P<0.01), suggesting aminotransferase alterations as a consequence of muscle damage, rather than hepatotoxicity.

**CONCLUSION:** This study supports the contention that physicians should diagnostically evaluate both CK and gamma glutamyl transpeptidase (γGT) levels in the diagnosis of AAS induced hepatotoxicity.

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**2592 Board #237 May 29 8:00 AM - 9:30 AM**

**Gene Expression And Autologous Blood Transfusion - A New Advance Towards Blood Doping Detection?**

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At present, there is no detection method of autologous blood doping. It is well documented that several molecular changes occur in stored red blood cells (RBCs), commonly referred to as the "storage lesion". We therefore hypothesize that autologous transfusion will lead to a sudden exposure of cell detritus to the immune system causing a cellular and molecular immune response including gene expression alterations of white blood cells.

**PURPOSE:** To investigate the transcriptional response of T-lymphocytes after autologous blood transfusion in order to deduce a theoretical model for the detection of autologous blood doping.

**METHODS:** RBCs were stored at 4°C and reinfused after a mean interval of 35±3 days. Total RNA gene expression profiles of isolated T-lymphocytes from peripheral whole blood were measured using whole human genome microarrays prior to and at 72h and 96h after autologous blood transfusion in 6 males (24±1 yr, 182±7 cm, 71.0±3.7 kg). Functional Gene Ontology (GO) annotation clustering of differentially expressed transcripts was performed and a gene expression score (GES) assigned, representing statistical significance with a high GES. Quantitative RT-PCR was performed for selected genes to confirm microarray expression findings.

**RESULTS:** At 72h, 728 transcripts were differentially expressed (639 transcripts up-, 89 transcripts down-regulated) while at 96h, 659 transcripts (594 transcripts up-, 65 transcripts down-regulated) were regulated. The most significant GO clusters of regulated genes at 72h included leukocyte immunoglobulin receptors (GES=7.44), toll-like receptor pathway (TLR, GES=2.25), adaptive immune response (GES=2.21) and cell death/apoptosis (GES=2.21) as well as regulation of endocytosis of surface receptors (GES=2.51) and the TLR pathway (GES=1.62) at 96h, respectively. The qRT-PCR confirmed significant up-regulation of TLR4, TLR5, TLR6, AATK and LRP1 at 72h as well as TLR6 at 96h.

**CONCLUSIONS:** Autologous blood transfusion triggers a distinct immune reaction. The observed up-regulation of genes involving immune cell activation and apoptosis may be related to the so-called storage lesion. Although having pilot character, this study may aid in the development of a practicable method to detect autologous blood doping based on molecular immune response measurements.

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**2593 Board #238 May 29 8:00 AM - 9:30 AM**

**Lc-ms-ms Screening Method For The Simultaneous Detection Doping In Diuretics And Stimulants**

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(No relationships reported)

Diuretics and stimulants were prohibited substances by World Anti-Doping Agency (WADA). Recently, the excellent suitability of liquid chromatography tandem mass spectrometry for the analytical screening of prohibited substances has been demonstrated. However, far fewer simultaneous methods have been reported for diuretics and stimulants by LC-MS-MS.

**PURPOSE:** A fast and selective liquid chromatography-tandem mass spectrometric (LC-MS-MS) method for the screening of diuretics and stimulants in human urine was developed.

**METHODS:** For the sample preparation prior to LC-MS-MS analysis, the urine sample was solid phase extracted and filtered through 0.45 μm syringe filter. The assay by LC-MS-MS in positive and negative ionization mode uses an electrospray ionization source (ESI) and multiple reaction monitoring (MRM) as the acquisition mode.

**RESULTS:** All stimulants and diuretics were separated in less than 13.1 min. The limits of detection were in the range of 5~500ng/mL for diuretics, and in the range of 5~50ng/mL for stimulants.

**CONCLUSIONS:** Thus satisfying the minimum required performance limits (MRPL) set by the WADA for the accredited anti-doping laboratories. This method can both shorten the pre-processing period and reporting time.

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**2594 Board #239 May 29 8:00 AM - 9:30 AM**

**Doping In Fitness-sports - A Five Year Follow-up Study**

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(No relationships reported)

Doping in sports is a problem that should not be underestimated; neither in competitive nor recreational but particularly not in fitness sports.

**PURPOSE:** In a five year follow up study, we examined to what extent the use of doping substances and illicit drugs by fitness center athletes has changed since the study in 2002.

**METHODS:** A total of 438 members of 84 of the fitness studios which were part of the 2002 study were questioned using an anonymous questionnaire. Athletes were questioned about their use of doping substances, their sources of information, and suppliers.

**RESULTS:** The prevalence of doping decreased by 2.7% to a total of 10.8%. In contrast to this, the use of illicit drugs increased by 8.4% to a total of 24.3%. Anabolic androgenic steroids, used by 76.6%, remained the most commonly used doping substance. The number of athletes who received doping substances through the health care system decreased by 11.9% to 36.2%. The main sources of supply named were other athletes (59.6%) and the black market outside the fitness center (57.4%). Reasons for using doping substances were still primarily body styling and increasing strength. Athletes reported that their sources of information were mainly physicians (45.7%) and the internet (40.0%). While only 0.3% of the questioned athletes reported having had legal problems due to doping, 6.5% reported legal problems related to illicit drugs.

**CONCLUSION:** Our results show a simultaneous reduction of doping substance use and an increase of illicit drug use, despite the observation that the number of athletes reporting legal problems as a result of their use of illegal substances is more than 20 times higher. A stricter law regarding the use of doping substances, therefore, does not look promising. Rather, based on their specialized knowledge, sports physicians and pharmacists should take on the responsibility of educating athletes about the possible harmful consequences of using doping substances. The decrease in the number of doping substances obtained through the health care system appears to be a step in the right direction.

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## **E-38 Free Communication/Poster - Women's Health: Observational and Intervention Studies**

MAY 29, 2009 7:30 AM - 12:30 PM  
ROOM: Hall 4F

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### **2595 Board #240 May 29 8:00 AM - 9:30 AM**

#### **Chasing The Kids: Does It Count? An Examination Of Physical Activity In Middle Aged Mothers**

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(No relationships reported)

Middle aged mothers with young children are one population in which more activity-based research is needed in order to plan gender-specific physical activity interventions.

**PURPOSE:** To examine the amount and pattern of physical activity obtained by middle aged mothers with young children, and compare those activity patterns to national physical activity guidelines.

**METHODS:** Fifty eight women ( $36.9 \pm 4.1$  years) with young children ( $< 6$  years) wore the Actigraph accelerometer for 7 days and completed a self report that consisted of the Kaiser Physical Activity Survey (KPAS) and the physical activity section of the Behavioral Risk Factor Surveillance System (BRFSS). Cross tabulation tested agreement between Actigraph and BRFSS data. Spearman rank correlation coefficients expressed associations among physical activity variables (Actigraph, KPAS, BRFSS) and between physical activity and demographic variables. Participants were sorted as meeting or not meeting physical activity guidelines, and differences in the context of physical activity were tested using Kruskal-Wallis analyses.

**RESULTS:** Actigraph data indicated that 31.7% of the women meet physical activity guidelines, while responses to BRFSS questions indicated 65.5%. Actigraph and BRFSS data were most concordant in the least active women. Spearman rank correlation coefficients indicated associations between older age ( $r = .32, p < .05$ ) and higher level of education ( $r = .34, p < .01$ ) with higher levels of physical activity, while working full-time, compared to homemaking, was associated with higher levels of physical inactivity ( $r = .27, p < .05$ ). KPAS sports/exercise index scores were positively associated with MVPA ( $r = .30, p < .05$ ), as measured by the Actigraph, and MVPA ( $r = .72, p < .01$ ) and frequency of MVPA ( $r = .60, p < .01$ ), as measured by BRFSS questions. KPAS household/care giving index scores, which includes chasing the kids, were not associated with meeting activity guidelines ( $r = .01$ ).

**CONCLUSION:** In this sample of middle aged mothers with young children, sports/exercise participation enhanced the likelihood of meeting physical activity guidelines, while it appeared that "chasing the kids" did not.

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### **2596 Board #241 May 29 8:00 AM - 9:30 AM**

#### **Maternal Physical Activity And Risk Of Small-for-gestational-age Among Latina Women**

Audra L. Gollenberg, Penelope Pekow, Elizabeth Bertone-Johnson, Patty S. Freedson, FACSM, Lisa Chasan-Taber, FACSM. *University of Massachusetts-Amherst, Amherst, MA.*

(No relationships reported)

The majority of studies of physical activity and risk of adverse birth outcomes have focused on leisure time physical activity and have not assessed other types of activity relevant to women of reproductive age (e.g. household, childcare, occupational).

**PURPOSE:** To estimate the association between multiple domains of physical activity before and during pregnancy and risk of small-for-gestational-age (SGA).

**METHODS:** We utilized data from 1,040 members of the Latina GDM Study, a prospective cohort of Latina prenatal care patients in Western Massachusetts. Physical activity was assessed by bilingual interviewers using a modified version of the Kaiser Physical Activity Survey in early (mean=15 weeks) and mid pregnancy (mean=28 weeks). Physical activity (i.e., sports/exercise, household, occupational, and active living) in pre, early and mid pregnancy was categorized in quartiles. Gestational age and birth weight were abstracted from medical records. SGA was classified as  $< 10$ th percentile of birth weight for gestational age.

**RESULTS:** Fourteen percent ( $n=148$ ) of participants were classified as having delivered an SGA infant. After adjusting for maternal age, parity, body mass index, and education, activity in pre and early pregnancy was not associated with SGA. In mid pregnancy, women with the highest level of total activity had a decreased risk of SGA ( $OR=0.44, 95\% CI 0.22, 0.86; p_{trend}=0.003$ ) as compared to women with low levels of total activity. Findings were similar, but not consistently statistically significant, for the highest levels of household activity ( $OR=0.69, 95\% CI 0.34, 1.39; p_{trend}=0.10$ ) and active living ( $OR=0.64, 95\% CI 0.36, 1.14; p_{trend}=0.05$ ). In contrast, women in the highest quartile of sports/exercise activity in mid pregnancy had an increased risk of SGA ( $OR=2.01, 95\% CI 1.01, 4.33$ ) as compared to women in the lowest quartile, however there was not a significant dose-response association ( $p_{trend}=0.34$ ). In addition, mean birth weight did not differ significantly across levels of sports/exercise.

**CONCLUSIONS:** Risk of SGA differed by domain and timing of physical activity. Results support prior studies in predominantly non-Hispanic women that activity has an overall neutral or favorable effect on fetal growth.

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### **2597 Board #242 May 29 8:00 AM - 9:30 AM**

#### **Examining The Stability Of Activity Monitors In Pregnancy**

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(No relationships reported)

The amount of time pregnant women spend in physical activity (PA) is not well-understood due to the conceptual and methodological issues with measuring PA in this

population. Objective measures provide a more accurate assessment of PA and have been well-studied and validated in non-pregnant populations. However, no studies have assessed the stability of objective PA measures across the pregnancy trimesters.

**PURPOSE:** To assess the stability of three PA monitors during a controlled treadmill walking protocol in pregnant women at 20- and 32-weeks gestation.

**METHODS:** Women (N = 17, M age = 31±5 yrs; BMI = 27±5 k.g.m<sup>-2</sup>) wore Actigraph accelerometers, NL1000 and Yamax pedometers, and walked on a treadmill for 5 min at four different speeds (54 m.min<sup>-1</sup>, 67 m.min<sup>-1</sup>, 80 m.min<sup>-1</sup>, and 94 m.min<sup>-1</sup>) at 20- and 32-weeks gestation. Measures included waist circumference, accelerometer tilt, BMI, heart rate (HR), and min-by-min VO<sub>2</sub>. Stability was determined using paired-samples t-tests.

**SUMMARY OF RESULTS:** A significant difference in Actigraph activity counts from 20- (20,399±2,546 counts) to 32-weeks gestation (16,678±2,833 counts) was observed at 94 m.min<sup>-1</sup>, t(9) = 3.58, p = 0.01. A significant difference was also observed for BMI from 20- (26.8±5.2 k.g.m<sup>-2</sup>) to 32-weeks gestation (29.3±5.6 k.g.m<sup>-2</sup>), t(15) = -11.04, p < 0.001; however, no significant differences were found for steps (NL1000 and Yamax), min of MVPA (NL1000), waist circumference (mm), tilt (degrees), VO<sub>2</sub> (ml.kg.min<sup>-1</sup>), and HR (bpm) at any of the four speeds from 20- to 32-weeks.

**CONCLUSION:** While tilt and waist circumference did not change, BMI significantly increased and the stability of the Actigraph activity counts was compromised at the fastest speed. Steps and min of MVPA remained consistent across pregnancy trimesters confirming the stability of the Yamax and NL1000 pedometers. It is possible that the distribution of weight gain may affect the stability of the Actigraph at increased speeds; however, further research is needed to test this assumption.

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**2598 Board #243 May 29 8:00 AM - 9:30 AM**

**Physical Activity Beliefs, Barriers, and Enablers Among Postpartum Women: The Pin Postpartum Study**

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(No relationships reported)

Physical activity during postpartum is both a recommended and essential contributor to maternal health. Understanding the beliefs, barriers, and enablers to physical activity during postpartum can more effectively tailor physical activity interventions to the needs of mothers.

**PURPOSE:** The objective of this study was to document maternal self-reported beliefs, barriers, and enablers to physical activity among a cohort of women queried at 3- and 12-months postpartum.

**METHODS:** Five questions about beliefs regarding physical activity and exercise were asked of 667 postpartum women at 3-months postpartum who were enrolled in the PIN Postpartum Study. Two open-ended questions about their main barriers and enablers to physical activity were also self-reported. Among the sample, 530 answered the same questions about barriers and enablers to physical activity at 12-months postpartum. These barriers and enablers were coded into categories according to the socio-ecologic framework, including intrapersonal, interpersonal, environmental/policy, and organizational levels.

**RESULTS:** Agreement on all five beliefs statements were high (≥90%), indicating that women agreed that exercise and physical activity were appropriate at 3-months postpartum, even if continuing to breastfeed. When exploring differences across groups, the only differences found were by education; those with less education reported lower agreement on the belief statements. For the cohort, the most common barrier to physical activity at both 3- and 12-months postpartum was lack of time (47% and 51%, respectively), followed by issues with child care (26% and 22%, respectively). No barrier changed by more than 5% from 3- to 12-months postpartum. The most common enablers at 3-months postpartum were partner support (15%) and desire to feel better (13%). From 3- to 12-months postpartum, only one enabler changed by more than 5%; women reported baby reasons (e.g., baby healthier, more active) more often at 12-months than at 3-months postpartum (32% vs. 10%). Environmental/policy and organizational barriers and enablers were reported less often than intrapersonal or interpersonal barriers at both time points.

**CONCLUSIONS:** This study provides information to create more successful interventions to help women be physically active during postpartum.

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**2599 Board #244 May 29 8:00 AM - 9:30 AM**

**Predictors Of Onset Of Knee Pain In Community-dwelling Elderly Women: A Prospective Study**

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(No relationships reported)

Knee pain is a common public health concern in older people. Predictors of its onset among community-dwelling elderly women have not been clear.

**PURPOSE:** To investigate determinants of onset of knee pain in community-dwelling elderly Japanese women.

**METHODS:** A prospective cohort study with 1-year follow-up was conducted among community-dwelling elderly women aged 50 and over in Kakeya, Unnan City, Shimane Prefecture, in rural Japan. 126 subjects without knee pain at baseline were prospectively followed over a 1-year period and assessed self-reported knee pain. Baseline surveys of potential predictors were physical (body mass index, low back pain), demographic (age, employed), psychological (depression) variables and physical activity (intensity of daily activity, daily means of transportation), and physical function (maximum walking speed, anteflexion). Predictors related to onset of knee pain were assessed by calculating odds ratios (OR) and their 95% confidence intervals (CI) adjusted for all measures at baseline using logistic regression.

**RESULTS:** The incidence of knee pain at the 1-year follow-up was 19.0% (24/126) among subjects with no knee pain at baseline. Baseline factors significantly associated with onset of new knee pain were overweight (BMI ≥ 25, OR 5.08, 95% CI 1.33-19.40, depression (OR 4.10, 95% CI 1.28-13.19), vigorous daily activity (OR 5.62, 95% CI 1.20-26.41) and low back pain (OR 2.96, 95% CI 1.02-8.60). Using inactive transportation (bus, train, car and motorbike) showed a somewhat increase but statistically insignificant OR (2.93, 95% CI 0.93-9.26, p=0.067) as compared with active transportation (walking and bicycle).

**CONCLUSIONS:** Overweight, depression, vigorous daily activity, and low back pain were associated with onset of knee pain among rural Japanese elderly women.

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**2600 Board #245 May 29 8:00 AM - 9:30 AM**

**Relationship Between Physical Activity And Body Habitus Among Free-living Women**

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(No relationships reported)

Physical activity (PA) is an important aspect of a healthy lifestyle when conducted at sufficient frequency, duration, and intensity to achieve a health benefit. Obesity is a major health issue that can affect morbidity and mortality risk. Previous studies have shown that PA attenuates many health risks associated with overweight and obesity.

**PURPOSE:** To determine the relationship between body habitus and self-reported (SR) PA behaviors.

**METHODS:** Body habitus measures obtained at baseline included body fat, height, weight, and BMI. Demographics included race and age. PA levels were estimated from self-reported moderate and vigorous PA (MVPA) and step count (SC) obtained weekly for up to 1.8 years (mean 0.8 ± 0.4). 556 women (mean age 52.3 ± 12.9) were categorized into 2 PA groups defined as whether they met sufficient MVPA level (≥500 MET-min/wk) and whether they met sufficient SC (≥7500 steps/day). Correlations were calculated between body habitus variables and PA measures. We used logistic regression (LR) models to evaluate body habitus measures as predictors of sufficient PA



level after adjustment for age and race separately for PA measures. LR was conducted with sufficient/insufficient defined from PA via 1) MET-min/week and 2) average steps/week. Variables in the LR model included body habitus, age, and race.

**RESULTS:** Bivariate correlations confirm that increased BMI relates to reduced SR-MVPA MET-min ( $r = -.20, p < .0001$ ) and SC per week ( $r = -.30, p < .0001$ ). Similar results were obtained for body fat ( $r = -.20, p < .0001$  and  $r = -.31, p < .0001$ ) for SR-MVPA MET-min and SC per week, respectively. Four LR models controlling for age and race indicated that unit increases in BMI or percent fat resulted in approximately a 5% decrease ( $0.93 < ORs < .96$ ;  $CI = 0.91-0.98$ ) in the odds that an individual would be categorized as meeting sufficient PA guidelines for a health benefit. Age and race were unrelated in both body fat models. Race ( $OR = 1.64$ ;  $95\%CI = 1.03-2.60$ ) was related in the MET-min/BMI model and age ( $OR = 0.98$ ;  $95\%CI = 0.98-0.99$ ) was related in the steps/BMI model.

**CONCLUSIONS:** In a population of free-living women, increases in body habitus are related to decreases in PA levels. Using long-term PA assessment, these results confirm the relationship between BMI, body fat, and measures of PA.

Sponsored by NIH Grant R01 AR052459-03

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**2601 Board #246 May 29 8:00 AM - 9:30 AM**

**Do Sex Steroids Contribute Significant Information Above Central Obesity In The Prediction Of Metabolic Risk?**

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**PURPOSE:** Sex steroids and sex hormone binding globulin (SHBG) have been used to predict cardiometabolic variables (CMV) associated with coronary heart disease risk and diabetes. Since waist circumference (WAIST) and visceral adipose tissue (VAT) are suitable anthropometric surrogates of CMV, this study was conducted to evaluate the contribution of androgens and SHBG to the prediction of CMV above that of WAIST and VAT.

**METHODS:** A total of 66 overweight/obese premenopausal Caucasian (CA) ( $n=36$ ) and African-American (AA) ( $n=30$ ) women interested in receiving weight management information, volunteered to participate in the study. All women were "apparently healthy" and none were taking any medications that would affect CMV. In addition to anthropometric measurements, serum samples were taken following an overnight fast to evaluate CMV.

**RESULTS:** Our findings showed that SHBG significantly predicted serum insulin ( $p = 0.003$ ) insulin resistance ( $p = 0.006$ ) and HDL<sub>2</sub> ( $p = 0.011$ ) above that of WAIST. In contrast, TT predicted many more variables above that of WAIST including: systolic ( $p < 0.001$ ) and diastolic ( $p < 0.001$ ) blood pressure (BP) total cholesterol (TChol) ( $p = 0.002$ ) TChol/HDL cholesterol ( $p = 0.052$ ) and Apo B ( $p = 0.002$ ). Free testosterone using the Free Androgen Index (FAI) predicted the most CMV above WAIST including: systolic BP ( $p = 0.004$ ) diastolic BP ( $p = 0.002$ ) fasting insulin ( $p = 0.009$ ) insulin resistance ( $p = 0.016$ ) TChol ( $p = 0.035$ ) HDL Cholesterol ( $p = 0.036$ ) LDL Cholesterol ( $p = 0.029$ ) and Apo B ( $p = 0.042$ ). There was also a significant race by FAI interaction for serum glucose ( $p = 0.029$ ) with CA women showing a positive relationship between FAI and glucose above WAIST ( $r = 0.477$ ;  $p = 0.004$ ) and AA women showing no relationship ( $r = -0.074$ ;  $p = 0.721$ ). Substituting VAT for WAIST almost mirrored the results obtained using sex steroids and SHBG to predict CMV.

**CONCLUSION:** In contrast to SHBG, both TT and FAI contributed to numerous CMV above that of central obesity measures, thereby providing a more comprehensive evaluation of metabolic risk in overweight/obese CA and AA women. It should be noted, however, that FAI may not provide sufficient information regarding glucose status in AA women.

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**2602 Board #247 May 29 8:00 AM - 9:30 AM**

**Comparison Of Subjective And Objective Assessments Of Physical Activity In Healthy Women**

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Valid assessment and quantification of physical activity (PA) status remains a challenge; specifically for studies that seek definitive answers to questions of health efficacy of PA in sub-populations at risk for disease. Overestimation is a concern for self-report and questionnaire assessments, but low cost and ease of administration make them the most common methods for assessing PA. The pedometer is a valid and more precise option for assessing PA in research; however, it cannot provide important contextual information. A combination of subjective and objective assessments may be useful to better evaluate and understand the health-efficacy of PA in various sub-populations.

**PURPOSE:** To compare pedometer step count (an objective method for assessing PA) and MET\*min/day (a combination method for assessing PA), with activity recall questionnaires in healthy women.

**METHODS:** Sixty-two women (Age: Mean  $\pm$  SD =  $38.6 \pm 4.5$  yr, BMI =  $25.2 \pm 5.6$  kg/m<sup>2</sup>) completed a physical activity questionnaire (PAQ) to quantify recent and long-term PA patterns (Paffenbarger et al. N Engl J Med 1986). Energy expenditure from recreational activities over the last year was expressed in kcals/week. Subjects wore pedometers for 4 days to determine an average daily step count (PA range: 2,593-18,878 steps/d). Subjects also completed a 4-day self-reported PA log to account for more strenuous activities when the pedometer was removed; an average MET\*min/day was calculated which incorporated the activity log and pedometer step count.

**RESULTS:** Pedometer step count correlated with daily blocks walked reported in the last year from the PAQ ( $r=0.46, p<0.01$ ), but not with recreational PA. MET\*min/day correlated only with the yearly recreational PA recall ( $r=0.35, p<0.01$ ).

**CONCLUSIONS:** While pedometer step count reflects incidental daily activity, it does not account for many types of planned physical activity. MET\*min/day, which combines both subjective and objective measures of PA, provides a more complete assessment of chronic PA patterns in healthy women. An overall assessment of PA using MET\*min/day may provide greater insight into the health efficacy of PA, which is of interest to researchers and health professionals.

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**2603 Board #248 May 29 8:00 AM - 9:30 AM**

**Lumbar Spine Flexion And Extension Extremes Of Motion In Women Of Different Age And Racial Groups**

Elaine Trudelle-Jackson<sup>1</sup>, James R. Morrow, Jr., FACSM<sup>2</sup>, Lisa A. Fleisher<sup>1</sup>, Nicole P. Borman<sup>1</sup>, Georita M. Frierson<sup>3</sup>. <sup>1</sup>Texas Woman's University, Dallas, TX. <sup>2</sup>University of North Texas, Denton, TX. <sup>3</sup>The Cooper Institute and Southern Methodist University, Dallas, TX.  
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Spinal range of motion (ROM) is one of the AMA Guides criteria used to estimate level of impairment and subsequent compensation entitlement. Studies show that spinal ROM varies with age, gender and possibly race/ethnicity but adequate normative values for women in different age and racial/ethnic groups do not exist.

**PURPOSE:** To provide normative values of lumbar flexion and extension for women of different age and racial groups using inclinometric measurements and compare lumbar flexion and extension values between age and racial groups.

**METHODS:** Participants were a cohort of free-living women who were recruited for the Women's Injury Study (WIN) at the Cooper Institute in Dallas, Texas. Nine hundred and seventeen women between the ages of 20 and 83 ( $M=52 \pm 13$ ) underwent an orthopedic examination that included lumbar spine flexion and extension measurement using an electronic inclinometer. Measurements were taken in the fully extended and fully flexed positions, respectively. This was done in order to remove the influence of initial



resting posture and is appropriately termed “extreme of motion” (EOM) as opposed to ROM. Comparisons between age and racial groups were made using a 2-way MANOVA with appropriate post hoc tests.

**RESULTS:** Means (+ SD) were calculated for racial (Caucasian, N = 619, African-American, N =147) and age groups (young; 20-39yrs, n=126, middle; 40-59yrs, n=412, older; > 60yrs, n=228). Lumbar extension for African-American women (60.1°) was significantly greater ( $p<0.05$ ) than for Caucasian women (52.6°) but flexion was not different (15.2° and 17.0°), respectively. Extension EOM for the young group (61.6°) was greater ( $p<0.05$ ) than the middle (56.6°) and older (50.8°) groups. The extension difference between the middle and older groups was also statistically significant. Flexion EOM for the young group (20.1°) was greater ( $p<0.05$ ) than the middle (15.2°) and older (12.8°) groups. The difference in flexion between the middle and older groups was not significant.

**CONCLUSION:** Normative values of lumbar extension are different for Caucasian and African-American women. Values for lumbar flexion and extension are different between age groups. Therefore, different criteria should be used to estimate impairment level in women of different racial and age groups.

Sponsored by NIH Grant R01 AR052459-01

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**2604 Board #249 May 29 8:00 AM - 9:30 AM**  
**Seasonal Variation And Objective Measures Of Physical Activity In Women Aged 65-75 Years**

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(No relationships reported)

Physical activity is an important component of a healthy lifestyle. Many factors can influence the uptake and adherence of an exercise program including the weather or reduced daylight hours. There are few reports on the seasonal variation of physical activity in older women, and even fewer that have used objective measures to capture physical activity patterns.

**PURPOSE:** To investigate the influence of season on daily moderate to vigorous physical activity (MVPA) minutes in healthy older women.

**METHODS:** The physical activity measures were part of a one-year randomized controlled trial of resistance training for community-dwelling women aged 65-75 years. Participants (N=77) wore a waist-mounted uni-axial accelerometer (GT1M ActiGraph, LLC, Fort Walton Beach, FL) 10 or more hours/day for at least four days over one week at four different times of the year. Days were included if participants had 10 hours of valid wear time. We used the cutpoints established by Freedson and colleagues for MVPA ( $\geq 1952$  counts). We compared seasonal variation in MVPA over time using repeated measures ANOVA. We also determined adherence to guideline recommendations by calculating the percentage of participants who met 30 minutes of MVPA.

**RESULTS:** Women had a mean age of  $69.7 \pm 2.8$  years and mean BMI of  $26.3 \pm 4.3$ . The mean ( $\pm$  SD) number of MVPA minutes for summer was  $27.4 \pm 23.0$ ; in fall was  $23.5 \pm 19.2$ ; in winter was  $23.5 \pm 20.7$ ; and in spring was  $26.6 \pm 23.4$ . There was no significant difference between seasons for minutes of MVPA. In summer 42% of participants met activity guidelines and approximately 30% of participants met guidelines during the other seasons.

**CONCLUSION:** In this group of healthy community-dwelling older women, we note there was no significant seasonal variation in objectively measured MVPA over one-year.

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**2605 Board #250 May 29 8:00 AM - 9:30 AM**  
**Influence Of Menopausal Status On Lipids And Lipoproteins And Fat Mass Distribution: The Pioneer Project**

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(No relationships reported)

Following menopause, fat redistribution and increased risk for dyslipidemia are common. The influence of menopause; however, on the associations between total and regional fat mass with lipids and lipoproteins remains unclear.

**PURPOSE:** The purpose of this investigation was to determine the influence of menopausal status on associations between total and regional fat mass and lipids and lipoproteins.

**METHODS:** Sedentary, non-smoking women (n=209) were grouped based on current menstrual status: premenopausal (n=143, mean $\pm$ SD; age=42.7 $\pm$ 7.7 yr, BMI=24.5 $\pm$ 4.0 kg·m<sup>-2</sup>, WC=77.4 $\pm$ 9.9 cm) or postmenopausal (n=66, mean $\pm$ SD; age=52.9 $\pm$ 5.3 yr, BMI= 24.9 $\pm$ 4.2 kg·m<sup>-2</sup>, WC=78.8 $\pm$ 9.9 cm). Fasting (12 hr) serum samples were analyzed for total cholesterol (TC), triglyceride (Tg), LDL-C, HDL-C, HDL<sub>2</sub>-C, and HDL<sub>3</sub>-C concentrations. Total (TF), abdominal (AF), hip (HF) and mid-thigh (MTF) fat mass were quantified by DXA. A MANCOVA was used to determine differences between groups for total and regional fat mass and lipids and lipoproteins controlling for HRT status. Stepwise multiple regression analysis was used to determine if menopausal status influenced the association of total and regional fat mass with lipids and lipoproteins. The criterion reference for statistical significance was set at a  $P < 0.05$ .

**RESULTS:** Postmenopausal women had significantly greater TC, HDL-C, LDL-C and HDL<sub>3</sub>-C concentrations than premenopausal women. No significant differences were observed between groups for total and regional fat mass. In premenopausal women, AF predicted TC, but no associations were observed in postmenopausal women. In premenopausal women, AF+HF and AF+MTF were significant predictors of Tg and LDL-C, respectively. In contrast, only AF predicted Tg and LDL-C in postmenopausal women. AF+MTF best predicted HDL-C in premenopausal women; however, TF+MTF best predicted HDL-C in postmenopausal women. In premenopausal women, no associations were observed with HDL<sub>2</sub>-C or HDL<sub>3</sub>-C. TF and TF+MTF were best predictors of HDL<sub>2</sub>-C and HDL<sub>3</sub>-C, respectively in postmenopausal women.

**CONCLUSION:** Menopausal status has an effect on lipid and lipoprotein-cholesterol concentrations, but not on total and regional fat mass. In addition, menopausal status had an influence on the associations of total and regional fat mass with lipids and lipoproteins.

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**2606 Board #251 May 29 8:00 AM - 9:30 AM**  
**Habitual Physical Activity Affects Brachial Artery Reactivity In Women Who Are Postmenopausal And Overweight**

Carl M. Maresh, FACSM, Kate E. Sanders, Kevin D. Ballard, Jeffrey M. Anderson, Jaci L. VanHeest, Jeff S. Volek, William J. Kraemer, FACSM. *University of Connecticut, Storrs, CT.*

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(No relationships reported)

The growing awareness of cardiovascular disease in women has intensified the concern for excess body weight in older age, especially after menopause. Furthermore, the inverse relationship of frequent, moderate-intensity exercise and all-cause mortality in post-menopausal women has been documented, but the mechanisms have received sparse attention in research.

**PURPOSE:** To examine brachial artery reactivity in women who exercise regularly, and who are post-menopausal and overweight.

**METHODS:** Regularly exercising women (EX: n=17; 55 $\pm$ 3 yrs; consistently exercising > 6 mo) were compared to sedentary women (CON: n=8; 56 $\pm$ 7 yr; sedentary > 6 mo) for cardiovascular fitness, measures of body composition, and brachial artery reactivity via flow mediated dilation (FMD). All of the women reported the complete cessation of menses for > 12 mo and were non-users of hormone therapy, medications or nutritional supplements that might have vasoactive properties. All were non-smokers and were weight stable over the previous six months. Exercise was defined by self-reported physical activities that, when equated for METs, represented > 3days/wk of moderate intensity (50-60% of VO<sub>2</sub>max) cardiovascular training. t-tests corrected for multiple comparisons were run for all appropriate measurements.

**RESULTS:** The groups were similar in body fat via DEXA (EX, 42.8±5.5 vs CON, 45.5±3.8%). Estimated VO<sub>2</sub>max was insignificantly higher in EX than CON (28±5 vs 24±4 ml/kg/min). FMD was greater (P<0.002) in EX (10.2±2.4%) than CON (6.6±2.2%).

**CONCLUSIONS:** We demonstrated that regularly performed exercise of a primarily aerobic nature appears to contribute to a higher FMD, presumably reducing endothelial dysfunction, in women who are both post-menopausal and overweight.

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## **F-22 Free Communication/Poster - Clinical Exercise Physiology**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### **2607 Board #1 May 29 2:00 PM - 3:30 PM**

#### **Comparison Of Body Fat Content And Distribution Of Familial Amyloidotic Polyneuropathy Patients Versus Healthy Subjects**

Nuno Pimenta<sup>1</sup>, Helena Santa-Clara<sup>2</sup>, Maria Teresa Tomás<sup>3</sup>, Estela Monteiro<sup>4</sup>, Jan Cabri<sup>5</sup>, António Freire<sup>6</sup>, Eduardo Barroso<sup>6</sup>, Luís Bettencourt Sardinha<sup>5</sup>, Bo Fernhall, FACSM<sup>7</sup>. <sup>1</sup>*Sport Sciences School of Rio Maior, Politechnic Institute of Rio Maior, Rio Maior, Portugal.* <sup>2</sup>*Faculty of Human Kinetics, Technical University of Lisbon, Lisbon, Portugal.* <sup>3</sup>*Health Technologies School, Polytechnic Institute of Lisbon, Lisbon, Portugal.* <sup>4</sup>*Faculty of Medicine, University of Lisbon, Lisbon, Portugal.* <sup>5</sup>*Faculty of Human Kinetics, Technical University of Lisbon, Lisbon, Portugal.* <sup>6</sup>*Curry Cabral Hospital, Lisbon, Portugal.* <sup>7</sup>*University of Illinois Urbana-Champaign, Champaign, IL.*

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The deposition of amyloid fibers at the peripheral nervous system can induce motor neuropathy in Familial Amyloidotic Polyneuropathy (FAP) patients. This produces progressive reductions in functional capacity. The only treatment for FAP is a liver transplant, followed by aggressive medication that can affect patients' metabolism. To our knowledge, there are no data on body fat distribution or comparison between healthy and FAP subjects, which may be important for clinical assessment and management of this disease.

**PURPOSE:** To analyze body fat content and distribution between FAP patients and healthy subjects.

**METHODS:** Body fat content and distribution were measured through Double Energy X-ray Densitometry (DXA) in two groups. Group 1 consisted of 43 Familial Amyloidotic Polyneuropathy patients (19 males, 32 ± 8 Yrs, and 24 females, 37 ± 5 yrs), who had liver transplant less than 2 months before. Group 2 consisted of 18 healthy subjects of similar age (8 males, 36 ± 7 yrs, and 10 females, 39 ± 5 yrs).

**RESULTS:** Healthy subjects showed higher values than FAP patients for: BMI (24.2±2.3 kg/m<sup>2</sup> vs 22.3±3.8 kg/m<sup>2</sup> respectively, p<0.05), % trunk BF (26.21±8.34 kg vs 20.78±9.05 kg respectively, p<0.05), % visceral BF (24.43±7.97% vs 19.21±9.30% respectively, p<0.05), % abdominal BF (26.63±8.51% vs 20.63±10.35% respectively, p<0.05) abdominal subcutaneous BF (0.533±0.421 kg vs 0.353±0.257 kg respectively, p=0.05), abdominal BF/BF ratio (0.09±0.02 vs 0.08±0.02 respectively, p<0.05) and abdominal BF/trunk BF ratio (0.19±0.03 vs 0.17±0.03 respectively, p<0.05).

**CONCLUSIONS:** These results showed that FAP patients soon after liver transplantation exhibited a healthier body fat profile compared to controls. However, fat content and distribution varied widely in FAP subjects, suggesting an individualized approach for assessment and intervention rather than general guidelines. Future research is needed to investigate the long term consequences on body fat following liver transplant in this population.

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### **2608 Board #2 May 29 2:00 PM - 3:30 PM**

#### **Visceral & Abdominal Subcutaneous Fat And Body Composition In Motor Complete Spinal Cord Injury**

Ashraf S. Gorgey<sup>1</sup>, Anthony E. Chiodo<sup>2</sup>, Gianna M. Rodriguez<sup>2</sup>, David R. Gater<sup>1</sup>. <sup>1</sup>*Hunter Holmes McGuire VA Medical Center, Richmond, VA.*

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(No relationships reported)

Visceral adiposity (VA) and abdominal subcutaneous adipose tissue (SAT) are associated with increased risks of metabolic and cardiovascular diseases. Waist circumference (WC) has been used as an accurate surrogate of VA. The distribution of VA and SAT in individuals with spinal cord injury (SCI) is yet to be investigated.

**PURPOSES:** 1-To measure the distribution of VA and SAT in multi-axial slices using magnetic resonance imaging (MRI) in motor complete SCI. 2-To determine if L4-L5 slice could be used as surrogate for VA. 3- To determine the relationship between VA and SAT (MRI) and trunk and body fat (DXA) and anthropometrics (tape measure).

**METHODS:** Five men and one woman (34 ± 8 yrs, 24 ± 4 Kg/m<sup>2</sup>, 10 ± 6 yrs post-injury; C6-T11; ASIA A and B) participated in the current study. Abdominal adipose tissue was measured by MRI from the first slice with iliac crest to the Xiphoid process (9-12 slices, slice thickness 10 mm and interslice space 10 mm). Images were matched at L4-L5 and at the level of umbilicus. Total and trunk body fat was measured using a total body DXA scans. Waist and abdominal circumferences were measured from lying and sitting positions.

**RESULTS:** The cross-sectional area (CSA) of VA ranged from 85 ± 27 (L4/L5) to 122 ± 25 (4 cm proximal to L4/L5) cm<sup>2</sup> in male. However, the VA ranged from 15 (L4/L5) to 49 (2 cm distal to L4/L5) cm<sup>2</sup> in the single woman. The CSA of VA<sub>L4/L5</sub> was correlated to the average CSA from multi-axial slices (r = 0.97, p < 0.0001). L4/L5 had the greatest SAT accumulation 201 ± 50 and 240 cm<sup>2</sup> in male and female, respectively. Neither waist nor abdominal circumferences were related to VA or SAT. However, waist (r = 0.76; p = 0.041) and abdominal (r = 0.88; p = 0.010) circumferences were related to the sum of VAT and SA. Finally, VA was related to the gynoid (r = 0.77; p = 0.036) region and SAT was related to the trunk (r = 0.74; p = 0.044) and total fat mass (r = 0.91; p = 0.005) as measured by DXA.

**CONCLUSION:** In individuals with SCI, VA and SAT appeared to be unevenly distributed in multi-axial slices. A single slice at L4/L5 can be used to reflect VA CSA, but it underestimates the actual magnitude. WC may be a valid surrogate to measure the sum, but not individual compartment, of VA and SAT. DXA cannot be used to measure VA, but can provide a reliable measure for SAT.

Supported by STARS, NIDRR (H133P030004) and GCRC (NIH-M01-RR000042) funding to ASG.

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### **2609 Board #3 May 29 2:00 PM - 3:30 PM**

#### **The Effects Of Exercise And Diet On Body Composition And Anabolic Hormones In Lactating Women**

Heather L. Collieran, Melanie Bopp, Heather L. Mackie, Laurie Wideman, Cheryl Lovelady. *The University of North Carolina at Greensboro, Greensboro, NC.* (Sponsor: Dr. Allan Goldfarb, FACSM)

(No relationships reported)

**PURPOSE:** To determine the effects of exercise and diet on body composition and anabolic hormone levels in lactating women.

**METHODS:** At 4wks postpartum (PP), women were randomized to either exercise group [EG, n=10, aerobic exercise (3 d/wk, 45 min/d) and 3 d/wk of resistance exercise] or control group (CG, n=10, no exercise) for 16 wks. Measurements were conducted at 4 and 20 wks PP for body composition, diet, and hormones. Weight, fat mass (FM), lean body mass (LBM), and appendicular (App) LBM were measured by DXA. LBM was defined as total non-bone lean mass and App LBM was defined as the sum of non-bone lean mass in arms and legs. The Nutrition Data System was used to obtain 2-24 hour dietary recalls. Growth hormone (hGH), insulin-like growth factor (IGF-1), and its associated binding protein-3 (IGFBP-3) were analyzed by ELISA. RMANCOVA was used to test for differences in body composition and anabolic hormones controlling for dietary intake. Data are reported as mean (SE).

**RESULTS:** Strength increased in the EG significantly more than in the CG after 16 wks. Energy intake decreased significantly in both groups (EG = 31.3 to 30.6 kcal/kg/d and CG = 31.0 to 26.0 kcal/kg/d), with no significant difference between groups after 16 wks. There were no differences in protein intake over time or between groups (EG = 1.3 to 1.2 g/kg/d and CG = 1.1 to 1.2 g/kg/d). Since energy intake and protein intake were highly correlated ( $r^2 = 0.6$ ,  $p < 0.0001$ ), we only controlled for protein intake in analyzing differences in body composition and hormones. Both groups lost the same amount of weight [EG = 3.6 (0.7) kg and CG = 3.5 (0.7) kg]. However, EG lost more weight from FM [2.9 (0.6) vs. CG = 1.9 (0.6) kg,  $p = 0.20$ ] and less weight from LBM [EG = 0.6 (0.3) kg vs. CG = 1.7 (0.3) kg,  $p = 0.04$ ]. EG gained more App LBM 0.02 (0.2) kg while CG lost 0.4 (0.2) kg ( $p = 0.02$ ). There were no differences in hGH, IGF-1, and IGFBP-3 levels over time or between groups.

**CONCLUSIONS:** These results suggest that aerobic and resistance exercise may slow the loss of total LBM while increasing LBM in the arms and legs during lactation and weight loss. There was no effect on hGH, IGF-1, and IGFBP-3 levels with exercise in this small sample of subjects.

*Supported by NC Agricultural Research Service*

**2610 Board #4 May 29 2:00 PM - 3:30 PM**

**Angiotensin-converting Enzyme Insertion/deletion Genotype And Body Composition In Pulmonary Disease Patients**

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*(No relationships reported)*

The insertion/deletion (I/D) polymorphism of the angiotensin-converting enzyme (ACE) gene has been shown to be associated with differences in strength and body composition in healthy older adults and to be associated with strength in chronic obstructive pulmonary disease (COPD) patients.

**PURPOSE:** The purpose of this study was to examine the effect of polymorphisms of the ACE gene on measures of body composition in COPD patients.

**METHODS:** The study included 148 COPD patients (82 M, 66 F) who were identified as having the II (33), ID (89) or DD (26) genotype and underwent a DEXA scan for body composition analysis.

**RESULTS:** After controlling for disease severity, there were no differences in body mass index or total body mass among the genotypes in men or women. However, measures of fat were significantly lower in men with the DD genotype. Adjusted means for men are shown in the table below. There were no differences in measures of fat among the three genotypes in women.

Body Composition for Men	II	ID	DD	P
Total Fat Mass (kg)	28.5±2.3	26.1±1.2	15.2±3.9	.019
Trunk Fat Mass (kg)	15.8±1.5	14.1±0.7	7.2±2.5	.018
Appendicular Fat Mass (kg)	11.5±0.9	10.8±0.5	6.9±1.5	.043
Leg Fat Mass (kg)	8.2±0.6	7.7±0.3	5.2±1.1	.066
Arm Fat Mass (kg)	3.3±0.3	3.1±0.2	1.7±0.5	.042
Total Body Fat (%)	29.8±1.4	28.6±0.7	22.0±2.3	.019
Trunk Fat (%)	32.2±1.7	30.3±0.9	22.3±2.9	.020
Appendicular Fat (%)	27.9±1.3	27.5±0.7	21.9±2.3	.062
Leg Fat (%)	27.8±1.4	27.4±0.7	22.3±2.3	.108
Arm Fat (%)	27.9±1.6	27.6±0.8	20.7±2.6	.046

**CONCLUSION:** After controlling for disease severity, men with the DD ACE genotype had lower amounts and percentages of body fat as compared to those with the II and ID genotypes.

*Supported by NIH grants HL 53755 and AG 10484.*

**2611 Board #5 May 29 2:00 PM - 3:30 PM**

**Assessment Of Energy Expenditure In Chronically Undernourished Indian Orphans**

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*(No relationships reported)*

Undernutrition during critical periods of development can permanently change the structure and function of developing systems. The current profile of rural Indian orphan children is that they are small statured and chronically undernourished.

**PURPOSE:** To assess physical activity (PA) and energy expenditure (EE) in chronically undernourished Indian orphans.

**METHODS:** 48 children (32 males, 16 females; age 12.9, BMI 14.8) in residence at the Indian Christian Mission Center, Salem, India ([www.icmcindia.org](http://www.icmcindia.org)) were assessed for PA and EE. Accelerometers (Mini-Mitter Inc., Bend, Oregon) were attached to the ankle for three consecutive days with d-2 used to assess PA. Additionally, accelerometer validity was assessed by having each child perform a 2-stage submaximal step test (stepping rates 20 and 27 step/minute, step ht. 17.6 cm) wearing an accelerometer and simultaneously being measuring for EE via indirect calorimetry (New Leaf Fitness, St. Paul, MN).

**RESULTS:** Using a single regression model, daily EE was estimated at  $1233 \pm 40$  kcal.  $49.7 \pm 7.0\%$  of the day was spent performing sedentary PA and  $49.4 \pm 9.2\%$  was spent performing light to moderate intensity PA. At stepping rates of 20 and 27 steps/minute, oxygen consumption was  $18.4 \pm 2.0$  and  $23.0 \pm 2.6$  ml/kg/min, respectively. Estimations of oxygen consumption from accelerometers were calculated at  $11.4 \pm 0.5$  and  $13.7 \pm 0.8$  ml/kg/min at stepping rates of 20 and 27 steps/min, respectively. Oxygen consumption estimations using ACSM metabolic calculations determined these stepping workloads to elicit an oxygen consumption of 15.9 and 20.9 ml ml/kg/min, respectively.

**CONCLUSION:** The ACSM calculation slightly underestimates oxygen uptake measured using indirect calorimetry and significantly overestimates EE via accelerometers. In these children, our findings bring into question the assessment of energy expenditure using accelerometers.

*Supported by New Leaf Fitness, St. Paul, MN*

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**2612 Board #6 May 29 2:00 PM - 3:30 PM**

**Self Efficacy, Physical Activity, And Fitness In Overweight And Obese African American Breast Cancer Survivors**

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**PURPOSE:** The purpose of this investigation was to evaluate measures of self efficacy in relation to physical activity and fitness in overweight and obese African American breast cancer survivors.

**METHODS:** Forty five African American Women (age  $55.0 \pm 8.1$  y, weight  $87.7 \pm 13.7$  kg, %fat  $41.9 \pm 4.1$ ) participated in the study. Self efficacy questions were asked concerning diet, exercise, ability to stick to goals, and control over home and work environments using a 0-4 point scale. Physical activity levels were assessed using the Seven Day Physical Activity Questionnaire. Objective measures included submaximal graded exercise testing which consisted of stationary cycling for 3 minute stages progressing at 25 watt (W) increments until subjects reached 85% of heart rate reserve or reached an RER in excess of 1.1. Respiratory gas exchange was measured continuously by open circuit spirometry indirect calorimetry and was used to determine ventilatory threshold as a measure of submaximal exercise capacity. Body composition was determined using DEXA.

**RESULTS:** Self efficacy concerning exercise was negatively associated with % body fat ( $r = -.40$ ), and positively associated with ventilatory threshold ( $r = .24$ ) and amount of time spent in hard physical activity during weekdays ( $r = .27$ ) and weekends ( $r = .26$ ). Ventilatory threshold was also associated with self efficacy over control of home environment ( $r = .35$ ), and work environment ( $r = .36$ ). Mean ventilatory threshold for this population was  $5.8 \pm 1.1$  ml/kg/min, and mean  $\text{VO}_{2\text{peak}}$  was  $10.0 \pm 2.0$  ml/kg/min. The Seven Day Physical Activity Questionnaire did not perform well in this population, possibly because moderate physical activity was defined as activities of three METs or greater (1 MET = 3.5 ml/kg/min) which is greater than the mean  $\text{VO}_{2\text{peak}}$  for this population.

**CONCLUSIONS:** These results suggest that even though this population has a very low aerobic capacity, measures of self efficacy related to exercise and environment are associated with measures of fitness. In addition, Physical activity assessment in this population using survey methods need to take into account the low aerobic capacity of this population.

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**2613 Board #7 May 29 2:00 PM - 3:30 PM**

**Safety Of Aerobic And Resistance Exercise Training In Early Breast Cancer Survivors**

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**PURPOSE:** Breast Cancer Survivors (BCS) who were sedentary before treatment are likely to experience low aerobic fitness and strength. There are limited data on following American College of Sports Medicine (ACSM) recommendations for both aerobic and resistance training in BCS, especially early survivors less than two years. Therefore, the purpose of the study was to examine if early BCS can safely perform aerobic and resistance training.

**METHODS:** The participants were 20 female early BCS (mean age = 56.0 years, SD = 8.5) recruited at three sites. They underwent lumpectomy or mastectomy along with chemotherapy and/or radiation without other co-morbid conditions. Physician clearance was required. The women received personal training onsite for a total of 60 minutes 3 times per week for 12 weeks. Strength was measured by 1-repetition maximum (1-RM) at baseline and every 3 weeks on the chest press, lat pull-down, lumbar extension, shoulder press, biceps curl, triceps extension, and leg press. Resistance training intensity was set at 70% of 1-RM to elicit 8-12 repetitions. Each resistance training session was 30 min. The participants also performed 30 min of aerobic training on cardio machines (elliptical, treadmill, stationary cycle) at 60%HRR. Heart rate (HR) and ratings of perceived exertion (RPE) were collected at rest and 5 min intervals of aerobic training, while blood pressure was collected at rest and every 10 min. Appropriate HRR was maintained by increasing intensity of the exercise. Orthopedic problems were monitored at each session. Hemoglobin levels were measured at baseline and every 4 weeks to check anemia ( $< 11.0$  Hb). The 1-RM was re-assessed every 4 weeks to ensure accurate training loads.

**RESULTS:** The attendance rate was 90%. There were no changes in HR, RPE, or blood pressure, which remained consistent throughout the sessions. All participants were able to perform resistance training and 1-RM testing. There were no reports of musculoskeletal injuries. No participants developed anemia.

**CONCLUSIONS:** These data suggest aerobic and resistance training at ACSM recommended levels is safe in early BCS. More data in these women are needed to support these findings, in addition to evaluation of programs beyond 12 weeks duration and in women who are longer survivors.

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**2614 Board #8 May 29 2:00 PM - 3:30 PM**

**Effects Of Exercise During Pregnancy On Maternal Insulin Sensitivity And Offspring Growth**

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Epidemiological studies have demonstrated a relationship between abnormal fetal growth and increased risk of childhood obesity and later adult disease. Previous studies have suggested that the maternal metabolic environment, in particular a reduction in maternal insulin sensitivity, contributes significantly to fetal growth. Regular aerobic exercise may therefore influence offspring size by regulating appropriate nutrient supply to the fetus, through an effect on maternal insulin sensitivity.

**PURPOSE:** To determine the effects of regular exercise during pregnancy on maternal insulin sensitivity, potential hormonal regulators of fetal growth, neonatal and offspring size.

**METHODS:** Healthy nulliparous women ( $30 \pm 4$  yrs, BMI  $25.5 \pm 4$  kg/m<sup>2</sup>) were randomized to either a monitored stationary cycling program ( $n=47$ ) or control ( $n=37$ ) from 20 weeks gestation to term. Maternal insulin sensitivity was assessed at 19 and 35 weeks using minimal model analysis of the frequently sampled intravenous glucose tolerance test. Neonatal auxology was assessed within 48 hours of delivery and at one year.

**RESULTS:** Offspring of exercisers had lower birth weights (Z-score control  $0.24 \pm 0.8$ ; exercise  $0.19 \pm 0.9$ ;  $p=0.03$ ) and BMI at birth (Z-score control  $0.40 \pm 0.9$ ; exercise  $-0.01 \pm 0.4$ ;  $p=0.04$ ). The reduction in maternal insulin sensitivity with advancing gestation was not affected by exercise ( $p=0.45$ ), and was unrelated to offspring birth size. However, exercise offspring had lower cord serum IGF-II ( $p=0.04$ ) and a trend towards lower IGF-I ( $p=0.08$ ), supporting an effect of exercise on endocrine regulation of fetal growth. Offspring size at one year remained lower in the exercise group, although not statistically significant due to reduced sample size at follow-up (BMI Z-score control  $-0.09 \pm 1.1$ ; exercise  $-0.40 \pm 1.1$ ;  $p=0.26$ ).

**CONCLUSIONS:** Regular exercise resulted in lower birth weights and leaner neonatal offspring with preliminary follow-up data suggesting a persistent effect at 1 year. However, exercise effects on offspring growth occurred independently of alterations in insulin sensitivity or markers of the maternal environment and unlike previous studies, maternal insulin sensitivity was not predictive of offspring birth size.

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**2615 Board #9 May 29 2:00 PM - 3:30 PM**



## Exaggerated Postprandial Triglyceride Response Identified In Individuals With Spinal Cord Injury With Cardiac Risk Factors

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Able-bodied individuals who have a greater number of cardiac risk factors and greater abdominal adiposity have increased difficulty in metabolizing fat loads, resulting in prolonged elevation of postprandial triglyceride. The lipemic response to a high fat meal and its relationship to abdominal adiposity and coronary heart disease (CHD) is unknown in individuals with spinal cord injury (SCI).

**PURPOSE:** To compare the postprandial lipemic (PPTG) responses, abdominal adiposity and CHD factors between able-bodied (AB) and individuals with SCI.

**METHODS:** Twenty-five men with SCI (13 paraplegia, 12 tetraplegia) and 13 able-bodied (AB) men participated. The CHD risk factors were determined and subjects were stratified as having low risk (2 or less risk factors) or elevated risk (3+ risk factors). Following a 10-hour fast, a high-fat milkshake was consumed to deliver approximately 1.3 g fat, 1.2 g carbohydrate, and 0.2 g protein per kilogram body mass. Blood samples were drawn at baseline, 2, 4, and 6 hours to measure PPTG, determined as the area under the curve. Total abdominal fat (TAF) was measured by abdominal ultrasonography.

**RESULTS:** SCI and AB subjects were similar in age, height, and weight. In AB and SCI subjects, TAF was significantly related to PPTG responses ( $R=0.49$ ,  $P=0.02$ ). TAF in low risk SCI was significantly less in AB with elevated risk ( $P=0.02$ ) and SCI with elevated risk ( $P=0.01$ ). SCI with elevated risk had the greatest PPTG response compared to low and elevated risk AB ( $2053\pm911$  vs.  $1356\pm633$ , and  $1725\pm981$  units, respectively), which was significantly greater than low risk SCI ( $1016\pm333$  units,  $P=0.01$ ). When controlling for TAF, the groups with SCI at low and elevated CHD risk had a PPTG response that was greater by  $183\pm83$  and  $366\pm83$  units, respectively, than the low risk AB group ( $P=0.001$ ).

**CONCLUSIONS:** Individuals with SCI appear to exhibit a greater postprandial response after a fat load than their able-bodied counterparts. An exaggerated postprandial response may be associated with greater overall cardiac risk in SCI.

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### 2616 Board #10 May 29 2:00 PM - 3:30 PM

#### Moderate Intensity Exercise Training Improves Lipid Profile In Hiv-infected Men.

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(No relationships reported)

**PURPOSE:** To determine the effects of a moderate dose of exercise training on blood lipids in HIV-infected men.

**METHODS:** Sixteen HIV-infected men were recruited for this study and randomized into either an exercise (EX) training group, or control (CON) group who attended the sessions but did not participate in exercise training. The EX subjects participated in a 6 week program of moderate intensity resistance training at 60% of their 3-rep max (approximately 20 min), as well as aerobic exercise for 30 min at 60% of their age predicted heart rate max (twice per week). The CON group received standard care during the same 6 week period and did not increase their activity level. All subjects provided a 12-hour fasting blood draw at pre- and post-treatment.

**RESULTS:** Results show that at baseline LDL cholesterol was in the "high risk" range for CVD ( $182\pm55$  mg/dl) and baseline triglyceride was in the "borderline high" range ( $155\pm70$  mg/dl). Pre- to post-intervention analysis showed a significant reduction in triglyceride level ( $155\pm70$  to  $110\pm30$  mg/dl) and a trend ( $p=0.07$ ) towards a decrease in LDL cholesterol ( $182\pm55$  to  $171\pm33$  mg/dl). Measurement of occupational and leisure activity showed no change in either group.

**CONCLUSIONS:** These data show moderate dosage of combined aerobic and resistance training can decrease HIV-associated high levels of circulating triglycerides and cholesterol after only 6 weeks. The results suggest that HIV infection does not reduce the beneficial effects of moderate intensity exercise training on blood lipids, and that training can reduce the risk of CVD in this population.

This project was Supported by the NIH/NCMHD (5P20MD001770-03) and the American College of Sports Medicine.

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### 2617 Board #11 May 29 2:00 PM - 3:30 PM

#### Aerobic Exercise Is Safe And Effective In Systemic Sclerosis

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**PURPOSE:** Pulmonary involvement is a major determinant of SSc morbidity and mortality. It is therefore relevant to evaluate if aerobic exercise training in female Systemic Sclerosis (SSc) is a safe and effective intervention to improve lung capacity.

**METHODS:** Seven SSc patients without pulmonary impairment (normal CT, FVC > 75% predicted, DLCO > 75% predicted, PASP < 40mmHg) and 7 healthy controls, sedentary and paired by age and body mass index (BMI), were enrolled in an 8-week program consisting of moderate intensity aerobic exercise twice a week. Aerobic capacity was assessed by treadmill ergospirometry. Blood lactate was evaluated once a week and oxygen saturation was registered in all exercise sessions (before and at peak of the exercise) **RESULTS:** The exercise program was well tolerated by both groups and adherence was 100%. At entry, VO2 peak and lactate parameters were comparable in patients and controls ( $p>0.05$ ), whereas rest and peak oxygen saturation were lower in patients ( $p=0.032$  and  $p=0.034$ , respectively) than controls. SSc patients and controls had a significant improvement in their VO2 peak ( $19.72\pm3.51$  vs.  $22.27\pm2.53$  and  $22.94\pm4.70$  vs.  $24.55\pm3.00$ , respectively,  $p=0.006$ ) after 8 weeks of exercise, but difference between groups was not statistically significant ( $p=0.149$ ). Reinforcing this finding, at the end of the study SSc and controls were able to perform a significantly higher exercise intensity when compared to the baseline, as measured by peak blood lactate ( $1.43\pm0.51$  vs.  $1.84\pm0.33$  and  $1.11\pm0.45$  vs.  $1.59\pm0.25$ , respectively,  $p=0.01$ ). SSc group showed an improvement in peak exercise oxygen saturation at the 8th week of training when compared to the baseline ( $84.14\pm9.86$  vs.  $90.29\pm5.09$ ,  $p=0.048$ ), but the same improvement was not observed in control group ( $96.29\pm1.70$  vs.  $95.86\pm2.12$ ,  $p=0.732$ ). Rodnan score was similar before and after the intervention ( $15.84\pm7.84$  vs.  $12.71\pm4.31$ ,  $p=0.0855$ ). Digital ulcers and Raynaud's phenomenon remained stable.

**CONCLUSION:** Our data support the notion that achieving improved lung capacity is a feasible goal in SSc management. The long term benefit of this intervention needs to be determined in large prospective studies.

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### 2618 Board #12 May 29 2:00 PM - 3:30 PM

#### A 6-week Protocol Based On Exercise And Antioxidant Supplementation Reduced Malondialdehyde In Mentally Retarded Athletes

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In the last years, there has been a major increase in opportunities for sports and physical activities for persons with mental retardation. Accordingly, it is also necessary to improve medical assessment of these athletes that may be focused on several issues such as oxidative stress. Firstly if we take into account individuals with mental retardation have been generally described as having high levels of oxidative stress. And secondly since it is widely accepted high physical performance may be associated to oxidative damage.

**PURPOSE:** The present study was undertaken to ascertain the influence of a mixed protocol based on regular exercise and antioxidant supplementation in lipoperoxidation in athletes with mental retardation.

**METHODS:** Fifty-five high-performance athletes with mental retardation from Special Olympics volunteered for this study (21.6±1.8 years-old). Forty were randomly included in experimental group to perform a 6-week protocol including exercise (low-moderate intensity aerobic exercise before breakfast 3 times per week) and supplementation (1g ascorbic acid + 400 UI  $\alpha$ -tocopherol; 6 times per week). Control group included 15 age, sex, trained and BMI-matched athletes with mental retardation that did not perform our protocol. Written informed consent was obtained from their relatives. Further our protocol was approved by an institutional ethic committee. Plasmatic MDA were determined by high performance liquid chromatography (HPLC) with fluorimetric detection as described elsewhere 72-hours before starting the protocol (pre-test) and after its ending (post-test). Comparisons were made by using Student "t" test for paired data. Significance was ascertained at p value <0.05.

**RESULTS:** When compared to baseline plasmatic MDA levels were decreased significantly after our 6-week protocol (0.50±0.12 vs 0.36±0.09  $\mu$ mol/l-1; p<0.05). No changes were reported in controls.

**CONCLUSION:** It was concluded a 6-week mixed protocol based on fasting exercise and antioxidant supplementation improved significantly lipoperoxidation in athletes with mental retardation. Further studies on this topic are highly required.

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**2619 Board #13 May 29 2:00 PM - 3:30 PM**

**Biceps And Triceps Oxygenation Changes In Competitive Wheelchair Racers With Spinal Cord Injury**

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Electromyographic evidence has indicated that the biceps and triceps muscles are recruited during different phases of the wheelchair propulsion cycle. However, the localized hemodynamic changes during this exercise mode have not been examined.

**PURPOSE:** To examine the alterations in muscle oxygenation and blood volume during incremental wheelchair exercise to voluntary fatigue in competitive wheelchair racers using Near Infrared Spectroscopy (NIRS).

**METHODS:** Written informed consent was obtained from 20 competitive male wheelchair racers with spinal cord injury (SCI, lesion levels C7 to L3; mean age = 33.8 ± 8.8 yrs). Each subject completed an incremental velocity wheelchair test to voluntary fatigue in their racing wheelchair mounted on frictionless rollers. Cardiorespiratory responses were recorded using a wireless metabolic system. Biceps and triceps blood volume (Bbv and Tbv) and oxygenation (Box and Tox) were recorded simultaneously using two dual-wave NIRS units for two minutes at rest and continuously during exercise.

**RESULTS:** Oxygen consumption and heart rate increased systematically until voluntary fatigue. The peak values attained were 34.4 ± 8.7 ml/kg/min and 172 ± 21.3 bpm respectively. There was considerable inter-subject variation in the hemodynamic responses of the two muscles during the incremental wheelchair test. In most subjects, Bbv and Tbv increased until approximately 50% to 60% of peak VO<sub>2</sub> and then leveled off or decreased slightly. In contrast, Box and Tox decreased simultaneously until approximately 80% of peak VO<sub>2</sub> and then leveled off or increased slightly. The absolute changes (peak minus resting value) in mean Box and Tox (-0.17 vs -0.18 OD units) were not significantly different (p > .05).

**CONCLUSIONS:** In competitive wheelchair racers with SCI: (1) the biceps and triceps reached their maximal capacity to extract oxygen before the onset of fatigue, thereby suggesting a peripheral limitation, and (2) there was a similar degree of aerobic metabolic activity in the biceps and triceps during wheelchair propulsion. These findings have important implications in designing aerobic training programs for Paralympic wheelchair athletes.

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**2620 Board #14 May 29 2:00 PM - 3:30 PM**

**Combination Nutrition And Exercise Program For Cancer Survivors**

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Low to moderate exercise intensity training has been shown to improve fitness parameters and quality of life (QOL) in cancer survivors. The influence of dietary modification concurrent with an exercise intervention is less clear.

**PURPOSE:** To determine if additional physical/QOL benefits may be achieved via combination dietary modification/exercise vs. exercise alone and usual care.

**METHODS:** Subjects were of various cancer types, both in and out of treatment. Group 1 (G1) (32 subjects; 20 female, 12 male; age 62±3 yrs), participated in a 12-week intervention that included two, 1-hour sessions of exercise training (flexibility, balance, resistance, aerobic) per week plus a weekly 40 minute group dietary informational session (this group also tracked a variety of dietary variables). Group 2 (G2) (27 subjects; 21 female, 6 male; age 60±7 yrs) participated in the exercise program, but not the nutrition intervention. Group 3 (G3) (19 subjects; 12 female, 7 male; age 58±3 yrs) received usual care for their cancer, but participated in no structured exercise or nutrition intervention. All subjects were tested pre and post on fatigue and QOL status, as well as several physical tasks: sit to stand, stair climb/descent, lift/carry (all timed tests), and treadmill walking (endurance time). All subjects completed a nutritional habits survey, pre and post. Repeated-measures ANOVA was used to analyze the data (.05 level of significance).

**RESULTS:** G1 reported increased consumption of fruits/vegetables, calcium, and fiber (p=.045). G2 and G3 reported no significant changes in diet. G1 and G2 improved significantly on treadmill walking (G1: 38%, p = .011; G2: 19%, p = .048), lift/carry (G1: -47%, p = .018; G2: -24%, p = .044), and sit to stand (G1: -20%, p = .046; G2: -31%, p = .022). G1 improved on fatigue (-27%, p = .023) and QOL (24%, p = .029), while G2 did not experience any significant changes in these variables or stair climb/descent (trend toward improvement). G3 had no significant change in any of the physical tasks (trend toward decline), but experienced a decline in QOL (-33%, p=.039) and an increase in fatigue (31%; p=.027).

**CONCLUSIONS:** Both G1 and G2 improved during the course of the study, but it appears that a nutrition intervention given in conjunction with exercise may offer additional benefit for cancer survivors.

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**2621 Board #15 May 29 2:00 PM - 3:30 PM**

**A Long-term Longitudinal Survey Of The Training Effects On Cardiorespiratory System In Paraplegics**

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Cardiovascular risk is higher in spinal cord injured (SCI) patients than in able-bodied people, mainly due to physical inactivity. Sedentary lifestyle can lead to the “hypokinetic syndrome”, characterized by progressive loss of functional muscular mass and cardiovascular fitness. In particular, left ventricle “electrical predominance” is not evident in sedentary SCI patients, whose ECG is often characterized by a right shift of cardiac electric axis.

**PURPOSE:** To evaluate the effects of long term regular aerobic sport practice on cardiac response to exercise, ventilatory function and ECG in SCI patients.

**METHODS:** Six SCI patients (lesion level T<sub>1</sub>-T<sub>10</sub>; age 34.6±2.8 yrs [m±SD], lesion duration 15.7±8.2 yrs) participated in the study. All the subjects were aerobically trained twice a week for two hours. Body weight (BW), ventilatory parameters (FVC, Forced Vital Capacity, FEV<sub>1</sub>, Forced Expiratory Volume in 1 Second) and ECG parameters (PQ, QT, electrical axis, heart rate [HR]) were monitored for 10 years, in occasion of yearly medical controls. All the patients were evaluated on a wheelchair ergometer, by means of an incremental maximal exercise test. ECG was recorded at rest (HR<sub>rest</sub>) and HR<sub>rec</sub> did not change. QT and PQ showed no changes throughout the observation period. Mean electric axis progressively shifted leftwards, from 68° to 43° (p<0.05).

**RESULTS:** BW monotonically increased through the observation period, from 61.1±8.0 Kg to 69.7±14.4Kg (p<0.05, year 1 vs year 10). CV and FEV<sub>1</sub> decreased from 3.6±0.7 to 3.0±1.2 l and from 3.1±0.8 to 2.4±1.1 l, respectively (p<0.05). Achieved maximal speeds decreased from 7.2±1.0 to 5.9±0.8 Km·h<sup>-1</sup> (p=ns). Although not significantly, HR<sub>max</sub> increased from 110±20 to 135±20 bpm, whereas HR<sub>rest</sub> and HR<sub>rec</sub> did not change. QT and PQ showed no changes throughout the observation period. Mean electric axis progressively shifted leftwards, from 68° to 43° (p<0.05).

**CONCLUSIONS:** Our results suggest an important role for physical activity in the cardio-respiratory reconditioning of SCI patients. Although in these patients BW, respiratory function and HR were not affected by long term aerobic training, myocardium positively adapted to chronic exercise, presumably by an increase of left ventricular mass. Thus, physical exercise may slow down the progressive deterioration of cardiovascular function in paraplegics.

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**2622 Board #16 May 29 2:00 PM - 3:30 PM**  
**Reference Values For Six Minute Walk Distances In Subacute Stem Cell Transplant Patients**

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**PURPOSE:** The six minute walk test (6-MWT) is widely used to assess the functional status of subacute stem cell transplant (STC) recipients. However, reference values for the 6-MWT in this population have not been published. Therefore this study sought to both provide a performance description and to develop reference values for this patient population.

**METHODS:** The protocol was approved by the UTMDACC Institutional Review Board. 6-MWT results were extracted retrospectively from the medical records of 118 consecutive STC recipients referred to Rehabilitation Services for physical therapy. Patients were asked to walk as far as they could in 6 min. on the level track that followed the perimeter of the Rehabilitation Services gym. Patients pushed their IV pole during the test and received verbal encouragement at 1-minute intervals. Hemodynamic status and oxygen saturation levels were monitored during and after this test.

**RESULTS:** These STC recipients (N=118) were 54 + 12 yrs. old, were 50 + 34 days post transplant and walked 402 + 140 m in 6 min.. The 6-MWT performance differed (p<0.05) by gender [male (n=84)= 423 + 134 m; female (n=34)= 351 + 142 m] but not (p>0.05) with regard to corticosteroid treatment status [treatment (n=64)= 392 + 136 m; no treatment (n=54)= 415 + 144 m]. While neither body weight nor height correlated significantly with 6-MWT performance (p>0.05), a significant relationship (p<0.05) was determined between 6-MWT performance and both body mass index (BMI) (r = -0.20) and time elapsed since SCT (r = -0.18). No significant relationship between 6-MWT performance and age was detected, but a trend was observed (r = -0.16, p=0.07).

**CONCLUSIONS:** These results provide a description of 6-MWT performance and reference values for subacute SCT patients which can be used to grade their relative functional status. Additionally, these data may be useful in developing 6-MWT performance norms for this population.

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**2623 Board #17 May 29 2:00 PM - 3:30 PM**  
**Six Vs Three Months Of Combined Exercise Training In Patients With Chronic Obstructive Pulmonary Disease**

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Expiratory airflow limitation is the main characteristic of chronic obstructive pulmonary disease (COPD). Exercise intolerance is frequently present in these patients, leading to a reduced ability to participate in activities of daily living and to a reduced health-related quality of life (HRQoL). Aerobic exercise training has been demonstrated to reduce the functional limitations imposed by this disease. Combined aerobic and strength training, increases muscle strength and improves endurance and functional capacity, and activities of daily living to a greater extent than aerobic training alone. However, the effects of the length of the training program are not well known.

**PURPOSE:** The purpose of this study was to compare the effects of 3 or 6 months of combined training on functional ability in patients with COPD.

**METHODS:** Twenty nine men with moderate COPD performed combined exercise training for 3 and 6 months, 3 times a week. Fifteen patients (FEV<sub>1</sub> 48,3±12,6%); were assigned to the 3 months group (3MG) (age, 66±5 yrs; weight, 78±8.0 kg; height, 168±8.3 cm) and fourteen patients (FEV<sub>1</sub> 45,2±12,9%) were assigned to the 6 months group (6MG), (age, 65 ±4.7 yrs; weight, 75,4±8.7 kg; height, 170,1±4,9 cm). The aerobic exercise was set at 60-70% HR reserve for 30 minutes and the resistance exercise was performed in 5 weight machines, 2 sets of 8-12 repetitions at 50-70% of 1RM, for both groups. The physical parameters assessed were strength, aerobic endurance, flexibility and agility/balance by the Fullerton's functional fitness tests.

**RESULTS:** The pre-values of the functional fitness test were similar for both groups. After training, the values of the functional fitness test were different (p<0.05) between 6MG and 3MG groups for 30-second chair stand 22.93±3 vs. 18.2±2.4; arm curl 24,37±2,0 vs. 18,6±2,8; 8-foot up-and-go 3,17±0,5 vs. 4,10±0,6; chair sit-and-reach 7,87±12,2 vs. 3,2±10,4; 6-minute walk 617,17±50,4 vs. 568,2±52,8; back scratch -2,07±3,0 vs. -7,4±10,2 respectively.

**CONCLUSION:** In conclusion, 6 months of combined exercise training produced greater improvement in functional ability, than 3 months of exercise training.

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**2624 Board #18 May 29 2:00 PM - 3:30 PM**  
**Increased Aerobic Fitness In Late Pregnancy Predicts Shorter Labor In Nulliparous, But Not Multiparous, Women.**

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Similar to the general population, the level of physical activity is inadequate among pregnant women. The ensuing state of over-nutrition as a consequence of physical inactivity prolongs labor and thereby the risk of several obstetrical implications including fetal asphyxia, infections and obstetrical fistulas. Well-trained women who maintain physical exercise during pregnancy have shorter labor compared to those who stop training before the end of the first trimester. Much less is known about whether aerobic fitness in a general cohort of pregnant women is related to duration of labor.

**PURPOSE:** We wanted to investigate the effect of aerobic fitness on duration of labor among nulli- and multiparous women using two valid indicators, namely measurement of maximal oxygen uptake and calculation of anaerobic threshold.

**METHODS:** Maximal oxygen uptake and anaerobic threshold were measured in 59 nulli- and 51 multiparous women at 36 weeks of gestation. Duration of labor was defined as the time between three cm cervical dilation with regular uterine contractions and delivery. Unpaired sample t-test, Pearson correlation test and multiple linear regression were used for statistical analysis.

**RESULTS:** Maximal oxygen uptake was similar for both groups (mean 2.1 L/min). Labor was as expected longer ( $p < 0.001$ ) in the nulliparous compared to the multiparous women:  $9.3 \pm 5.0$  and  $4.5 \pm 2.3$  hours, respectively. For nulliparous women who started labor spontaneously, duration of labor was inversely associated with maximal oxygen uptake ( $p=0.03$ ). This indicates that for an increase in maximal oxygen uptake of 0.1 L/min, labor would be shortened by on average 33 minutes. In contrast, in multiparous women who started labor spontaneously, anaerobic threshold was positively associated with duration of labor ( $p=0.002$ ). This indicates that an increase in anaerobic threshold of 0.1 L/min would prolong labor by on average 22 minutes.

**CONCLUSION:** Increased maximal oxygen uptake is associated with shorter labor in nulliparous women who start labor spontaneously, whereas increased anaerobic threshold is associated with prolonged labor in multiparous women.

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**2625 Board #19 May 29 2:00 PM - 3:30 PM**

**Running Efficiency Of A Trans-tibial Amputee With Different Prosthetic Stiffness: A Case Study**

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( R.M. Otto, Ossur America's, Inc., Contracted Research.)

Intense training, along with the advent of new materials and technology available for development of prosthesis, are allowing amputee athletes to reach greater success in sport. To improve run performance, trans-tibial amputee athletes strive to improve efficiency of movement, which in part, is attributed to the amount of rebound provided through their prosthetic. The popular carbon fiber Ossur running foot, Flex Run, is manufactured with nine specific categories of stiffness, each with a difference in the coefficient of restitution. Currently, guidelines are provided by the manufacturer for fitting the appropriate running foot stiffness to the athlete based on body mass and fitness.

**PURPOSE:** To objectively quantify run efficiency based on the energy cost of different running feet.

**METHODS:** A sub- 3:10 marathon BK runner (age 40 yr, body mass 74.5 kg and ht.175 cm) participated in a treadmill run GXT to Max  $\dot{V}O_2$  ( $62.2 \text{ mL/kg}\cdot\text{min}^{-1}$ ) starting at  $187.6 \text{ m/min}$  with increments of  $13.4 \text{ m/min}$  every 3 min. AnT was determined from the max GXT at  $262.6 \text{ m/min}$  ( $52.4 \text{ mL/kg}\cdot\text{min}^{-1}$  or 87% max  $\dot{V}O_2$ ). The subject completed three randomly assigned double blind trials at AnT with three consecutive categories of running foot stiffness. The running foot stiffness categories included one standard category recommended by the manufacturer (S), as well as one category above (S+) and one below (S-) the standard.

**RESULTS:** The following data were obtained:  $\dot{V}_e$  (106.4, 108.5, &  $113.4 \text{ L/min}$ ), HR (164, 159, 165 b/min) and  $\dot{V}O_2$  (58.5, 57.6 &  $59.5 \text{ mL/kg}\cdot\text{min}^{-1}$ ) at S-, S, and S+ trials, respectively. All trials resulted in the same 186 foot strikes/min and the same stride length. His energy cost was 4.4%, 2.8%, and 6.2% greater than the ACSM prediction equation for S-, S, and S+ trials, respectively. Although the athlete reported the greatest comfort during the S+ trial, his  $\dot{V}O_2$  was elevated 3.2% above the S trial.

**CONCLUSION:** The prosthesis does not appear to offer any advantage in terms of efficiency. The evaluation of additional subjects and running speeds are necessary to effectively quantify running efficiency attributed to prosthetic running foot stiffness.

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**2626 Board #20 May 29 2:00 PM - 3:30 PM**

**The Physical Activity Scale For Individuals With Physical Disabilities: Limited Validity In People With Sci**

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Physical activity is an important part of a healthy lifestyle in people with spinal cord injury (SCI). The Physical Activity Scale for Individuals with Physical Disabilities (PASIPD) was developed to assess the physical activity level of individuals with a disability (Washburn et al., 2002). The PASIPD has not yet been validated for use in people with SCI.

**PURPOSE:** To determine the construct and divergent validity of the PASIPD in people with SCI.

**METHODS:** Construct validity was examined by relationships between PASIPD scores and measures of fitness (peak oxygen uptake, peak power output, muscular strength) and activities (wheelchair skills, Utrecht Activity List, mobility range and social behaviour subscales of the SIP68) in 139 persons with SCI 1 year after discharge from inpatient rehabilitation. Divergent validity was determined by comparing group scores of people with different personal (age, gender, body mass index) and lesion characteristics (level (paraplegia/tetraplegia), completeness, time since injury).

**RESULTS:** PASIPD scores showed low correlations with fitness parameters (0.25-0.36,  $p < 0.05$ ) and low to moderate correlations with activities (0.36-0.51,  $p < 0.01$ ). Persons with a tetraplegia or long time since injury had significantly lower PASIPD scores compared to those with a paraplegia ( $p < 0.02$ ; effect size: 0.17) or a short time since injury ( $p < 0.03$ ; effect size: 0.30).

**CONCLUSION:** The PASIPD showed a weak relationship with fitness measures and a moderate relationship with activity parameters in people with SCI. This construct validity is comparable to well established self-report questionnaires from the general population. The divergent validity of the PASIPD was low. Therefore, the PASIPD should be used with caution in persons with SCI, however, more research is needed to obtain better insights in the PASIPD.

References: Washburn et al., Arch. Phys. Med. Rehab. 2002;83:193-200.

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**2627 Board #21 May 29 2:00 PM - 3:30 PM**

**A Peer-guided Exercise Program For Youth With Intellectual Disabilities**

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Youth with intellectual disabilities (ID) do not engage in sufficient physical activity and, in turn, have lower fitness levels and higher body fat than their peers. This group faces unique barriers to physical activity participation due to cognitive, social, motor and behavioral limitations. Peer support is an important determinant of physical activity among adolescents and may be one strategy to address barriers encountered by youth with ID. Although peer modeling and peer-tutoring have been associated with positive physical activity outcomes in youth with ID, additional research is needed to determine if peer mediated interventions are effective.



**PURPOSE:** To investigate the extent to which youth with and without ID adhered to a peer-guided exercise program, and to determine if participation enhanced health-related fitness. **METHOD:** Twenty adolescents with mild ID were paired with a trained partner (i.e. nondisabled adolescent) to exercise 2 days/week for 1 hour over 15 weeks. Each pair provided reciprocal support during structured, individualized exercise sessions led by certified fitness trainers. The intervention was implemented at two YMCA fitness centers and daily sessions included 20 min each of aerobic exercise, weight training, and core strengthening activities.

**RESULTS:** Attendance and adherence to the program was high and no adolescents with ID dropped out of the study. All youth successfully engaged in the planned exercises, although a greater proportion of the aerobic and core activities were completed compared to the weight training. Repeated measures ANOVA with Group (Participant or Partner) as a factor revealed there was significant improvement in modified curl-ups  $F(1,32) = 11.45, p = .002, h^2 = .263$  and 6-minute walk distance  $F(1,32) = 43.087, p < .001, h^2 = .574$ . There was no change in grip strength  $F(1,32) = .760, p = .390, h^2 = .023$ ; sit and reach  $F(1,30) = 2.148, p = .153, h^2 = .067$ ; or BMI  $F(1,32) = 4.133, p = .050, h^2 = .114$ . In addition, there were no significant Group x Fitness variable interactions ( $p > .05$ ).

**CONCLUSION:** This peer-guided model integrates social and instructional support for adolescents with ID and was effective for engaging our sample in exercise. The findings are encouraging for health promotion in an underserved population of youth. The project was funded by the Medical Foundation.

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**2628 Board #22 May 29 2:00 PM - 3:30 PM**

**Physical And Motor Fitness And Physical Activity In Adolescents With Asperger Syndrome: A Comparative Study**

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Physical fitness and physical activity are vital for a healthy lifestyle for individuals with and without disabilities. Not only has low motor and physical fitness a negative effect on daily life of individuals with Asperger syndrome (AS), at the same time it increases the likelihood of becoming less physically active.

**PURPOSE:** To compare motor fitness and health related physical fitness, and physical activity levels in adolescents with and without AS.

**METHODS:** Thirty adolescents, diagnosed with AS ( $X=17.2\pm1.2$  yrs), agreed to participate in the study together with thirty age and gender matched neurotypical peers ( $X=16.9\pm0.8$  yrs). Physical fitness evaluations were done using the EUROFIT test (Oja & Tuxworth, 1995). In addition, a research questionnaire regarding the participants' physical activity during leisure time was administered to all participants (Baecke et al., 1982). A 2X2 multivariate analyses of variance, with standard scores on all EUROFIT subtests, were conducted to assess whether differences between groups (AS vs. controls) and genders on fitness items exist. Differences between the groups' average scores on the Baecke questionnaire were analyzed using t-test for independent groups.

**RESULTS:** Adolescents with AS scored significantly lower than the comparison group on all subtests of motor skill (MSRF)- and health related (HRF) physical fitness in the EUROFIT ((MSRF)=.428,  $F(1,58)=18.37 (p<.001)$  and (HRF)=.432,  $F(1,58)=11.63 (p<.001)$ ). Effect size across items ranged from  $h^2=.09$  to  $.53$ . Adolescents with AS were less physically active than adolescents in the comparison group ( $p<.001$ ).

**CONCLUSION:** Adolescents with AS have lower levels of physical fitness in balance, coordination, flexibility, muscular strength, running speed and cardio-respiratory endurance and have higher levels of physical inactivity when compared to age matched peers. Engagement in physical activities and individualized training adapted for individuals with AS is recommended.

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**2629 Board #23 May 29 2:00 PM - 3:30 PM**

**Predicting Exercise Training Intensity in Obese African American Breast Cancer Survivors**

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**PURPOSE:** Physical activity is an effective recommendation for weight loss, however little information is available regarding exercise capacity in obese African American breast cancer survivors. The purpose of this study was to evaluate alternative methods for establishing exercise training intensity levels during progressive cardiovascular exercise in ( $n = 20$ ) obese African American breast cancer survivors.

**METHODS:** Submaximal graded exercise testing consisted of stationary cycling for 3 min stages progressing at 25 watt (W) increments until subjects reached 85% of their heart rate reserve or a respiratory exchange ratio (RER) in excess of 1.1. Continuous heart rate and RR interval measurements (time duration between two consecutive R waves of the EKG) were recorded via a Polar® heart rate monitor with computer interface, where 20 sec averages were used for analysis of heart rate variability. Body composition was determined using DEXA.

**RESULTS:** Ventilatory threshold occurred at  $5.32 \pm 1.07$  ml·kg<sup>-1</sup>·min<sup>-1</sup> and heart rate variability threshold occurred at  $5.23 \pm 1.06$  ml·kg<sup>-1</sup>·min<sup>-1</sup>. The two thresholds correlated well with each other ( $r = 0.82$ ). The mean pRER was  $1.16 \pm 0.09$ , where 30% of the participants had a pRER in excess of 1.20. Measurements of body composition reported  $42.46 \pm 4.05$  % body fat. Peak VO<sub>2</sub> was  $10.29 \pm 2.16$  ml·kg<sup>-1</sup>·min<sup>-1</sup>, where 40% of participants had a peak VO<sub>2</sub> that was  $>10$  but  $\leq 14$  ml·kg<sup>-1</sup>·min<sup>-1</sup> (reduced exercise capacity) and 55% had a peak VO<sub>2</sub>  $\leq 10$  ml·kg<sup>-1</sup>·min<sup>-1</sup> (severely reduced exercise capacity). While 75% of participants did not reach their target heart rate, 15% reported between 13-14 (somewhat hard), 45% reported between 15-16 (hard), 40% reported  $\geq 17$  (very hard), on the Borg scale rating of perceived exertion.

**CONCLUSIONS:** Given the importance of regular exercise in a weight loss program, this study considered a variety of exercise guidelines and determined some of them to be unsuitable for this population.

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**2630 Board #24 May 29 2:00 PM - 3:30 PM**

**Exercise Mode Effect On Ankle Strength, Activity Balance, And Functional Fitness Of Stroke Patients**

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**PURPOSE:** The purpose of this study was to investigate the effective exercise mode in improving ankle strength, activity balance, and functional fitness of stroke patients.

**METHODS:** 14 stroke patients volunteered to participate and divided into two groups ( $n=14$ ): ball exercise group ( $n=7$ ), treadmill exercise group ( $n=7$ ). All of them were capable of independent walking without other's aid. Cybex770 and activity balance coefficient scale were used to evaluate ankle isokinetic strength and activity balance, respectively. 6min walking, sit to stand, grip strength, sit & reach, 3m up & go, reaction time, functional reach, and closed one leg stand were measured for functional fitness before and after the 12-week of exercise training.

**RESULTS:** In ankle isokinetic test, although there was no interactions, right 60 °/sec dorsal flexion increased significantly in time ( $p=.019$ ). Significant interaction ( $p=.002$ ) and time difference ( $p=.018$ ) were shown in activity balance after training. In functional fitness, left grip strength ( $p=.043$ ), closed one leg stand ( $p=.005$ ), functional reach ( $p=.015$ ) showed significant interaction and closed one leg stand ( $p=.000$ ), sit to stand ( $p=.003$ ), reaction time ( $p=.029$ ), and 3m up & go ( $p=.002$ ) showed significant time differences.

**CONCLUSIONS:** Even though, both exercises proved to increase ankle isokinetic strength, activity balance, and functional fitness, ball exercise seems to more affect on activity balance and functional fitness compare to treadmill exercise by increasing core stability. Therefore, ball exercise is recommended for improving balance and functional fitness.

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**2631 Board #25 May 29 2:00 PM - 3:30 PM**  
**Analysis Of Education Programming For Personal Trainers: Exercise Implementation For Clients With Neurological Impairments**

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**PURPOSE:** Increasing numbers of people suffer from diseases related to inactivity or obesity and this problem is of greater magnitude for those with disability. Lack of resources and knowledgeable providers is a key factor that prevents access to services for this population in the community. Personal trainers, key community providers, do not typically have training for working with this population. This project included development and implementation of an educational program for personal trainers in exercise management for clients with neurological impairments focusing on cerebrovascular accident, spinal cord injury, Parkinson's disease, multiple sclerosis and acquired brain injury.

**METHODS:** A six-hour program was taught to twenty personal trainers. Subjects had certifications in personal training from the American College of Sports Medicine and/or the National Strength and Conditioning Association or degrees in exercise management. Program curriculum was based on current evidence-based literature and texts. Subjects completed a pre-test and a post-test for outcome analysis.

**RESULTS:** Improvement of scores was statistically significant. The mean pretest score was 44.2 +/- 11.2%. The mean posttest score was 87.4 +/- 10.0%. Utilizing a paired t-test, the mean improvement score of 44.2% was significant ( $t[19] = 12.577$ ,  $p < 0.001$ , 95% CI of the improvement is 36.0% to 50.4%). Of the sixteen items comprising the exam, performance was significantly improved on ten items. Analysis was done with McNemar test using exact binomial probability calculations. Validity of exam questions was verified using analysis of point biserial correlation. Fifteen items were found to be valid with a positive point biserial correlation. One item had a negative point biserial correlation meaning subjects who overall did well on the exam tended to get this question wrong. This item was not included in analysis.

**CONCLUSIONS:** This educational program was proven to be effective in improving the personal trainers' knowledge base regarding exercise implementation for clients with neurological impairments.

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**2632 Board #26 May 29 2:00 PM - 3:30 PM**  
**The Effect Of Vision On Muscle Power In Trained And Untrained Males And Females**

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(No relationships reported)

Recent studies have documented significant isokinetic strength and power differences in the visually impaired compared to age-and-sex matched sighted individuals. However, these differences have been solely attributed to a decreased activity level in the visually impaired.

**PURPOSE:** The purpose of this study was to determine if vision affects muscle power production. In addition, the ability of a regular lower body strength training regimen (2x's per wk) to accommodate for the absence of vision was also examined.

**METHODS:** Thirty college-aged participants performed a seated leg press with and without vision (blindfold) in two separate counterbalanced trials. Quadriceps' power was calculated using the following variables: distance the leg press footplate was displaced, time of concentric muscle activity, and an individualized force variable for each participant (60% of 1 Repetition Maximum). Muscle activity was measured using surface electromyography. An alpha level of .05 was established and separate repeated measures analysis of variance were performed to determine the effect of visual stimuli, training status, and gender on muscle power production.

**RESULTS:** A significant main effect was found for visual stimuli ( $p < .01$ ). There was a significant interaction between vision x training status ( $p < .05$ ), but not vision x gender ( $p = .147$ ). A Tukey HSD revealed untrained females saw the greatest decrease in power ( $p < .001$ ). Power significantly decreases in the absence of vision, but a regular strength training program in the visually impaired can be implemented to help counteract such occurrences.

**CONCLUSIONS:** Strength and power differences in visually impaired individuals are rightfully attributed to activity level, but these findings suggest the role of vision in muscle power production should also be considered.

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**2633 Board #27 May 29 2:00 PM - 3:30 PM**  
**Relation Between Heart Sound Amplitude And Diastolic Time During Exercise In Persons With Cardiac Disease**

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(No relationships reported)

**PURPOSE:** The amplitude of the first heart sound (AHS1), an index of the left ventricular contractility, increases during graded exercise and results in a clear break-point called the heart sounds breaking point (HSBP). The workload corresponding to HSBP has been demonstrated to be closely associated with the  $\dot{V}O_{2\max}$  and the workload at the LT. The systolic and diastolic time (DT) can be observed from the timing of the first heart sound (S1) and the second heart sound (S2). A close correlation between the DT (DT/RR interval (%)) and ST depression in exercise in patients with effort angina has been reported, however, the ischemic threshold of the DT was not related to the corresponding values of the RR interval. The heart sound is a convenient and noninvasive technique for assessing cardiac performance and may provide valuable information regarding exercise stress. Consequently, this study investigated the relationship between the HSBP and DT.

**METHODS:** Nineteen subjects, aged 71+10 years with a BMI of 26.4+3.4 kg/m<sup>2</sup>, underwent a submaximal graded cycle ergometer test. The work rate started at 15 watts and then increased at 15 watts every 90 sec until reaching an RPE of 15. The AHS1 was expressed by the ratio of amplitude immediately after exercise versus rest. For determining the HSBP of each subject, AHS1 of each stage was plotted on a graph versus workload. The point of the abrupt increase in AHS1 versus the workload was determined from visual inspection. The %DT was measured at rest and at each stage of exercise. Values of the %DT were calculated by the formula [(RR-S1S2 interval)/RRx100].

**RESULTS:** The HSBP was obtained in 16 subjects. The HSBP was not obtained in 3 subjects due to weak heart sounds. The average of HSBP and %DT at HSBP were 61.1 + 23.7 watts, 54.0 + 6.0 %. The correlation between the HSBP and age was statistically significant (HSBP vs. age,  $r = -0.64$ ,  $p < 0.01$ ). The correlation between the HSBP and %DT was not statistically significant.

**CONCLUSION:** Monitoring heart sound appears to provide valuable information related to level of exercise stress. This information may be useful when determining an appropriate exercise prescription.

*This study was partly Supported by grants from the Japanese Ministry of Education, Science, Sports, and Culture (No. 19200049) and a Global FU Program by Fukuoka University.*

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**2634 Board #28 May 29 2:00 PM - 3:30 PM**  
**Validity Of Talking Pedometers In Measuring Steps: Effect Of Free-living, Speed, And Stair Climbing**

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(No relationships reported)

Talking pedometers are commercially available for individuals with visual impairment as a tool for objectively monitoring physical activity. The functions of these pedometers for individuals who may have difficulty reading pedometer read-outs or function data makes them usable for both research and in the general population.

**PURPOSE:** To examine the accuracy of 4 electronic talking pedometers in measuring steps during free-living, stair climbing, and increasing walking speeds. Pedometers included: Oregon Scientific (OS), Sportline (SL), Brookstone (BS), and Accusplit Alliance (AA).

**METHODS:** Twenty participants, 10 young adults (avg. 24+5 years) and 10 older adults (avg. 73 years), wore each talking pedometer simultaneously with a criterion pedometer (Digiwalker SW-200) during a 24-hour period. Participants recorded steps at the end of each day on a log. Both young and older adults completed the stair climbing section by walking up and down a flight of stairs wearing the talking pedometers on a waistbelt while actual steps were hand-tallied (HT) by the investigator. To determine the effect of speed on pedometer validity, the 10 young participants completed a 5-stage treadmill test at increasing speeds of 54, 67, 80, 94 and 107 m[Unsupported Character - &#903;]min<sup>-1</sup>. Each stage was 4-minutes, with actual steps measured using HT.

**RESULTS:** There was no effect for age on free-living measurement, with the AA being the only valid pedometer in step counting when compared to the criterion ( $p=0.748$ ; % error = -1.72%). There was also no effect for age on step measurements during stair climbing for any pedometers, with the BS being the only valid pedometer for both upstairs and downstairs when compared to HT ( $p>0.05$ , avg % error = -8.03% ). There was an effect for walking speed on pedometer validity for OS and SL, with both becoming more accurate with increasing speeds. BS (avg % error = -0.89% ) and AA (avg % error = 1.01%) were valid at all walking speeds ( $p>0.05$ ).

**CONCLUSION:** In general, the AA was the most valid of all talking pedometers in measuring steps during free-living and at different walking speeds. The BS was the only valid talking pedometer for measuring steps during stair climbing. These results show that there are valid pedometers available for those with visual impairment to objectively monitor daily step accumulation.

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## **F-23 Free Communication/Poster - Determinants of Physical Activity and Health Behaviors in Various Populations**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### **2635 Board #29 May 29 3:30 PM - 5:00 PM**

#### **Correlates Of Child Activity And Television: The Contribution Of Children's Athletic Identity**

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There is evidence that athletic self-concept can be both an important outcome and/or a mediating variable for physical activity in children and adolescents. However much less is known about the relationship between sedentary behaviors, such as television with athletic self-concept.

**PURPOSE:** This study examined the contribution of children's athletic self-concept to physical activity and sedentary behavior over and above effects of demographic factors related to child activity.

**METHODS:** Two age groups of children (N = 1503) completed the 40-item Athletic Identity Questionnaire (AIQ), measuring athletic appearance, competence, importance of physical activity and sports, and encouragement for activity from parents, teachers, and friends. Hierarchical multiple regression analysis assessed the effects of athletic identity, ethnic group, gender, and overweight status on moderate-to-vigorous physical activity and television watching in each age group. Secondary analyses considered the contribution of each factor of athletic identity to both behavioral outcomes.

**RESULTS:** In both age groups of children, the global score of athletic identity was independently related to physical activity ( $p < .0001$ ,  $p < .0001$ ) and television ( $p = .01$ ,  $p = .002$ ). More variance in physical activity was explained in younger (23%) than older children (5%), with almost equal amounts for television across age (2%, 4%). Secondary analyses showed that relationships for competence, importance, and parental encouragement persisted independent of the effects of demographic factors on behavior.

**CONCLUSIONS:** Results support the potential role of athletic self-concept in promoting exercise, sports, and physical activity behavior, but provide less support for substantially reducing time spent watching television. Although the positive influence of self-concept operated over and above the effects of gender, ethnicity, and overweight status, these demographic variables influence specific self-conceptions, which should be recognized in the development of interventions to change active and sedentary behaviors.

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### **2636 Board #30 May 29 3:30 PM - 5:00 PM**

#### **A Two Year Comparison Of The Psychosocial Correlates Of Physical Activity For Middle School Youth**

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(No relationships reported)

**PURPOSE:** To conduct a two-year comparison of the reported physical activity (PA) levels and psychosocial variables influencing the PA of 6<sup>th</sup> and 7<sup>th</sup> Graders within the context of the Youth Physical Activity Promotion Model.

**METHODS:** The Children's Physical Activity Correlates Scale (CPAC), Physical Activity Enjoyment Scale (PACES) and Physical Activity Questionnaire for Older Children (PAQ-C) were administered in two consecutive years to middle school youth. In Year 1, 77 6<sup>th</sup> (n = 34) and 7<sup>th</sup> (n = 43) graders completed the surveys. In Year 2, 66 7<sup>th</sup> (n = 24) and 8<sup>th</sup> (n = 42) of the same students, boys (n = 31) and girls (n = 35), completed the surveys. Physical activity was measured by the average of the scores reported on the PAQ-C which was administered twice during the semester.

**RESULTS:** Significant differences were found in the reported PA levels and psychosocial correlates of the participants. The mean PA scores were significantly ( $p < .01$ ) lower in Year 2 than in Year 1. Scores reported for 'enjoyment' of PA were also significantly ( $p < .01$ ) lower in Year 2 than in Year 1. The predisposing factor of 'Attract' (liking games and sports, finding physical exertion fun, liking exercise, finding exercise important) was significantly lower ( $p < .01$ ) in Year 2 than in Year 1. However, 'perceived competence' was not significantly ( $p > .05$ ) different from Year 1 to Year 2. Reinforcing factors relating to the perception of 'parent influence' and perception of 'parent role modeling' were not significantly ( $p > .05$ ) different from Year 1 to Year 2. 'Self-esteem' was significantly ( $p < .05$ ) lower in Year 2 than in Year 1. 'Peer Acceptance' was the only factor that was significantly ( $p < .05$ ) higher in Year 2 than in Year 1.

**CONCLUSIONS:** In the transition from 6<sup>th</sup> to 7<sup>th</sup> and 7<sup>th</sup> to 8<sup>th</sup> Grade, reported PA levels of boys and girls decreased. Some psychological and social variables that influence PA also decreased. Students tended to enjoy PA less, have lower self-esteem and were less attracted to PA. How these students perceived their parent's support, encouragement and function as role models did not change. The role of peers in the acceptance of PA increased. Additional research is needed to develop programs focusing on ways to make PA more likable and appealing in peer-accepted settings.

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2637 Board #31 May 29 3:30 PM - 5:00 PM

**Physical Activity And Social Support For Exercise In A Sample Of Sorority And Fraternity Members**

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(No relationships reported)

Many factors, including social support, influence the decision to be physically active. College students' physical activity patterns have been examined, but less is known about these patterns among college students belonging to fraternities and sororities, a potential source of social support.

**PURPOSE:** 1) to provide a description and comparison of the levels of physical activity and social support for exercise among fraternity and sorority members, and 2) to examine the relationship between social support for exercise and physical activity in fraternity and sorority members.

**METHODS:** Fraternity and sorority members at a large university were recruited online via email and asked to complete a survey. The online survey included the International Physical Activity Questionnaire, the Social Support for Exercise Survey, and demographic questions. Physical activity was contrasted and modeled using MANOVA and stepwise multiple regression in SPSS version 15.0.

**RESULTS:** Three hundred thirty-seven members of fraternities and sororities completed an online survey (74.8% female). The majority (90%) of fraternity and sorority members reported some moderate or high intensity physical activity. However, most (62.3%) were not vigorously active 3 days per week for at least 20 minutes per session. Males were significantly more likely to report being active than females ( $p < 0.001$ ). There were moderate correlations between social support for exercise from friends and moderate activity ( $r = 0.27$ ,  $p < 0.01$ ) and vigorous activity ( $r = 0.39$ ,  $p < 0.01$ ). Social support for exercise from friends and gender predicted 22% of the variance in moderate and vigorous physical activity.

**CONCLUSION:** Consistent with previous studies, less than half of these students engaged in recommended levels of vigorous exercise. Also similar to previous reports of male and female college students, fraternity members reported more participation in vigorous activity than did sorority members. Social support for exercise from friends was higher in both male and female students reporting structured moderate and vigorous exercise. This suggests that friends provide an important source of encouragement for those who exercise. The strongest predictors of moderate and vigorous exercise in these students were social support from friends and gender.

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2638 Board #32 May 29 3:30 PM - 5:00 PM

**A Description Of Internet Usage For Health And Fitness Information Among Middle-aged And Older Adults**

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(No relationships reported)

Census data indicate that almost one third of adults have used the internet for health information. That number is reported to be much higher for older adults. There is limited research on internet use for exercise or fitness information among older adults.

**PURPOSE:** This descriptive study examined internet usage for health and fitness information among middle-aged and older adults.

**METHODS:** Participants (N= 140; 50 - 94 yrs) completed a questionnaire that assessed personal demographics and characteristics of internet use for health and fitness information.

**RESULTS:** Participants were mostly women (63.4%) and Caucasian (93.6%), and 95% had completed at least some college. Most participants (91%) had internet access for personal use and 79% reported using the internet multiple times per week or daily. Of participants who seek health information, 46.8% indicated the internet was a primary source for health information. Only 17.9% of those who seek fitness information listed the internet as a primary source, but 37% reported they had ever used it for exercise or fitness information. Half reported checking the credentials of their primary sources for health information, and only 31% reported checking credentials of their primary sources for fitness information. Over half (56%) use a regular website for health information, but few (26.7%) used a regular site for fitness information. Only 37.3% of participants reported never receiving inaccurate health information from a primary source, but 60.2% indicated they had never received inaccurate fitness information from a primary source. Participants rated internet information as good or excellent for health (87.2%) and fitness (88.6%). The ability to understand information was reported as the most important criterion for evaluating the quality of health (47.2%) and fitness (43.6%) websites.

**CONCLUSION:** The internet was a common source for health information, but was used less for fitness information. Participants typically did not check the credentials of sources, but rated internet information as good or excellent. Being able to understand information was considered most important. Health and fitness professionals should educate older adults on evaluating internet information and be able to provide them with quality websites for health and fitness information.

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2639 Board #33 May 29 3:30 PM - 5:00 PM

**A Social Ecological Approach To Increase Walking Among Sedentary Women**

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(No relationships reported)

Less than half of American women are sufficiently active to reduce their risk for chronic disease. Current evidence emphasizes the importance of creating programs to increase physical activity that encompass multiple levels of the social environment.

**PURPOSE:** To evaluate the efficacy of a social ecological intervention to increase walking among sedentary women.

**METHODS:** We delivered the intervention at the organizational level (church), and we operationalized walking as average steps/day, measured by the New-Lifestyles Digi-Walker SW 200 pedometer. A convenience sample of N = 7 Christian churches in the Greater Columbus area participated in the study, and women were recruited from cooperating churches into the social ecological intervention (SE: n = 20) or a self-monitoring only comparison group (SM: n = 18). Both groups monitored steps/day over the 10 week study. Women in the SE group only attended four sessions targeting intrapersonal (self-efficacy, self-regulation), and interpersonal (social network, group cohesion) levels of the social environment.

**RESULTS:** Women in the SE group increased steps/day more than women in the SM comparison group (~ 2660 vs. ~ 1316,  $p < .05$ ). Additionally, the SE intervention had a significant impact on self-regulatory self-efficacy ( $p < .05$ ) and social network index church ( $p < .001$ ). Self-regulation and social support for physical activity significantly increased over time ( $p < .001$ ), but the difference between the groups was not significant. Associations between change in steps/day, self-regulatory self-efficacy, and the social network index church ( $r = .309$ ,  $r = .305$ , respectively), suggest they were possible mediators of the intervention on steps/day. Associations between change in steps/day with BMI ( $r = .435$ ), age ( $r = .453$ ), and education ( $r = .391$ ), imply their role as moderators.

**CONCLUSIONS:** The findings support including multiple levels of the social environment in interventions to increase physical activity among sedentary women.

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2640 Board #34 May 29 3:30 PM - 5:00 PM

**Factors Predicting Adherence To 9 Months Of Supervised Exercise In Healthy Older Women**

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(No relationships reported)

The determinants of physical activity participation in older people have been well-documented. Less is known, however, about factors affecting adherence to highly-structured and supervised exercise programs.

**PURPOSE:** To determine factors related to adherence to a 9-month exercise trial among previously-inactive, healthy older (> 65 y) women (N=30).

**METHODS:** Subjects were randomized into a: 1) higher- ( $AT_H$  - 80%  $VO_{2peak}$ ); or 2) moderate- ( $AT_M$  - 65%  $VO_{2peak}$ ) intensity aerobic; or 3) lower-intensity resistance ( $RT_L$ ; 50%  $VO_{2peak}$ ) group. All three groups were identical in exercise frequency (4 days/week); however, subjects in the  $AT$  groups exercised for a duration necessary to expend 300 kcal/session. All sessions were supervised at on-site facilities and subjects exercised in groups to enhance convenience and social support. Heart rate was measured continuously and recorded throughout exercise. Attendance was defined as the proportion of completed to prescribed exercise sessions (N=144). Adherence was defined as the proportion of prescribed sessions in which subjects achieved their: 1) prescribed heart rate; and 2) their prescribed duration. Determinants of adherence included age, BMI, lean mass (kg), %body fat,  $VO_{2peak}$ , prescribed intensity (METs) and prescribed duration (min), and exercise self-efficacy score.

**RESULTS:** Age,  $VO_{2peak}$ , and body composition were similar among the three groups. Attendance was greatest in the  $AT_H$  group (94%) and lowest in  $AT_M$  (90%). Adherence to the prescribed duration was 95%, 91%, and 85% in the  $RT_L$ ,  $AT_H$ , and  $AT_M$  groups, respectively. Adherence to the prescribed intensity was 100% for all three groups. We observed a positive (rather than inverse) correlation between the prescribed METs and attendance ( $r=0.48$ ;  $p<0.03$ ), as well as adherence to the prescribed duration ( $r=0.53$ ;  $p<0.01$ ). Prescribed duration was not associated with attendance ( $r=0.14$ ;  $p<0.46$ ); however, the prescribed duration of each session was the strongest determinant of adherence to that duration ( $r=-0.72$ ;  $p<0.0001$ ).

**CONCLUSIONS:** Exercise duration (not intensity) may negatively affect adherence to structured exercise programs. Programs comprising exercise of shorter duration, but greater frequency may be more effective in helping older adults achieve the health benefits of an active lifestyle.

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**2641 Board #35 May 29 3:30 PM - 5:00 PM**

**Relationship Between Prepregnancy Body Mass Index, Psychological Health, And Physical Activity In Pregnancy**

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(No relationships reported)

Women's prepregnancy body mass index (BMI) is an independent predictor of pregnancy complications including poor psychological health. Regular physical activity (PA) is one strategy for improving women's psychological health, however, the research examining the association between BMI, psychological health, and PA during pregnancy is scant.

**PURPOSE:** To examine the moderating influence of prepregnancy weight status on psychological health and PA behaviors during the second pregnancy trimester.

**METHODS:** Women ( $N = 40$ ,  $M$  age =  $29 \pm 5$  yrs; prepregnancy BMI =  $26 \pm 8$   $kg\ m^{-2}$ ) completed self-reported measures of depression (CES-D), body satisfaction (BASS), anxiety (STAI), and wore NL1000 pedometers at 20- weeks gestation. Participants were categorized by their prepregnancy BMI as either normal weight ( $19.8$  to  $24.9$   $kg\ m^{-2}$ ) or overweight ( $> 25$   $kg\ m^{-2}$ ); and one-way ANOVA's with Bonferroni correction were used to examine group differences across the study measures.

**RESULTS:** Women classified as normal weight prior to pregnancy had significantly higher body satisfaction ( $M = 29$ ) compared to overweight women ( $M = 23$ ),  $F(1, 26) = 5.8$ ,  $p < .05$ . In addition, normal weight women accumulated more min of moderate-vigorous PA (MVPA;  $M = 33$ ) per day compared to the overweight women ( $M = 21$ ),  $F(1, 28) = 3.4$ ,  $p < .05$ . No significant group differences were observed for the CES-D and STAI ( $p$ 's  $> .05$ ).

**CONCLUSION:** These preliminary findings illustrate that prepregnancy BMI may have an important influence on psychological health and PA behaviors in pregnancy. Women who were classified as normal weight prior to pregnancy reported feeling more satisfied with their bodies and exercised at a higher intensity during pregnancy compared to women who were overweight prior to pregnancy. These findings have important implications for the role of preconceptional interventions in promoting healthy weight before women are pregnant in an effort to improve psychological health and PA and reduce complications during pregnancy.

Funding: NIDDK DKR21-075867-02 and the Children, Youth, and Families Consortium of The Pennsylvania State University.

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**2642 Board #36 May 29 3:30 PM - 5:00 PM**

**Perceived Control And Physical Activity Determinants And Behaviors Among Pregnant Women With Gestational Diabetes**

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(No relationships reported)

Perceived control is an important determinant of physical activity (PA) motivation and behavior, and it may be particularly salient for pregnant women with complications such as gestational diabetes (GDM). While PA is safe and recommended as a strategy for controlling blood sugar, most GDM women are inactive. Little is known about how GDM women feel about engaging in PA during pregnancy and whether perceived control influences their PA determinants and behaviors during this time.

**PURPOSE:** To prospectively examine PA determinants and behaviors among GDM women with low and high perceived control using the framework of the Theory of Planned Behavior.

**METHODS:** Women with GDM ( $N = 45$ ,  $M$  age =  $29 \pm 4$ , 78% Caucasian) completed self-reported measures of their PA attitude (ATT), subjective norm (SN), intention (INT), and perceived behavioral control (PBC), and wore Actigraph accelerometers and NL1000 pedometers during their 2nd and 3rd trimesters. Based on their PBC scores, women were classified as having low or high perceived control for PA; one-way ANOVAs with Bonferroni correction were used to determine significant group differences across the study variables.

**RESULTS:** In the 2nd trimester, the high PBC group had significantly higher ATT ( $M = 44$ ), SN ( $M = 20$ ), INT ( $M = 19$ ), and Actigraph activity counts/min ( $M = 340$ ) compared to the low PBC group ( $M = 37$ , 15, 14, 267, respectively;  $p$ 's  $< .001$ ). No significant differences for the NL1000 steps/day or min of moderate-vigorous PA (MVPA) were observed. In the 3rd trimester, the high PBC group had significantly higher ATT ( $M = 42$ ), SN ( $M = 18$ ), INT ( $M = 18$ ), Actigraph activity counts/min ( $M = 317$ ), NL1000 steps/day ( $M = 6,689$ ), and NL1000 MVPA min ( $M = 22$ ) compared to the low PBC group ( $M = 32$ , 14, 10, 255, 4,404, 12, respectively,  $p$ 's  $< .01$ ).

**CONCLUSION:** These preliminary data suggest that perceived control may be an important factor influencing GDM women's PA determinants and behaviors, particularly in later pregnancy when there are more physical and psychological barriers to PA participation. Increasing GDM women's perceived control for PA may help this group to increase their PA and better manage their diabetes, which in turn, can result in better health outcomes for these women and their offspring.

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**2643 Board #37 May 29 3:30 PM - 5:00 PM**

**Physical Activity Levels Of Adults With Mild Intellectual Disabilities**

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**PURPOSE:** Regular physical activity participation is considered as a critical element in health promotion. Little is known regarding physical activity levels of individuals with intellectual disabilities. The purpose of this study was to investigate levels of physical activity among adults with mild intellectual disabilities (MID) in Taiwan.

**METHODS:** A national sample of 116 adults with MID recruited from four major geographical regions in Taiwan participated in this study. Step counts were gathered from each participant for 7 consecutive days. Additionally, direct caregivers recorded physical activity logs of participants with MID for 3 days using the Bouchard three-Day Physical Activity Record.

**RESULTS:** The results indicated that participants spent 15.6 hours in sedentary activity, 6.8 hours in mild physical activities, and 1.6 hours in moderate and vigorous physical activities (MVPA) on average per day. On average, participants walked 9,273 steps per day. Approximately 34% of participants met the 10,000 steps per day recommended physical activity level.

**CONCLUSION:** A unique and unexpected finding of this study was the overall level of physical activity as reflected in the step counts and time engaged in the MVPA.

Although this finding is likely related to the younger age of the adult sample and the selective recruitment from work sites in which manual labor was often part of their job responsibilities, it remains a provocative outcome. The potential interactive effect of work-related and leisure time physical activity, as well as age, gender, and health status ought to be further explored in health promotion practices for this population.

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**2644 Board #38 May 29 3:30 PM - 5:00 PM**

**Body Mass Index, Function, And Physical Activity In Hypertensive Older Adults: Theory Of Planned Behavior**

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(No relationships reported)

Physical activity (PA) participation declines with age and may result in the development of chronic disease and disability. The theory of planned behavior (TPB) has been shown to explain PA behavior.

**PURPOSE:** To identify the predictors of intention and PA behavior of older adults with hypertension.

**METHODS:** A secondary analysis was conducted in a sub-sample (n=404) of hypertensive older adults (M age= 75.8 years,  $\pm$  6.5) from an initial survey of 2056 retirees from a large Midwestern university.

**RESULTS:** Multiple regression analyses revealed that a modified TPB model that included functional ability (FA) and BMI explained 54.3% of the variance in *intention* to be physically active and 30% of *PA behavior* ( $p < .05$ ). Perceived behavioral control (PBC), attitude and FA influenced *intention* to participate in PA ( $b = .44$ ,  $b = .33$ ,  $b = .11$ ,  $p < .05$  respectively) while FA, intention and BMI influenced *PA behavior* ( $b = .49$ ,  $b = .16$ ,  $b = .13$ ,  $p < .01$  respectively). Further analyses of BMI status revealed that FA was the strongest predictor of *PA* across all groups: normal weight, overweight, and obese ( $b = .54$ ,  $b = .43$ ,  $b = .47$ ,  $p < .01$  respectively). Perceived behavioral control was the strongest predictor of *intention* in all groups: normal, overweight, and obese ( $b = .42$ ,  $b = .38$ ,  $b = .52$ ,  $p < .01$  respectively). For the overweight group, age and gender ( $b = -.22$ ,  $b = .15$ ,  $p < .05$  respectively) predicted *PA*, while gender ( $b = .25$ ,  $p < .05$ ) predicted *PA* in the obese group. Attitude predicted *intention* across all weight groups ( $p < .01$ ) while subjective norm did not. Gender predicted *intention* in the normal weight group ( $b = .16$ ,  $p < .01$ ) and age was a significant predictor in the overweight group ( $b = .18$ ,  $p < .05$ ). Further analyses of gender indicated that men were significantly more physically active and had higher FA than women across all weight groups. Obese men had the highest PA and FA scores while obese women had the lowest.

**CONCLUSION:** PA interventions need to be individualized for older adults across different weight groups. FA, gender, and age should also be considered when designing interventions for older adults with hypertension.

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**2645 Board #39 May 29 3:30 PM - 5:00 PM**

**Demographic and Lifestyle Correlates of Physical Activity: The Shanghai Physical Activity Study**

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(No relationships reported)

**BACKGROUND:** To understand the mechanisms by which physical activity influences health and to target public health recommendations, it is important to determine factors correlated with activity.

**METHODS:** We examined demographic and lifestyle factors in relation to questionnaire and accelerometer measured physical activity in 251 men and women aged 40 to 70 years in Shanghai, China. Physical activity over the past year was assessed by a newly developed questionnaire (PAQ) during two in-person interviews one year apart and by Actigraph accelerometer worn for four one-week periods over the same year. We evaluated both total physical activity energy expenditure (PAEE) and time in moderate to vigorous activity (MVPA) per day by averaging the PAQs and the four accelerometer wears, and categorizing each physical activity domain into two levels split at the median. Multiple logistic regression examined the association of demographic, anthropometric, lifestyle, and female reproductive factors reported at baseline with PAEE and MVPA as measured by PAQ and by accelerometer.

**RESULTS:** Over 70% of the study population achieved at least 60 minutes of average MVPA per day. In multivariate logistic regression analyses, a number of covariates were differentially associated with physical activity depending on the method of activity assessment. A high level of physical activity was less common among older men and women when measured by accelerometer, but more common when measured by self-report. In addition, while women self-reported higher PAEE, men showed suggestively higher accelerometer-assessed PAEE.

Certain dietary and reproductive factors (intake of fish, fruit, and poultry; number of pregnancies) also showed distinct associations depending on method of activity assessment, although occupation, waist-hip ratio, and smoking were consistently correlated with physical activity regardless of physical activity measurement method.

**CONCLUSION:** The association of physical activity with demographic, anthropometric, and lifestyle factors may vary according to method of physical activity measurement. However, these methods likely differ in the ability to capture certain domains of physical activity.

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**2646 Board #40 May 29 3:30 PM - 5:00 PM**

**My Baby, My Move: Examination Of Perceived Barriers And Motivating Factors To Antenatal Physical Activity**

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(No relationships reported)

**PURPOSE:** The American College of Obstetrics and Gynecologists recommends that pregnant women who are free of obstetrical complications engage in regular leisure physical activity (RLPA), but pregnant women engage in less RLPA than their nonpregnant counterparts. Given the low rates of RLPA among pregnant women, especially those of low socioeconomic status (SES),

coupled with the many maternal benefits associated with antenatal RLPA, there is a definite need to promote engagement in antenatal RLPA among pregnant women. Based on a socio-ecological model framework, the present study compared and contrasted multi-level barriers and facilitators related to physical activity engagement during pregnancy to better understand what motivates and prevents pregnant women from engaging in RLPA and whether or not and to what extent these may differ among level of activity, parity, and SES.

**METHODS:** Informant interviews and focus groups were conducted with 60 pregnant women (aged 18-46 yrs, 17-40 weeks gestation). Atlas/Ti software was used to code the verbatim interview transcripts by organizing codes into categories that reflect symbolic domains of meaning, and within domains, relational patterns, and finally overarching themes.

**RESULTS:** Perceived barriers and motivating factors differed between groups at various intra- and interpersonal, social and environmental levels. For example, sources of interpersonal support among low income women centered more on support from friends and family whereas healthcare providers played a primary support role among women from higher income levels.

**CONCLUSIONS:** Future interventions should take into account key motivating factors and barriers pertaining to SES groups, in order to tailor more meaningful advice for pregnant women.

*This work was funded by the CDC 1 K01 DP001127-01*

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**2647 Board #41 May 29 3:30 PM - 5:00 PM**  
**Determinants Of Physical Activity In Older Adults With Peripheral Vascular Disease.**

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Functional impairment limits participation in leisure activities and decreases the ability to perform activities of daily living for older adults with peripheral vascular disease (PVD). The Theory of Planned Behavior has been found to explain older adult physical activity (PA). The determinants of PA are unclear for older adults with PVD.

**PURPOSE:** To examine a modified Theory of Planned Behavior model and identify the determinants of PA for older adults with PVD.

**METHODS:** Older adults with PVD (n=132), 66-97 years old (M age=75.8 years,  $\pm 6.5$ ), completed a cross-sectional survey. Measures included the TPB questionnaire, Physical Activity Scale for the Elderly and the Physical Functioning Scale.

**RESULTS:** The sample was mostly sedentary (M PA score=96.7,  $\pm 58.9$ ) with moderate limitations (M=55.8,  $\pm 28.8$ ) in functional ability (scores were 0=unable to do to 100=no difficulty). Linear regression analyses revealed that the modified TPB model that included functional ability explained 64% of the variance in intention to be physically active ( $p < .05$ ) and 35% of the variance in PA behavior ( $p < .01$ ). Attitude had the greatest influence on intention ( $b = .51$ ,  $p < .01$ ), followed by subjective norm, perceived behavioral control and functional ability ( $b = .17$ ,  $b = .17$ ,  $b = .15$ ,  $p < .05$ , respectively). Functional ability was the strongest predictor of PA ( $b = .39$ ,  $p < .01$ ), followed by intention ( $b = .24$ ,  $p < .01$ ). This population of older adults with PVD identified moderate difficulty in each functional ability task measured including performing heavy housework (M=46.5,  $\pm 37.5$ ), walking (M=50,  $\pm 35$ ), climbing stairs (M=53,  $\pm 31$ ), lifting/carrying 10 lb. (M=53,  $\pm 34.6$ ), light housework (M=66,  $\pm 32.8$ ), and rising from a chair (M=67.7,  $\pm 29$ ).

**CONCLUSIONS:** Exercises that promote increasing functional ability, with emphasis on activities related to daily living such as walking, stair climbing and housework, should be incorporated into the management of older adults with PVD.

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**2648 Board #42 May 29 3:30 PM - 5:00 PM**  
**The Relationship Between Perceived Stress And Health Promoting Behaviors In Male And Female Undergraduate Students.**

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During college, students are inundated by a variety of stressors. Stress and the inability to effectively cope with stress can be detrimental. A relationship exists between stress and health-risk behaviors. However little research has examined the relationship between stress and health-promoting behaviors.

**PURPOSE:** To examine the relationship between perceived stress levels and health promoting behaviors in undergraduate students.

**METHODS:** Two surveys, the Perceived Stress Scale (PSS) and the Health Promoting Lifestyle Profile II (HPLP-II), were administered as part of a larger study to undergraduates enrolled in a wellness class at a small, private Midwestern university. A regression was performed with the perceived stress score (predictor) and health promoting lifestyle profile score (criterion). Correlations were performed with each subscale of the HPLP-II to examine their relationship to stress.

**RESULTS:** Pearson correlation co-efficient between the variables was  $-0.324$  ( $p = .005$ ). \*  $R^2 = .105$  [ $F(1,61) = 7.039$ ;  $p = .010$ ]. All subscales revealed a negative correlation with stress.

**CONCLUSIONS:** As stress increases, participation in a health promoting lifestyle and health promoting behaviors decreases. These results suggest that stress is harmful not only because it may influence individuals to engage in risky behaviors, but also because it is negatively associated with participation in health promoting behaviors.

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**2649 Board #43 May 29 3:30 PM - 5:00 PM**  
**Caregiving And Perceptions Of Health**

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(No relationships reported)

It is generally accepted that caregiving responsibilities have a detrimental effect on the health of the caregiver.

**PURPOSE:** The purpose of this research was to examine the effects of caring for a relative on the perceived health of the caregiver.

**METHODS:** Participants were 31 female employees at a local university. Caregivers ( $n = 12$ ) were defined as those currently providing care for a family member and those who had been a caregiver at some point in the past year. Six caregivers were members of the faculty. The *Perceived Stress Scale* (PSS) was used to assess how much stress the participants were experiencing. The *Short Form 36* (SF-36) was used to assess general perceptions of health. The mental component score (SFMC) and physical component score (SFPCS) were used as generalized measures of mental and physical health. A MANOVA was used to test for multivariate significance, with follow up univariate ANOVA tests when appropriate. Multivariate significance was set at  $p < .10$ . Significance for the univariate follow-up tests was set at  $p < .03$ .

**RESULTS:** Caregivers scored higher on the PSS ( $18.75 \pm 6.18$  vs.  $13.21 \pm 5.89$ ). Non-caregivers scored higher on the SFMC ( $53.18 \pm 6.12$  vs.  $46.32 \pm 13.41$ ) and the SFPCS ( $52.93 \pm 4.35$  vs.  $50.33 \pm 6.02$ ). The multivariate  $F$  test was significant for the caregivers versus non-caregivers comparison ( $F_{3,25} = 2.58$ ,  $p = .08$ ). The follow-up univariate tests showed significance only on the PSS ( $F_{1,27} = 6.59$ ,  $p = .02$ ). Multivariate significance was not found for faculty caregivers compared to staff caregivers. Effect size was large for both the caregiver-non-caregiver ( $D^2 = 0.98$ ) and faculty caregiver-staff caregiver ( $D^2 = 1.49$ ) comparisons.

**CONCLUSIONS:** These data indicate differences in perceptions of health in caregivers compared to non-caregivers. The majority of the perceived health differences is

accounted for by differences in perceived stress. This indicates caregivers perceive their stress levels to be significantly higher than do non-caregivers. Additional research into the health ramifications of caregiving is needed. Research should focus on both caregivers compared to non-caregivers and caregivers with differing types of employment. Health should also be assessed objectively (i.e. blood pressure or cortisol levels) to determine whether the health differences are objective.

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**2650 Board #44 May 29 3:30 PM - 5:00 PM**

**A Description Of Adolescent Twins' Body Composition And Physical Activity**

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(No relationships reported)

Limited research is available regarding body composition and physical activity (PA) patterns among twins during adolescence.

**PURPOSE:** Our purpose was to evaluate body composition and physical activity in monozygotic (MZ) and dizygotic (DZ) adolescent twins.

**METHODS:** Participants were 296 adolescent female (n=202; 92 MZ, 110 DZ) and male (n=94; 52 MZ, 42 DZ) twins (age=12.4±1.4 yr). Body fatness (%Fat) was assessed by bioelectrical impedance analysis and PA by a 3-Day Physical Activity Recall. Participants reported activities completed in 30 min increments over 3 consecutive days. MET values were assigned to each activity and then used to calculate time spent in moderate to vigorous PA, as well as, whether the study participant achieved current physical activity recommendations (≥60 min/day of moderate to vigorous PA). Intraclass correlations, chi-square, t-test, z-scores, and Mann-Whitney U tests were used to assess the relationships and differences in % Fat and PA among MZ and DZ twins as appropriate.

**RESULTS:** There were no significant differences between average±SD %Fat (females: MZ 26.2±7.1 % DZ 26.8±7.8 %; males: MZ 21.6±7.2 % DZ 20.3±8.7 %), total number of blocks spent in moderate to vigorous PA over three days (females: MZ 9.7±7.8 blocks DZ 8.9±6.8 blocks; males: MZ 11.6±10.1 DZ 14.1±11.9 blocks), or the proportion of twins meeting PA recommendations (females: 28.3 % MZ vs 30.9% DZ; males: 36.5 % MZ vs. 38.1% DZ;  $\chi^2 = 1.6$ , nonsignificant) by zygosity. %Fat was more tightly correlated in MZ twin pairs (females  $r = 0.97$ ; males  $r = 0.92$ ) compared to DZ twin pairs (females  $r = 0.76$ ; males  $r = 0.80$ ). However, female DZ twin pairs showed a significantly stronger correlation for spending similar time in moderate to vigorous PA ( $r = 0.79$ ) than did female MZ twins ( $r = 0.41$ ), while the male twins did not show a significant difference in this relationship (MZ  $r = 0.86$ , DZ  $r = 0.82$ ).

**CONCLUSION:** Twin zygosity did not significantly alter body composition or PA when comparing group means or the proportion of twins meeting PA recommendations. However, while anthropometric similarities were greater in both male and female MZ twins, physical activity profiles were not. Future studies should examine the reasons why gender appears to modify physical activity behavior among adolescents with identical genetic profiles.

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**2651 Board #45 May 29 3:30 PM - 5:00 PM**

**The Correlates Of Physical Activity In Older Adults With Arthritis**

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(No relationships reported)

Older adults with arthritis are less active than those without arthritis. Understanding the correlates of PA in persons with arthritis can help in the design of more effective interventions.

**PURPOSE:** To examine the correlates of PA in black and white older adults (age 50+) with a self-report of diagnosed arthritis.

**METHODS:** A cross-sectional study grounded in the Social Cognitive Theory was conducted. Questionnaire data (demographics, self-efficacy, social support, arthritis impact, environmental factors, etc.) were obtained from people with arthritis. Participants were recruited through advertisements in community settings (e.g., senior centers, fitness centers) and Arthritis Foundation mailings. Bivariate associations between PA (meets/does not meet AHA/ACSM PA recommendations) and potential correlates were examined with  $\chi^2$  and simple logistic regressions stratified by race. A stepwise logistic regression was conducted to examine which factors best predicted PA.

**RESULTS:** Participants (n=209) were fairly diverse (median age 67; 56% white, 44% black; 87% female; 22.2% had a HS diploma or less, and 41.9% had a college degree or higher) and 29% met PA recommendations. BMI ( $\chi^2 = 9.98$ ,  $p=0.0187$ ) and race ( $\chi^2 = 6.03$ ,  $p=0.014$ ) were associated with PA level. A larger proportion of overweight (71%) and obese individuals (81%) did not meet PA recommendations compared to normal weight individuals (56%). More whites (36%) met PA recommendations than blacks (20%). Race stratified simple logistic regression analyses found no association between PA and age, gender, exercise outcome expectations, social support for exercise, affect, arthritis pain, arthritis self-efficacy or environmental factors in whites or blacks. Education (OR=1.54 CI=1.03-2.3), BMI (OR=0.86 CI=0.79-0.94), exercise self-efficacy (OR=1.14 CI=1.05-1.24) and physical function (OR=0.56 CI=0.35-0.88) were associated with PA in whites only. Stepwise logistic regression indicated BMI, exercise self-efficacy and age were the strongest PA predictors.

**CONCLUSIONS:** Findings suggest BMI, exercise self-efficacy and age are important predictors of PA in older adults with arthritis. Findings also suggest that factors associated with PA in people with arthritis may differ by race.

Supported by UIC Roybal Center Grant # 5P30AG022849-05.

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**2652 Board #46 May 29 3:30 PM - 5:00 PM**

**Preventing Type 2 Diabetes: Recommendations On Achieving Lifestyle Change From The Image Guideline Development Project**

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(No relationships reported)

**PURPOSE:** The IMAGE project (European Commission grant No: 2006309) is developing evidence-based guidelines on diabetes prevention and a training curriculum for prevention managers. To inform these guidelines, we aimed to summarise, with an emphasis on behaviour change methods, the evidence from prior systematic reviews on interventions for promoting physical activity and weight loss in populations at risk of type 2 diabetes.

**METHODS:** We searched electronic bibliographic databases and other sources for systematic reviews, published between 1998 and 2008 on interventions for adults at risk of developing type 2 diabetes. Two reviewers undertook selection and data extraction and methodological quality was assessed using the Overview Quality Assessment Questionnaire (OQAQ).

**RESULTS:** Of 3856 identified articles, 30 met our quality and selection criteria. We identified 150 analyses using descriptive, meta-analytic and meta-regression approaches to investigate the association of intervention components with effectiveness. Results related to Overall Effectiveness; Theoretical basis; Behaviour change techniques; Mode of delivery, Intervention provider, Intervention intensity and Target population. Recommendations for practice include that interventions should target both diet and physical activity, use established behaviour change techniques (eg. goal-setting, relapse prevention, self-monitoring), engage social support wherever possible, include a clear focus on behaviour maintenance, and maximise intensity during the initial intervention stage. Recommendations for future research will also be presented.

**CONCLUSIONS:** It is possible to achieve clinically meaningful behaviour change in dietary and physical activity at an individual level. A training curriculum reflecting the recommendations is being developed for implementation with adults at risk of type 2 diabetes.



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**2653 Board #47 May 29 3:30 PM - 5:00 PM**  
**Identifying Culturally Sensitive Physical Activities Using Dif Analysis**

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Promoting physical activity (PA) among traditionally disadvantaged PA subgroups as a means to reduce PA disparities is very important to help with the elimination of health disparities. However, the success of PA promotion and intervention programs for these subgroups has been very limited. Lack of culturally sensitive PA in the promotion and intervention is likely one of the reasons.

**PURPOSE:** To identify subgroup preferred PA using differential item functioning (DIF) analysis.

**METHODS:** A sub-unweighted sample of 3,083 (males = 1,511 and females = 1,572) from the National Health and Nutrition Examination Survey (NHANES 2003-2004) PA questionnaire data was used for the analyses. Using Mantel-Haenszel and SIBTEST DIF methods, 33 specific items related to leisure time moderate and vigorous PA (MVPA) were analyzed for DIF across race/ethnicity, gender, education, income and age groups.

**RESULTS:** Approximately 12% to 39% of MVPA questions used in NHANES PA questionnaire were identified as large DIF items according to widely accepted DIF identification criteria in educational and psychological measurement practice. The presence of DIF in this study implies a subgroup is more comfortable with a specific activity due to likely its social and cultural context; therefore, persons in that group report a preference to participate in that activity when engaging in the same amount of total leisure time MVPA as another group. For example, basketball and dance favored non-Hispanic Blacks while golf and hiking favored non-Hispanic Whites; Dance, hiking and soccer favored Hispanics while bicycling, golf, swimming, and walking favored non-Hispanic Whites; Aerobics, dance, stretching and walking favored females while basketball, fishing, golf, running, soccer, weightlifting and hunting favored males; Jogging, treadmill and yoga favored persons with high education levels; Golf and treadmill favored persons with high incomes; and finally basketball, dance, jogging, running, and weightlifting favored adults while walking and golf favored older adults.

**CONCLUSIONS:** DIF methods were able to identify subgroup preferred PA, which provides information to allow a deeper understanding of a subgroup's PA pattern which in turn can help design culturally sensitive, targeted interventions for disadvantaged PA subgroups.

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**2654 Board #48 May 29 3:30 PM - 5:00 PM**  
**Comparison Of Completers Versus Non-completers Of A Community-based Youth Physical Activity And Nutritional Counseling Program**

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Because the attrition rate in community-based health promotion programs for youth can be high, determining demographic and behavioral differences between completers and non-completers is important to inform retention strategies.

**PURPOSE:** To determine whether differences existed in demographics, self-reported sedentary and physical activity (PA) behaviors in girls 9 - 15 years who completed (C) versus those who did not complete (NC) a community-based PA and nutritional promotion program.

**METHODS:** Sedentary girls (n = 311, 51% white) were recruited from 3 YMCA/YWCAs in eastern Massachusetts to participate in a 12-week physical activity and nutritional counseling program. At baseline, girls completed a food and activity questionnaire developed by the Massachusetts Department of Public Health and had their height and weight measured. Differences between C (n = 169) and NC (n = 142) for body mass index (BMI), self-reported "screen time" (sum of TV, videos, video games, and computer time), and self-reported PA were determined using either independent t-tests or chi-square analyses. Significance was set at  $p < 0.05$ .

**RESULTS:** NC were older than C ( $12.4 \pm 1.4$  yrs vs  $11.7 \pm 1.2$  yrs,  $p < 0.001$ ). The percent that were white was 40.4% for the NC group and 60.1% for the C group ( $p < 0.001$ ). BMI was higher in NC ( $27.9 \pm 6.2$  kg/m<sup>2</sup>) than C ( $26.4 \pm 6.2$  kg/m<sup>2</sup>,  $p = 0.04$ ) but the percent defined as overweight ( $> 85^{\text{th}}$  percentile for age and gender) was not different between groups (58.6% for C, 61.3% for NC,  $p = 0.63$ ). The number of TVs in the household was similar for C ( $3.2 \pm 1.3$ ) and NC ( $3.4 \pm 1.4$ ) ( $p = 0.17$ ) and a higher percent of NC (67.4%) had TVs in their rooms than C (56.6%) ( $p = 0.055$ ). The percent of C and NC who were allowed to watch unlimited TV was similar (34.3% and 41.8% for the C and NC, respectively,  $p = 0.17$ ). "Screen time" was high ( $6.1 \pm 4.0$  hrs/day for C and  $6.93 \pm 4.6$  hrs/day for NC) but was not different between groups ( $p = 0.12$ ). C reported higher amounts of vigorous PA than the NC ( $p = 0.008$ ) but light PA was similar between groups ( $p = 0.82$ ).

**CONCLUSIONS:** Non-completers in this study were mostly minorities, overweight, and less active than those completers. Therefore, community PA promotion programs should implement innovative retention strategies targeted to retain minority populations who are overweight and inactive.

Supported by: MA Dept of Public Health.

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**2655 Board #49 May 29 3:30 PM - 5:00 PM**  
**Spartners For Heart Health: Baseline Characteristics Of Physical Activity And Self-efficacy Behavioral Correlates**

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The prevalence of cardiovascular disease (CVD) risk factors including low physical activity (PA) is rapidly increasing among children in Michigan and in the United States. (S)Partners for Heart Health is a school-based PA and nutrition intervention designed to promote healthy behaviors and improve selected PA correlates as a means of primary CVD prevention.

**PURPOSE:** The purposes of this study were: 1) to compare baseline characteristics for PA to national recommendations (survey and pedometer) and 2) to examine the relationships between PA and self-efficacy (SE) and outcome/expectancy (OE).

**METHODS:** Participants were 134 5<sup>th</sup> grade students (55 boys, 79 girls; mean age  $10.4 \pm 0.7$  yrs) from three Michigan primary schools. Habitual PA was assessed by a pedometer over a one-week period and a self-report PA question. Screen time (TV, video, & computer) was also self-reported. SE was assessed using a 5-point scale questionnaire designed for children. OE was assessed using one question with a 4-point Likert scale. Descriptive statistics, t-tests, Pearson and Spearman correlations were used for analyses.

**RESULTS:** Boys and girls averaged 12,117  $\pm$  4,927 and 13,321  $\pm$  10,932 steps per day, respectively. The proportion of students meeting recommendations ( $\geq 13,000$  steps-d<sup>-1</sup> for boys,  $\geq 11,000$  steps-d<sup>-1</sup> for girls) was 44% for boys (n = 23) and 41% for girls (n = 42). The PA survey question revealed that 51% of boys and girls met the recommendations of at least 60 min  $\geq 5$  days/week. SE scores were  $3.3 \pm 0.5$  for boys and  $3.1 \pm 0.6$  for girls. Average OE scores for boys and girls were  $2.2 \pm 0.9$  and  $2.2 \pm 0.7$ , respectively. Screen time was similar between boys ( $4.3 \pm 2.9$  hrs) and girls ( $4.5 \pm 10.7$  hrs). The proportion of girls meeting recommendations ( $< 4$  hrs-d<sup>-1</sup>) (74%) was significantly higher compared to boys (55%;  $p < 0.001$ ). The correlations between PA and SE and OE were  $r = 0.48$  and  $0.34$  ( $p < 0.01$ ) for boys and  $r = 0.64$  and  $0.23$  ( $p < 0.05$ ) for girls, respectively.

**CONCLUSIONS:** This sample of Michigan students' PA levels are slightly above national levels. Correlations between SE and reported PA were higher than those for OE and PA. The strong correlation of the SE for PA with PA indicates the SE measure has potential utility for predicting PA levels in this age group.

*Supported by Blue Cross Blue Shield of Michigan Foundation.*

**2656 Board #50 May 29 3:30 PM - 5:00 PM**

# **Body Mass Index And Physical Activity As Predictors Of All-cause Mortality In White, Black, And Mexican American Men**

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**Background** - Physical inactivity and obesity may be independently related to all cause and cardiovascular mortality. As these conditions continue to increase in the population it is important to assess the independent effect they have among specific segment of the population that may be disproportionate affected by them. Therefore, the purpose of this study is to examine the effects of body mass index (BMI) and leisure time physical activity (LTPA) on all cause and cardiovascular mortality using a nationally representative sample of Non-Hispanic White, Non-Hispanic Black, and Mexican American men.

**METHODS:** This study uses data from the Third National Health and Nutrition Examination Survey (NHANES III) conducted between 1988 and 1994 and the mortality follow up (2002) among adults 20 years of age and older. Anthropometric measurements were obtained at a mobile examination center by a health technician and leisure time physical activity was obtained via a questionnaire. Other covariates analyzed were age, education, smoking, and presence of chronic disease conditions. SAS and SUDAAN software programs were used estimate relatives risk of mortality and to take into account the complex sample design.

## **RESULTS:**

Relative Risk ratio with 95% confidence interval of all cause mortality among non-Hispanic White, non-Hispanic Black and Mexican American men, 20 yrs and older.						
	Non-Hispanic White		Non-Hispanic Black		Mexican American	
	BMI no PA	BMI with PA	BMI no PA	BMI with PA	BMI no PA	BMI with PA
Women						
Normal weight	1.0	1.0	1.0	1.0	1.0	1.0
Overweight	0.75 (0.59-0.95)	0.75 (0.59-0.95)	0.73 (0.56-0.95)	0.74 (0.58-0.96)	0.75 (0.54-1.04)	0.75 (0.54-1.04)
Obese	0.80 (0.60-1.06)	0.76 (0.56-1.03)	0.94 (0.70-1.25)	0.96 (0.74-1.26)	0.65 (0.42-1.00)	0.65 (0.43-0.99)
Physical Activity						
Frequent Active*		1.0		1.0		1.0
Infrequent Active**		1.07 (0.83-1.38)		0.92 (0.71-1.20)		0.91 (0.57-1.45)
Sedentary***		2.06 (1.47-2.88)		1.72 (1.24-2.38)		1.28 (0.87-1.88)

\* 5+ times per week \*\*1-4 times per week \*\*\* < 1 time per week

**CONCLUSION:** Sedentary behavior was an independent predictor of all cause mortality and cardiovascular mortality. Overweight status in men was found to be protective of all-cause mortality or cardiovascular mortality, even when physical activity was included in the model. More research is needed to examine the effect of other more precise measurements of adiposity.

## **F-24 Free Communication/Poster - Exercise and Diabetes**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

**2657 Board #51 May 29 2:00 PM - 3:30 PM**

# **Aerobic Conditioning And Hepatic Steatosis Markers In Exercise-trained Diabetic Rats**

Leandro P. Moura, Ricardo J. Gomes, José Alexandre C. Leme, Fabricio A. Voltarelli, Rodrigo F. Moura, Michel B. Araújo, Carla Ribeiro, Eliete Luciano, Maria Alice R. Mello. *UNESP, São Paulo State University, Rio Claro, Brazil.*

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(No relationships reported)

**PURPOSE:** The present study aimed to analyze the effects of exercise performed at aerobic/anaerobic transition intensity on both aerobic conditioning and on non-alcoholic hepatic steatosis (NAHS) markers, as Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) enzymes, in diabetic rats.

**METHODS:** Adult (90 days) male Wistar rats were divided into 4 groups: Sedentary Control (SC), Trained Control (TC), Sedentary Diabetic (SD) and Trained Diabetic (TD). At the beginning of the experiment, all the animals were submitted to maximal lactate steady state (MLSS) test in order to identify the aerobic/anaerobic metabolic transition intensity during swimming exercise. The trained groups were submitted to swimming, supporting overloads (% of body weight - bw) equivalent to aerobic/anaerobic metabolic transition intensity, 1h/day, 5 days/week, during 8 weeks. We analyzed: body weight, aerobic conditioning (MLSS after the training period), total lipid concentrations in the

liver, and serum ALT and AST concentrations as well as serum glucose and FFA levels.

**RESULTS:** The DS group showed higher serum glucose in relation to the other groups (SC= 102 ± 10; TC= 105 ± 9; SD= 323 ± 12; TD= 301 ± 13). The diabetic groups showed higher serum FFA (SD= 15.5 %; D= 17.4%) and weight loss (SD= 0.8%; TD= 10.5%) when compared to control groups. The aerobic/anaerobic metabolic transition intensity (overload, in % of bw) obtained by MLSS test was similar in TD (4.7%) and TC (5.6%) groups after exercise-training. The NAHS markers (U/L) did not show differences (two-way ANOVA,  $P < 0.05$ ) between groups (AST: SC= 81.6 ± 15.0; TC= 87.0 ± 23.2; SD= 69.8 ± 47.3 and TD= 78.7 ± 29.9; ALT: SC= 39.7 ± 14.6; TC= 38.9 ± 9.4; SD= 40.0 ± 17.4 and TD= 44.6 ± 17.0). The same was observed for total liver lipid concentrations (mg/100mg) (SC= 3.5 ± 0.4; TC= 3.5 ± 0.5; SD= 3.6 ± 0.6 and TD= 3.7 ± 0.8).

**CONCLUSION:** Taken together, the results of the present study suggest that physical training performed at the aerobic/anaerobic metabolic transition intensity was able to maintain the aerobic conditioning of diabetic rats similar to the control animals as well as to improve the glycaemic condition of the DT group. In addition, serum ALT and AST enzymes proved to be adequate markers of liver lipid levels in this animal model.

Supported by CNPq, Fapesp and CAPES

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**2658 Board #52 May 29 2:00 PM - 3:30 PM**

**Impaired Heart Rate Variability In Type 2 Diabetes: Roles Of Major Cardiovascular Disease Risk Factors**

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(No relationships reported)

Heart rate variability (HRV) is sensitive to the presence and development of numerous disease processes, including cardiovascular disease (CVD). Individuals with type 2 diabetes mellitus (T2DM) are at increased risk of CVD and also present with reduced HRV (particularly HRV indices related to parasympathetic output) when compared to nondiabetic controls.

**PURPOSE:** To examine HRV indices between older women with T2DM and non-diabetic women matched for age, aerobic power, BMI and lipid profile.

**METHODS:** Fifteen subjects with uncomplicated T2DM (age 69 ± 2 yr; BMI 29 ± 6 kg·m<sup>-2</sup>; aerobic power 19.9 ± 3.8 ml·kg<sup>-1</sup>·min<sup>-1</sup>; Chol/HDL 3.7 ± 1.1) and fifteen nondiabetic matched controls (age 68 ± 4 yr; BMI 27 ± 4 kg·m<sup>-2</sup>; aerobic power 21.5 ± 4.4 ml·kg<sup>-1</sup>·min<sup>-1</sup>; Chol/HDL 3.4 ± 1.0) were recruited for this study. All thirty subjects were using lipid-lowering medication (statins). Following 20 min of supine rest, RR intervals were recorded over 5 min and subsequent HRV analysis included key indices of time, and frequency domains. Auto-regression (AR model) was used to extract frequency characteristics from the data sets.

**RESULTS:** No significant differences were observed in any of the key time-domain parameters: standard deviation of RR intervals (RRSD;  $p = 0.145$ ), square root of the mean of squared differences between successive intervals (RMSSD;  $p = 0.709$ ), the percentage of consecutive normal-to-normal RR intervals differing by more than 50 ms (pNN50;  $p = 0.744$ ). There were no significant differences between the groups for absolute ( $p = 0.164$ ) and normalised ( $p = 0.473$ ) units of power in the high-frequency (HF) range. While absolute low-frequency (LF) power was significantly reduced in the T2DM compared to the nondiabetic group (mean difference = 128.9 ms<sup>2</sup>,  $p = 0.002$ ), normalised LF power was similar between groups ( $p = 0.469$ ). Additionally, the LF/HF ratio was not significantly different between groups ( $p = 0.264$ ).

**CONCLUSION:** Time-, and frequency-domain indices of HRV were not altered in individuals with uncomplicated T2DM compared with nondiabetic matched controls. Specifically, HRV indices of parasympathetic output (e.g. pNN50, HF power) were similar between the two groups.

This project was Supported by the National Health and Medical Research Council of Australia.

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**2659 Board #53 May 29 2:00 PM - 3:30 PM**

**Low Intensity Strength Training In Women With Type 2 Diabetes: Effect On Hba1c And Lipids**

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(No relationships reported)

Strength training for patients with type 2 diabetes has reached evidence level A.

**PURPOSE:** To investigate the effects of low dose strength training in women with type 2 diabetes.

**METHODS:** We included 15 women in the training (T) and 6 in the control group (C). Before training, the patients were tested for HbA1c, cholesterol, HDL, LDL and triglycerides as well as for strength on a rowing machine, abdomen crunch machine, leg press, chest press and back extension. Patients then completed 12 weeks of training two times a week for 60 minutes with an intensity of about 50% of 1 - RPM. The intensity of the strength training was increased by 10% every 4 weeks. HbA1c was reduced from 7.02 ± 0.77 in T to 6.61 ± 0.73 ( $p < 0.001$ ) and from 7.05 ± 0.65 to 6.88 ± 0.32 in C.

**RESULTS:** Cholesterol remained constant at 197 mg/dl, triglycerides were reduced from 146 ± 43 to 134 ± 56 mg/dl, LDL remained nearly constant with 130 ± 39 and 132 ± 42 mg/dl, HDL rose from 37 ± 9.9 to 46 ± 9.3 ( $p < 0.001$ ). The risk indicator LDL/HDL decreased ( $p < 0.05$ ). Bodyweight and waist circumference were slightly reduced as well as triceps, subscapular and abdominal skinfolds. No changes were found in C. Strength increased on the rowing machine by 63%, and abdominal crunches by 62%, leg press by 82%, chest press by 62% and back extensions by 57%, which were all highly significant. C showed no significant differences.

**CONCLUSIONS:** Low dose strength training has beneficial effects on carbohydrate metabolism and also on increasing HDL. Strength training for large muscle groups should be recommended for diabetic women.

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**2660 Board #54 May 29 2:00 PM - 3:30 PM**

**Training With Joba Core Trainer For Obese Patients With Type 2 Diabetes**

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Physical activity (PA) and weight control are important in diabetes prevention and management. However, PA programs often fail to achieve optimal results in diabetic patients. The Joba® Core Trainer (JOBA) is an ergometric device, simulating horseback riding, which has been proved to improve insulin sensitivity in diabetic patients.<sup>1</sup>

**PURPOSE:** To assess if a training program with JOBA improves endothelial function, glycaemic control, and body mass in obese patients with type 2 diabetes mellitus (DM).

**METHODS:** 24 obese pts. with DM were randomly allocated either to an Exercise (EX) group (3 sessions with JOBA/week for 12 weeks) or to usual care (C). Endothelial function, fasting glucose, insulin, glycated haemoglobin (HbA1C), body weight and composition were measured before and after the intervention.

**RESULTS:** In the C group no significant changes were observed. In the EX group the endothelial-dependent (ED) dilation of the brachial artery significantly increased after training (4.6±3.2 vs. 7.0±3.6,  $p < 0.045$ ). Although fasting glucose was significantly reduced (142.0±41.9 vs. 118.7±40.8,  $p < 0.001$ ), HbA1C and insulin levels were not. Finally, Body Mass Index (BMI) and Fat Mass (FM) were not influenced by the intervention.

	EX (n=12)	C (n=12)
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	Before	After	Before	After
ED Dilation (% increase)	4.6±3.2	7.0±3.6*	4.8±2.9	5.0±3.1
Non-ED Dilation (% increase)	9.5±4.2	9.4±5.6	9.3±4.4	9.5±4.7
Fasting glucose (mg/dL)	142.0±41.9	118.7±40.8**	146.0±47.3	142.4±41.2
Insulin (μU/mL)	22.7±14.9	17.6±10.5	23.2±13.2	21.4±11.3
HbA1C (%)	7.2±1.3	7.2±1.1	7.3±1.4	7.4±1.3
BMI (Kg/m <sup>2</sup> )	36.7±6.1	36.7±5.9	35.9±5.1	36.2±6.4
FM (%)	38.9±6.7	37.5±6.3	37.3±6.2	37.2±6.9
* p<0.045	** p<0.001			

**CONCLUSION:** Training with JOBA resulted in a slight increase of ED vasodilation. Little effect, if any, was observed on glycaemic control. The training program did not affect body mass. It may be that the training intensity of JOBA exerts a favourable effect on vascular function, but it is not sufficient to influence metabolic control and body mass of obese pts. with DM.

<sup>1</sup> Kubota M et al. Mechanical horseback riding improves insulin sensitivity in elder diabetic patients. *Diabetes Res Clin Pract.* 2006;71:124-30

## 2661 Board #55 May 29 2:00 PM - 3:30 PM NT-proBNP And Selected Variable Responses To Short-term Cardiovascular Rehabilitation In Patients With Type 2 Diabetes

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N-terminal-pro-brain (B-type) natriuretic peptide (NT-pro-BNP) is a hormone released from ventricles in response to myocyte stretch.

**PURPOSE:** The aim of the study was to investigate the influence of 3-4 wk exercise training on plasma NT-pro-BNP and selected variables in 54 patients with diabetes.

**METHODS:** 54 patients (mean age: 65.7±10.4 yrs, 50 males, 4 females, body mass index (BMI) 29.5±4.6) with documented coronary heart disease in 47 patients, 7 patients with valve replacement therapy with and without aortocoronary bypass surgery and 36 patients with hypertension entered a (average=26 d) residential exercise and lifestyle intervention program at a rehabilitation facility in central Austria. Standard pre and post completion measurements included: fasting plasma measurements of NT-pro-BNP, hemoglobin A1C (HbA1C), glucose (GLUC), cholesterol (CHOL), high density lipoprotein-cholesterol (HDL-C), low density lipoprotein-cholesterol (LDL-C), triglyceride (TRIG), heart rate (HR), heart rate reserve (HR-R), physical working capacity (PWC), estimated relative VO<sub>2</sub>peak determined on a cycle ergometer, and systolic (SBP) and diastolic (DBP) blood pressure. Training included supervised daily exercise (20 min cycling and 45 min walking at 60% HRmax), nutrition/diet prescription depending on individual needs, and pharmacologic intervention.

**RESULTS:** Program participation significantly reduced NT-pro-BNP (-20%) (P55% (-32%), EF 45-55% (-23%), EF 30-44% (-18%), EF<30% (-10%), respectively. PWC, VO<sub>2</sub>peak and heart rate reserve increased significantly by 19%, 16% and 13%, (P<0.001, P<0.001, P<0.001), respectively. Post completion GLUC, HbA1C, CHOL, LDL-C and TRIGs were reduced significantly (P<0.001). There was a consistent inverse relationship between NT-pro-BNP and PWC, VO<sub>2</sub>peak, HR-R. BMI was reduced significantly (P<0.001) in all patients. There were no significant changes in prescription for beta-blockers, ACE inhibitors, AT II receptor blockers or diuretics; however, there was a significant increase in statin prescription (P<0.002).

**CONCLUSION:** Our results indicate that 3-4 wk of exercise intervention reduces NT-pro-BNP levels and improves exercise capacity in diabetic patients.

## 2662 Board #56 May 29 2:00 PM - 3:30 PM Relationship Between Regional Adiposity And Risk For Type II Diabetes In College Age Individuals

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(No relationships reported)

Research has determined several risk factors associated with the development of Type II diabetes, including adipose tissue distribution. However, this relationship has not been investigated in college aged populations. Adiposity around the trunk has been cited as being indicative of future health problems. This study investigated how body composition variables in college age individuals are associated with the risk of this metabolic disease.

**PURPOSE:** To determine the relationship between regional adiposity and risk for type II diabetes in college age individuals.

**METHODS:** A total of 23 male and female students (mean age of 20 years, SD ±1.06) participated in the study. Institutional Review Board approval was obtained. Each subject completed an informed consent, medical health history, two surveys (Assessing Your Diabetes Risk [ADR] and Diabetes Risk Test [DRT]). Physical measurements were then taken including height and weight (to calculate BMI), waist and hip circumference (to calculate WHR) and peripheral and appendicular skin folds measurements. Air displacement plethysmography (ADP) was then used to assess overall body composition.

**RESULTS:** Descriptive statistics (means and standard deviations) were calculated for all data and Pearson Product-Moment Correlations were used to determine the relationship between regional adiposity and diabetes risk. There were significant correlations between BMI (r=0.77 DRT; r=0.59 ADR), truncal adiposity (r=0.82 DRT; r=0.62 ADR), and ADP (r=0.64 DRT; r=0.72 ADR) with diabetes risk. Only the Diabetes Risk Test showed a relationship between WHR (r=0.45) and diabetes risk. **DISCUSSION:** There appears to be a significant relationship between diabetes risk and selected measures of body composition in this population. A relationship was found between truncal skinfolds, a measure of regional adiposity, and diabetes risk. Future research should be conducted to determine why these relationships exist and how they might impact health.

## 2663 Board #57 May 29 2:00 PM - 3:30 PM Acceleration Training In Diabetic Patients



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(No relationships reported)

It is well known the importance of Physical Activity (PA) in diabetic patients. But also the problem to prescribe traditional activities at Gym because of comorbidity and specially for the possibility of skin damage :

**PURPOSE:** To determine the effect, efficiency and safety of an acute program of four weeks Acceleration Training with Power Plate in this patients. It works increasing acceleration instead of mass to increase force. :

**METHODS:** 30 patients both gender. Ages from 18 to 65, Type 1 and Type 2 diabetes, including patients with different comorbidities excepting retinopathy III-IV or recent cardiac events developed a program trying to improve mostly total body metabolic effects during four weeks. People with peripheral arterial disease were included. Working on Power Plate pro5 AIRdaptive™ warming up consisted in four different activities during 30 seconds each. Low intensity and no rest between them. Work out: six activities from 30 to 60 seconds 30Hz. 60 to 30 second rest. Cooling down: four activities High intensity, 60 seconds 35Hz without rest between them. Measurement before and after each session of glycemic levels, cardiac frequency, and blood pressure. At the beginning and end of the study Fructosamine and Hormones: Testosterone, catecholamine, cortisol. :

**RESULTS:** Easy and quick adaptation. Excellent tolerance. During each session glucose levels were reduced from 10 to 27%. Cardiac frequency rised in a range of 44 to 62 %. Systolic pressure rised 10 to 20%. Diastolic pressure showed no changes or 5% reduction. No changes in Hormonal measurements were seen. :

**CONCLUSIONS:** Power Plate Acceleration Training does appear to be a good option to develop programs of physical activity to contribute to better diabetes treatment and prevention. :

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**2664 Board #58 May 29 2:00 PM - 3:30 PM**  
**Translating Scientific Knowledge into Better Diabetes Self-Management with Basic, Nutrition, and Exercise Education**

Emily Carolyn Johnson, FACSM<sup>1</sup>, Sue N. Butkus<sup>2</sup>, Sandra G. Brown<sup>2</sup>, Shirley M. Broughton<sup>2</sup>. <sup>1</sup>Washington State University Spokane College of Pharmacy, Spokane, WA. <sup>2</sup>Washington State University Extension, WA.

(No relationships reported)

An estimated 7.8% of the U.S. population (~23.6 million people) have diabetes.<sup>1</sup> Associated annual costs of diabetic complications are estimated at \$173 billion,<sup>2</sup> but diabetic complications can be prevented if diabetes is properly managed.<sup>3</sup> Patient education and self-management are crucial for improving health outcomes and decreasing costs of diabetes.<sup>1</sup>

**PURPOSE:** To determine the effectiveness of a scientifically-based diabetes education program taught in a community setting on health indicators of diabetes outcomes.

**METHODS:** All participants (type 2 diabetics; n=24; >45 YO) received a basic diabetes lesson, then had lessons on: 1) nutrition; 2) physical exercise; or 3) a combination of nutrition/exercise. Data were collected before (pre) and 3 mo after (post) lessons. Outcome measures were: blood glucose; A1c; height; weight; waist circumference; BMI; blood pressure; blood lipids (total cholesterol, LDL, HDL); distance walked in 6 min; physical activity level; and knowledge, attitude, and psychological distress variables. Data were analyzed for pre-post differences by paired t-tests with all subjects grouped together.

**RESULTS:** Preliminary results for 18 subjects completing the 3-mo study (mean age=63.5 yr) indicate significant (p<0.05) pre to post improvements in knowledge and attitudes of subjects, ie: knowing what they need to do; confidence in managing their diabetes; and increased understanding of A1c, microalbumin, LDL levels, portion control, and correct food portions. Some physiological variables also improved. Direction and mean of significant (p<0.05) changes are shown in parentheses after each variable and were: systolic (-8 mmHg) and diastolic (-7 mmHg) blood pressure, weight (-6.2 pounds), A1c (-0.44%), LDL (-20.9 mg/100 mL), 6-min walk distance (+2.4 laps). Future analyses will be done on 6-mo post data and by individual groups.

**CONCLUSIONS:** These results suggest that scientifically-based diabetes education taught in a community setting can cost-effectively improve physiological and psychological indicators of better diabetes management.

Supported by Washington State University Extension.

References: 1. CDC, National Diabetes Fact Sheet, 2007. 2008., 2. ADA. Diab Care. 2008;31:1-20., 3. Diabetes Control and Complications Trial Research Group. NEJM. 1993;329:977-86.

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**2665 Board #59 May 29 2:00 PM - 3:30 PM**  
**Metabolic And Functional Improvements In Diabetic And Nondiabetic Veterans Following A Cardiac Rehabilitation Program**

Susan G. Beckham, FACSM<sup>1</sup>, Kristi A. Fitz<sup>2</sup>, Conrad P. Earnest, FACSM<sup>3</sup>, Maram Museitit<sup>4</sup>, Manisha J. Shah<sup>4</sup>. <sup>1</sup>The Cooper Institute, Dallas, TX. <sup>2</sup>Consultants in Cardiology, Ft. Worth, TX. <sup>3</sup>Pennington Biomedical Research Center, Baton Rouge, LA. <sup>4</sup>Department of Veteran's Affairs, Dallas, TX.

(No relationships reported)

**PURPOSE:** To examine the effect of an 8-12 week cardiac rehabilitation program on glucose control, blood lipids, BMI, and functional capacity in diabetics vs. nondiabetics.

**METHODS:** We performed a retrospective database review of 56 male veteran patients with diabetes and 43 patients without diabetes (mean + SD; age 62.7 + 8.3 y; weight 94.3 + 38.8 kg) who participated in a Phase II cardiac rehabilitation program between 2003 and 2006 at the Veteran's Affairs Medical Center, Dallas, Texas. Primary outcomes included hemoglobin A1C (HbA1C), TG/HDL, and blood glucose. Secondary outcomes included blood lipids and sub-maximal functional aerobic capacity (FC). We examined mean change scores with ANOVA and Tukey post-hoc tests including 95% CI. Data were log normalized when appropriate.

**RESULTS:** Patients with diabetes had a higher BMI (31.2 + 5.5 vs. 28.8 + 4.6 kg/m<sup>2</sup>, p<0.03), HbA1C (6.7 + 1.2 vs. 5.7 + 0.6 %, p<0.001), and lower FC (2.9 + 1.0 vs. 3.7 + 1.6 METs, p<0.001) compared to patients without diabetes at baseline. Following rehabilitative exercise, we observed significant reductions in log normalized HbA1C (p<0.007) for diabetic (-0.68%; 95% CI, -0.97, -0.39) and non-diabetic patients (-1.28%; 95% CI, -0.96, -1.59). Nondiabetic patients exhibited a greater reduction in HbA1C compared to diabetic patients (p<0.05). In addition, both diabetic (-0.55; 95% CI, -1.02, -0.07) and non-diabetic (-0.81; 95% CI, -1.53, -0.11) patients exhibited a significant reduction in log normalized TG/HDL ratio. The TG/HDL ratio is a surrogate marker for identifying insulin resistance in overweight, nondiabetic patients. Functional capacity improved significantly in diabetic (1.46 METs; 95% CI, 0.97, 1.96) and non-diabetic (1.47 METs: 0.91, 2.04) patients; however, no differences were observed for glucose or triglycerides.

**CONCLUSIONS:** Though exercise training appears to improve HbA1C and functional capacity in both diabetic and non-diabetic patients, longer interventions may be necessary to produce more robust changes in markers associated with glucose control.

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**2666 Board #60 May 29 2:00 PM - 3:30 PM**  
**Chronic Exercise Effects In Obese Patients With Impaired Glucose Tolerance**

Andrea M. McNeilly<sup>1</sup>, Conor M. McClean<sup>1</sup>, Thomas R. Trinick<sup>2</sup>, Marie H. Murphy, FACSM<sup>1</sup>, Ellie Duly<sup>2</sup>, Jane McEneny<sup>3</sup>, Gareth W. Davison<sup>1</sup>. <sup>1</sup>University of Ulster, Jordanstown, United Kingdom. <sup>2</sup>Ulster Hospital, Dundonald, United Kingdom. <sup>3</sup>Queens University, Belfast, United Kingdom.

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G. Davison presenting

(No relationships reported)

**PURPOSE:** To examine the effects of chronic exercise training on insulin sensitivity, glycaemic control and multimeric adiponectin concentration in obese patients with impaired glucose tolerance (IGT).

**METHODS:** Eleven obese patients (mean  $\pm$  SD, 48  $\pm$  9yrs; 168  $\pm$  7cm; 91 kg  $\pm$  17kg; BMI 32  $\pm$  7kg/m<sup>2</sup>) diagnosed with IGT completed a 12 week chronic exercise training programme. This involved undertaking 30 minutes moderate intensity exercise equivalent to 65% of maximum heart rate (HR), on 5 days of the week. Anthropometrical measurements and blood pressure (BP) were measured prior to and following intervention. Venous blood samples were drawn for the determination of glucose, glycosylated haemoglobin (% HbA<sub>1c</sub>), blood lipids, insulin and multimeric adiponectin concentration.

**RESULTS:** Following intervention, body mass (89  $\pm$  17 vs. 86  $\pm$  16kg), total body fat (48  $\pm$  10 vs. 44  $\pm$  10%), systolic BP (145  $\pm$  15 vs. 135 $\pm$ 15 mmHg), diastolic BP (86  $\pm$  14 vs. 78  $\pm$  10 mmHg), waist (102  $\pm$  17 vs. 97  $\pm$  14cms) and hip circumference (118  $\pm$  13 vs. 106  $\pm$  14cms) decreased significantly ( $P < 0.05$ ). High density lipoprotein cholesterol (HDL) increased from 1.23  $\pm$  0.24 to 1.27  $\pm$  0.24 mmolL<sup>-1</sup>. Plasma concentrations of glucose, triacylglycerol, total cholesterol, low density lipoprotein cholesterol (mmolL<sup>-1</sup>) and insulin ( $\mu$ mol/L) although decreased, were not statistically significant ( $P > 0.05$ ). All multimeric forms of adiponectin (total, high, the ratio total: high, medium and low) were not found to be statistically different following 12 weeks exercise.

**CONCLUSIONS:** These findings suggest that a 12 week chronic exercise training programme is effective in eliciting positive changes to the cardiovascular risk profile in obese patients with IGT.

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## **F-25 Free Communication/Poster - Hydration, Thermoregulation, and Performance**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### **2667 Board #61 May 29 2:00 PM - 3:30 PM**

#### **Soccer Skill Performance And Hydration Level in Female Intercollegiate Soccer Players**

Astrid E. Mel<sup>1</sup>, Tiffany Anderson<sup>2</sup>, Kate Battista<sup>2</sup>, Tracey Mathews<sup>2</sup>, John Gibson<sup>2</sup>, Vincent Paolone, FACSM<sup>2</sup>. <sup>1</sup>Methodist University, Fayetteville, NC.

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Exercising promotes fluid loss resulting mostly from sweat evaporation from skin to the ambient air. Hydration is an important factor to consider when participating in an outdoor sport such as soccer, due to the extended duration of matches and the intermittent high-intensity pace of the game. Sweating characteristics differ distinctly between men and women, influencing how each gender adjusts to stresses imposed on thermoregulation.

**PURPOSE:** To compare female soccer skill performance under three different hydration conditions: no hydration (NH), ad libitum (AL), and replacement equal to sweat loss (ESL).

**METHODS:** Mean ambient T<sup>o</sup> was controlled at 17.94°C ( $\pm$  1.32), with a mean RH% of 53.85 ( $\pm$  13.82%). Soccer skill performance of NCAA Division III female intercollegiate soccer players (N = 15) was measured using the Modified Loughborough Soccer Passing Test (MLSPT), under three separate hydration conditions: NH, AL, ESL. Performance was measured before, at midpoint, and at the end of the Loughborough Intermittent Shuttle Test (LIST) which is designed to closely approximate the activity pattern occurring during a soccer game. Hematocrit (H<sub>c</sub>), lactate (L<sub>a</sub>), rate of perceived exhaustion (RPE), and core temperature (T<sub>c</sub>) were the physiological variables measured. A 3 X 3 repeated measures ANOVA was computed to compare differences between performance and hydration level, and 3 X 4 repeated measures ANOVAs were computed for the physiological variables.

**RESULTS:** Average dehydration levels for the NH, AL, and ESL trials were 1.54% ( $\pm$  0.54), 0.63% ( $\pm$  0.73), and 0.01% ( $\pm$  0.50), respectively. No significant interactions ( $p > 0.05$ ) were found for soccer skill performance across trials. No significant interactions ( $p > 0.05$ ) were found for H<sub>c</sub>, L<sub>a</sub>, and HR across trials. Significant interactions ( $p < 0.05$ ) were found for mean RPE and T<sub>c</sub> across trials. Significant main effects for time existed for HR and L<sub>a</sub>.

**CONCLUSION:** Based on the results, hydration status does not appear to affect soccer skill performance in female intercollegiate soccer players in a temperate climate, when dehydration is less than 2%.

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### **2668 Board #62 May 29 2:00 PM - 3:30 PM**

#### **Effect Of Hypohydration And Intermittent Running In The Heat On Field Hockey Skill Performance**

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(No relationships reported)

The development of hyperthermia during intermittent running in the heat results in a decline in skill performance. If players begin a match in a state of hypohydration, the thermoregulatory system is stressed further. However, there is limited research into the influence of hypohydration on skill performance during sports that are multifaceted in their demands, such as field hockey.

**PURPOSE:** To determine the influence of moderate hypohydration on field hockey skill performance following simulated field hockey exercise in the heat.

**METHODS:** Seven elite female field hockey players completed two 70-min field hockey-specific intermittent treadmill running trials (FHITP), separated by ~7 days, in a randomised crossover design. The evening preceding each trial, participants performed a baseline skills tests before dehydrating via passive hyperthermia to elicit 2% dehydration. Subjects then either immediately rehydrated (EUH) or remained dehydrated (DEH). The next morning subjects completed a skills test pre- and post performing the FHITP in the heat (33°C, 60% rh). Hydration status was maintained with ad libitum water intake. Heart rate (HR), rectal temperature (T<sub>rec</sub>), rating of perceived exertion (RPE) and thirst sensation (TS) were measured during exercise. Total Time (TT), Decision Time (DT) and Penalty Time (PT) were recorded during the skills test.

**RESULTS:** PT was higher post-FHITP in the DEH trial (EUH: 8.4  $\pm$  3.4 vs. DEH: 14.6  $\pm$  6.1 s;  $P < 0.05$ ). TT and DT were slower post-FHITP, with no difference between trials ( $P = 0.02$  and  $P = 0.01$ , respectively). DT was faster in the EUH trial compared to DEH (EUH: 4.06  $\pm$  0.20 vs. DEH: 4.18  $\pm$  0.23 s;  $P = 0.01$ ). There was a significant difference in body mass loss between trials at the start on the FHITP (DEH: 1.8  $\pm$  0.6% vs. EUH: 0.1  $\pm$  0.4%;  $P < 0.05$ ) and at the end of the FHITP (DEH: 2.1  $\pm$  0.5% vs. EUH: 0.2  $\pm$  0.6%;  $P < 0.05$ ). T<sub>rec</sub> increased over time ( $P < 0.01$ ) with a concomitant increase in HR in the 2<sup>nd</sup> half ( $P < 0.01$ ), with no difference between trials. No difference in RPE or TS was evident ( $P > 0.05$ ).

**CONCLUSIONS:** Mild hypohydration may increase decision time and error rate without any detrimental effects to physiological parameters. Furthermore, field hockey specific intermittent running in the heat decreases skill performance, which may be linked to increased thermoregulatory strain.

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### **2669 Board #63 May 29 2:00 PM - 3:30 PM**

#### **Impact Of Dehydration To 3% Body Weight On A Full Body Resistance Training Protocol**

Justin Kraft<sup>1</sup>, James M. Green, FACSM<sup>2</sup>, Phillip A. Bishop<sup>3</sup>, Mark T. Richardson<sup>3</sup>, Yasmine Neggers<sup>3</sup>, James Leeper<sup>3</sup>. <sup>1</sup>Missouri Western State University, St. Joseph, MO. <sup>2</sup>University of North Alabama, Florence, AL. <sup>3</sup>University of Alabama, Tuscaloosa, AL.

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(No relationships reported)

While resistance training is a common training mode, the potential impact of dehydration is not well-understood. If dehydration impairs daily resistance training overload, then subsequent training-induced gains may be sub-optimal.

**PURPOSE:** This study examined effects of dehydration (3% of bodyweight) on resistance training performance.

**METHODS:** Ten males completed two trials: heat exposed (~39° C hot water bath) with water replacement offsetting dehydration (HE) and heat exposure with 3% dehydration (DEHY). Using their 12 rep max resistance (12RM), participants performed three sets to failure of bench press (bench), lat pull down (lat), overhead press (press), barbell curl (curl), triceps press (tri), and leg press (leg).

**RESULTS:** A paired *t*-test showed a significant difference for total reps (HE: 169.4 ± 29.1 vs. DEHY: 144.1 ± 26.6). ANOVAs showed significantly lower reps for DEHY vs. HE for bench, lat, press, curl, tri, and leg (DEHY average ~1-2 reps lower per exercise). Pre-set RPE was significantly higher in DEHY vs. HE for bench, lat, press, curl, tri, and leg (DEHY ~0.6 to 1.1 units higher on average). Pre-set heart rate (HR) was significantly higher for DEHY than HE for bench, lat, press, curl, tri, and leg (DEHY ~6 -13 b•min<sup>-1</sup> higher on average). Session RPE approached significance (DEHY: 8.6 ± 1.9, HE: 7.4 ± 2.3) (*p* = 0.06), with recovery HR significantly higher for DEHY (116 ± 15) vs. HE (105 ± 13).

**CONCLUSIONS:** Dehydration (3%) significantly reduced repetitions performed during a whole body resistance training session. Furthermore, elevated pre-set HR and RPE with dehydration indicated attenuated recovery between sets. Recovery HR was also higher for DEHY than HE also suggesting dehydration impaired recovery. Current results suggest dehydration may inhibit maximum performance in routine strength training. Dehydration magnifies feelings of exertion (RPE) and may lead to sub-optimal overload, compromising training-induced gains.

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**2670 Board #64 May 29 2:00 PM - 3:30 PM**  
**Endurance Performance After Modest Hypohydration Evoked By Prolonged Fluid Restriction And Exercise Or Diuretics**  
Jennifer Heaney<sup>1</sup>, Mahdi Jibani<sup>2</sup>, Juliet Milne<sup>2</sup>, Samuel J. Oliver<sup>1</sup>. <sup>1</sup>Bangor University, Bangor, United Kingdom. <sup>2</sup>North West Wales NHS Trust, Bangor, United Kingdom.  
(No relationships reported)

Different dehydration methods may explain previous contrasting findings concerning the effect of modest hypohydration (2-3% body mass: BM) on endurance performance in a temperate environment. Greater performance decrements may be related to diuretics causing greater cardiovascular strain during exercise compared with fluid restriction and exercise.

**PURPOSE:** To examine the effect of modest hypohydration evoked by different dehydration methods on endurance performance and cardiovascular function.

**METHODS:** Seven males (mean ± SEM: age 25 ± 1 y; VO<sub>2peak</sub> 59 ± 3 mL•kg<sup>-1</sup>•min<sup>-1</sup>) completed three randomised trials prior to completing a time to exhaustion (TTE) at 70% peak power output on a cycle ergometer in temperate conditions (21°C, 61% RH). On the control trial (C) participants received water equal to 40 mL•kg•bm•d<sup>-1</sup>. To achieve hypohydration prior to the TTE, on one trial participants received 40 mg of the diuretic Furosemide (D) and on another trial completed exercise followed by 48 hours of fluid restriction (FR: 239 ± 129 mL•d<sup>-1</sup>). This exercise bout was also completed with fluid replacement on C and D. BM, plasma volume change (PV) and osmolality (POsm) were assessed pre and post these interventions. During the TTE heart rate (HR), stroke volume (SV), cardiac output (Q) and ratings of perceived exertion (RPE) were assessed. Data were analysed by repeated measures ANOVA and Post hoc Tukeys test.

**RESULTS:** Prior to TTE, BM and PV were significantly decreased on D (-2.0 ± 0.3 and -9.5 ± 1.9%) and FR (-2.3 ± 0.1 and -10.2 ± 4.4%) compared with C (0.2 ± 0.3 and 3.1 ± 4.8%; *P* < 0.01). POsm was significantly greater on FR compared with D and C (FR, 299 ± 2; D, 293 ± 1; C, 286 ± 3 mOsmol•kg<sup>-1</sup>; *P* < 0.01). TTE was significantly decreased on D but not on FR compared with C (D, 17:51 ± 2:10; FR, 19:30 ± 2:40; C, 22:49 ± 2:35 min:sec; *P* < 0.05, ES = 0.41). Compared with C, HR was greater on D during the TTE (C, 167 ± 2; D, 173 ± 2 bpm; *P* < 0.01) and SV and Q were lower in the final minute of exercise on D and FR (*P* < 0.05). RPE was not significantly different between trials.

**CONCLUSIONS:** These results show a detrimental effect for modest isotonic hypohydration evoked by diuretics, which may be related to greater cardiovascular strain, but no significant effect of hypertonic hypohydration evoked by exercise and fluid restriction on endurance performance in a temperate environment.

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**2671 Board #65 May 29 2:00 PM - 3:30 PM**  
**Effect Of Sports Beverage Temperature On Body Temperature And Cycling Performance In The Heat**  
Catriona A. Burdon<sup>1</sup>, Helen T. O'Connor<sup>1</sup>, Janelle A. Gifford<sup>2</sup>, Philip G. Chapman<sup>1</sup>, Susan M. Shirreffs<sup>3</sup>. <sup>1</sup>University of Sydney, Sydney, Australia. <sup>2</sup>NSW Institute of Sport, Sydney, Australia. <sup>3</sup>University of Loughborough, Loughborough, United Kingdom.  
(No relationships reported)

Rising body temperature may influence the evolution of fatigue during exercise in the heat. Cooler beverage temperature may attenuate the rise in body temperature in the heat by generating a heat sink or via oral sensory mechanisms.

**PURPOSE:** To determine the effect of a cold (4°C; C) or thermoneutral (37°C; N) sports beverage on evolution of body temperature and exercise performance in the heat and explore the influence of sensory factors to ingesting a cold stimulus (ice puree).

**METHODS:** Seven non-acclimatised males (age 32.8±6.1y, mass 81.1±11.1kg) were recruited to complete C, N, and N plus ice (NI) trials in randomised order. Subjects cycled for 90 min at 65% VO<sub>2peak</sub> (SSE) followed by a 15 min time trial (TT) in 28°C, 70% relative humidity and ingested 3.5 mL•kg<sup>-1</sup> of 7.4% carbohydrate-electrolyte drink every 10 mins including 30ml ice puree every 5 mins in NI during SSE. Rectal (T<sub>re</sub>) and skin temperature (T<sub>sk</sub>) were measured, and mean body temperature (T<sub>mb</sub>), heat storage (HS), and total body heat content (TBHC) calculated from these. Total work (TW), distance (D), average and peak power output (AP, PP) were measured during TT. One and two factor repeated-measures ANOVAs were used to evaluate differences in performance and physiological variables across time and within trials respectively. Statistical significance was set at *p*<0.05.

**RESULTS:** Differences in T<sub>re</sub>, T<sub>sk</sub> or between C, N, and NI were not significant across SSE however for C versus N, rise pre to post in T<sub>sk</sub> (0.22±1.10°C v 1.14±0.90°C; *p*=0.02) and (1.2±0.3 v 1.6±0.3°C; *p*=0.03), and HS (45.1±8.8J•°C<sup>-1</sup>•kg<sup>-1</sup>•min<sup>-1</sup> v 60.1±1.0J•°C<sup>-1</sup>•kg<sup>-1</sup>•min<sup>-1</sup>) were lower. There was a significant improvement in TW (263±60kJ v 252±63kJ; *p*<0.01), AP (296.0±66.3W v 287.0±71.3; *p*=0.03) and D (10.1±0.09km v 9.8±0.9km; *p*=0.01) over the TT on C compared to the N trials. Difference in TW and AP for C compared to the N trial was 4.9% and 3.9% respectively. Although most measures tended to improve with I, results were not significant when compared to N.

**CONCLUSIONS:** Consumption of cold sports beverage during prolonged exercise in the heat improves body temperature measures and performance. Provision of ice did not reveal a sensory response, but requires further study as frequency of ingestion may have masked the sensory effect by generating a minor heat sink.

Supported by a NESC Discretionary Research Grant

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**2672 Board #66 Abstract Withdrawn**

**2673 Board #67 May 29 2:00 PM - 3:30 PM**  
**Neck Cooling Enhances Running Capacity And Thermal Tolerance During Exercise In Hot Conditions**  
Christopher J. Tyler, Caroline D. Sunderland. Nottingham Trent University, Nottingham, United Kingdom.  
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(No relationships reported)

Exercise performance can be improved in hot conditions by cooling the neck via a practical cooling device. The mechanisms by which this works are not fully understood, however it appears that cooling this region may disrupt the pacing mechanism by providing a false signal regarding the body's thermal state.

**PURPOSE:** To investigate the effects of cooling the neck region on treadmill running capacity in the heat.

**METHODS:** Seven well-trained males completed four runs to exhaustion at 70%  $\dot{V}O_{2max}$  in the heat (32°C; 52% rh) following an 8-minute warm-up. All trials were separated by 7-days. The first two trials (F1 and F2) were non-collar for all participants and they wore a cold collar around the neck during one of the other trials. The order of the third non-collar (NC) and the cold collar (CC) trial was randomised and counter-balanced. Rectal temperature, neck temperature, heart rate, RPE, thermal sensation (whole-body and neck) were measured every 5-mins and at the point of exhaustion in NC and CC. Time to exhaustion was recorded for all trials. The reliability of the test to exhaustion was assessed via the coefficient of variation (CV) between F1 and F2 and between F2 and NC trials. The distances covered and the variables recorded at the termination of exercise in CC and NC trials were compared using a one-way ANOVA. Results are presented as percentages for CV and mean  $\pm$  standard deviation for distances and variables.

**RESULTS:** The CV between F1 and F2 and between F2 and NC was 9.2% and 7.8% respectively ( $P > 0.05$ ). Subjects ran longer in CC than NC ( $42:41 \pm 13:46$  v  $37:42 \pm 12:32$  (mm:ss);  $P = 0.02$ ). All subjects ran for longer in CC than NC- improvement range: 11.3 to 22.4%. Despite no significant differences at the beginning of NC and CC trials subjects terminated the CC trial at a higher core temperature ( $39.68 \pm 0.5$  v  $39.19 \pm 0.75$  °C;  $P = 0.22$ ) and heart rate ( $180 \pm 6$  v  $176 \pm 8$  bpm;  $P = 0.039$ ) with no difference in RPE ( $P = 1.00$ ) or whole body thermal sensation ( $P = 0.061$ ). Neck temperature and neck thermal comfort were both significantly lower in CC compared to NC ( $P = 0.003$  and  $P = 0.006$  respectively).

**CONCLUSIONS:** Cooling the neck improved exercise capacity in the heat. The current data supports the idea that cooling the neck can provide a false signal of the body's thermal state allowing for a greater strain to be tolerated before exercise is voluntarily terminated.

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**2674 Board #68 May 29 2:00 PM - 3:30 PM**  
**Cool Shirt™ Use As An Ergogenic Aid In Distance Runners Training In North Louisiana**

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(No relationships reported)

Distance runners compete in a variety of environments such as hot humid conditions for extended periods of time. Extended performance in hot humid environments negatively affects running performance.

**PURPOSE:** The purpose of this study was to investigate the effects of a Cool Shirt™ worn by male and female distance runners training in a hot humid environment.

**METHODS:** Fourteen distance runners participated in the study. Testing was performed in Human Performance Lab at the University of Louisiana at Monroe. Subjects  $\dot{V}O_{2max}$  was measured using open circuit spirometry on a treadmill ergometer. On two separate occasions participants returned to the lab for treadmill run in a hot humid environment at the speed and grade at which 85% of the subject's predetermined  $\dot{V}O_{2max}$  was maintained. Randomly assigned, each participant conducted a control run and a run utilizing a Cool Shirt™. Heart rate, Borg's Rate of Perceived Exertion, temperature of the auditory canal, and sweating rate were measured. Statistical analysis was conducted using SPSS 13.0. Significance level was preset at  $p < .05$ .

**RESULTS:** No significant difference in RPE, HR, and run to exhaustion time was found between Cool Shirt™ runs and control runs.

**CONCLUSIONS:** The materials that are used to create the Cool Shirt™ may be the largest factor that prevents the effective cooling of the user. The cotton material used may absorb sweat and contribute to more energy expenditure needed to support the weight of the shirt. More research is needed to determine if the weight of the shirt outweighs the possible benefits that it could possibly provide for users. In the current state of development, this product is not feasible for use during most training situations and competition because of its lack of portability by the individual user. With the development of a smaller portable storage tank and pump along with the development of a shirt with lighter, more technical materials, ergogenic effects could be possible. More research is needed in this area to confirm the feasibility, use and benefits. Cool Shirt™ use for a precooling protocol may be a more applicable and more efficient use of the current product. An area of future research with Cool Shirt™ could be to investigate use as a precooling agent and to develop precooling protocols for optimal performance.

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**2675 Board #69 May 29 2:00 PM - 3:30 PM**  
**Effect Of Hydration Pattern On Thermoregulation During Exercise In Dehydrated Females: Preliminary Data And Trends**

Patrick W. Davidson, Katie J. Bouley, Christine A. Craig, Sean M. Collins, Gregory C. McMahon, Mary C. Pieklo, Jan E. Redmond, Jason C. Sawyer, Deborah L. VanLagen, Vincent J. Paolone, FACSM. Springfield College, Springfield, MA.

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(No relationships reported)

Rehydrating dehydrated females during exercise is critical for maintaining proper thermoregulation and blood values; however, the optimal timing for administering doses of water is unclear. Administering 1L of water with 2 doses of 500 ml shows trends of maintaining blood values and allowing for more efficient thermoregulation compared to ingesting 1L of water with 4 doses of 250 ml.

**PURPOSE:** to compare the effect of varying the timing and volume of ingesting 1L of water during 1-h of steady state exercise with moderately fit dehydrated females.

**METHODS:** Four moderately fit females performed two experimental rides on a Velotron training system at between 65-75% of peak oxygen uptake ( $\dot{V}O_{2peak}$ ) for 1-h. During the ride, the subjects drank a total of 1L of water. During one experimental condition, subjects ingested 250 ml of water immediately prior to and during exercise at 15, 30, and 45 min (RH250). During the second experimental condition, subjects ingested 500 ml of water at 30 and 45 min into exercise (RH500).

**RESULTS:** The RH250 group demonstrated trends of increased body heat storage (RH250, 238.05 kcal; RH500, 207.76 kcal) sweat rate (RH 250, 16.89 ml/min; RH 500, 12.98 ml/min), and heat dissipation via evaporation (RH250, 388.75 kcal; RH500, 218.86 kcal) and radiation and conduction (RH250, 284.46 kcal; RH500, 85.23 kcal) compared to the RH500 group. The RH500 group showed trends of having higher values for delta blood volume (RH250, -0.12%; RH500, 4.39%), cellular volume (RH250, -3.59%; RH500, 2.76%), and plasma volume (RH250, 2.62%; RH500, 5.70%) in comparison to the RH250 group. There were no trends for differences in degrees Celsius for core temperature (RH250 38.73; RH500, 38.42), mean skin temperature (RH250, 33.97; RH500, 34.07), and core to shell gradient (RH250, 4.76; RH500, 4.34).

**CONCLUSION:** drinking 1L of water with two doses of 500 ml appears to be better for maintaining blood values as compared to drinking 1-L of water with four doses of 250 ml due to a decrease in the need to dissipate heat via sweating and evaporation for moderately fit dehydrated females.

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**2676 Board #70 May 29 2:00 PM - 3:30 PM**  
**Neuro-muscular Fatigue Development During Repeated Cycling Sprints In A Hot Environment**

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(No relationships reported)

The mechanisms contributing to the alteration in neuromuscular function during repeated sprints have been recently documented. However, the effect of hot environment on these neuro-muscular alterations remains unclear.

**PURPOSE:** To investigate the contributions of central and peripheral factors in the development of neuro-muscular fatigue during repeated sprints in a hot environment

**METHODS:** Ten male subjects ( $23.1 \pm 3$  yrs) performed two 38 min repeated sprint trails consisting of eight 6sec sprint of maximal cycling interspaced by 5 min of active recovery (1W/kg body weight). Trails were performed in control (CON; 24°C - 24% rH) and hot (HOT; 40°C - 40% rH) environmental conditions in random order After each sprint, maximal percutaneous electrical stimulations were applied to the femoral nerve both at rest and during maximal voluntary contraction (MVC). To examine potential impairment in central drive,



changes in EMG activity of the *vastus lateralis* muscle normalized to the M-wave amplitude (RMS/M) as well as muscle activation (VA) were quantified during MVC of knee extensors. Peripheral fatigue was assessed by examining the amplitude of the M-wave and twitch contractile properties following single stimuli. Both Core and skin temperatures were monitored throughout by telemetric pill and patches respectively.

**RESULTS:** RPE, HR, and skin temperature were significantly (all  $P < 0.05$ ) higher in HOT compared to CON; RPE:  $15 \pm 3$  vs.  $13 \pm 3$ , HR:  $141 \pm 10$  vs.  $123 \pm 15$  bpm. However core temperature, peak power production, MVC and muscle electrical activity during the MVC's or the cycling sprints was not influenced by the environmental condition in this pattern of exercise.

**CONCLUSION:** Despite HR, RPE, and skin temperature being higher in hot than control, the body was able to produce the same power in both conditions. These findings suggest that there are no anticipatory decrements in power production when it comes to repeated sprints even if, RPE do increase in hot environment.

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## **F-26 Free Communication/Poster - Molecular Biology Muscle**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### **2677 Board #71 May 29 2:00 PM - 3:30 PM**

#### **Force And Unloaded Shortening Velocity During Fatigue In Skeletal Myosin Light Chain Kinase Deficient Muscles**

William J. Gittings<sup>1</sup>, Rene Vandenboom<sup>1</sup>, Jian Huang<sup>2</sup>. <sup>1</sup>Brock University, St Catharines, ON, Canada. <sup>2</sup>University of Texas Southwestern Medical Center, Dallas, TX.

(No relationships reported)

The myosin regulatory light chain (R-LC) of type II fibers is phosphorylatable. Contraction-induced activation of a skeletal muscle specific  $Ca^{2+}$  - calmodulin-dependent myosin light chain kinase (MLCK) catalyzes the phosphorylation reaction, an event that may modulate myosin motor behavior. The influence of this molecular mechanism on the contractile performance of fatigued fast twitch skeletal muscle remains unclear, however.

**PURPOSE:** To determine the effect of skeletal muscle MLCK gene ablation on the fatigability of force and velocity in mouse extensor digitorum longus (EDL) muscles.

**METHODS:** Muscles from wildtype (WT) and skeletal MLCK knockout (KO) mice ( $n=10$ ) were studied in vitro at 25° C during a fatigue protocol consisting of 5 minutes of repetitive high frequency stimulation (150 Hz for 1000 ms every 5 sec). Isometric twitch (Pt) and tetanic (Po) forces and unloaded shortening velocity (Vo) were assessed throughout the fatigue protocol.

**RESULTS:** Pt was increased to a greater extent in WT than in KO muscles ( $36.8 \pm 5.9\%$  vs.  $14.9 \pm 2.7\%$ ,  $p < 0.05$ ) during the initial stages of stimulation when Po was depressed less than 40% in both muscle types; thereafter, Pt declined to similar levels in both WT and KO muscles (to ~ 35% of initial levels). On the other hand, values for Vo were greater for WT than for KO muscles ( $10.3 \pm 0.90$  vs.  $8.4 \pm 0.36$  fiber lengths/s) during the final stages of stimulation, when Po was reduced ~ 90% in both muscle types.

**CONCLUSION:** These results suggest that MLCK gene ablation selectively impairs low frequency force during moderate fatigue and impairs unloaded shortening velocity during severe fatigue of fast twitch skeletal muscle.

Supported by NSERC.

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### **2678 Board #72 May 29 2:00 PM - 3:30 PM**

#### **Muscle-specific MicroRNAs Are Not Altered In Human Muscle Following Ingestion Of Leucine-enriched Essential Amino Acids**

Micah J. Drummond, Erin L. Glynn, Chris S. Fry, Elena Volpi, Blake B. Rasmussen. University of Texas Medical Branch, Galveston, TX. (Sponsor: Elizabeth Protas, FACSM)

(No relationships reported)

**INTRODUCTION:** Essential amino acid (EAA) ingestion results in a significant increase in mixed muscle protein synthesis in humans. The muscle-specific microRNAs (miR-1, -133a, and -206) have been postulated to participate in the regulation of skeletal muscle size by inhibiting translation of specific target mRNAs. Our laboratory has recently shown that miR-1 expression decreased immediately following the combined anabolic stimulus of resistance exercise and EAA ingestion.

**PURPOSE:** We hypothesized that expression of miR-1, -133a, and -206 would be decreased immediately following ingestion of leucine-enriched EAA in young healthy humans.

**METHODS:** Five young subjects (2 men, 3 women,  $31 \pm 2$  yr) ingested leucine-enriched (35%) EAA (10g) following an overnight fast. Muscle biopsies were sampled before and 1 and 2h following EAA ingestion. Standard laboratory procedures were utilized to isolate RNA. This was followed by real-time PCR using commercially available kits (mirVana) and primers in order to determine the expression of miR-1, -133a, and -206.

**RESULTS:** The expression levels of miR-1, -133a, and -206 were unaltered following EAA ingestion as compared to baseline.

**CONCLUSION:** We conclude that the muscle-specific microRNAs (miR-1, -133a, and -206) are not associated with the acute increase in human skeletal muscle protein synthesis during the first couple of hours following essential amino acid ingestion. Therefore, it appears that the changes we detected in microRNA expression following resistance exercise and EAA ingestion were likely due to muscle contraction rather than increased amino acid availability. However, future studies are needed to determine the individual effect of resistance exercise on microRNA expression and whether increased amino acid availability post-exercise is a contributing factor.

Supported by ACSM Research Endowment Grant (MJD), P30 AG-024832 (MJD) and NIH/NIAMS grant RO1 AR049877 (BBR)

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### **2679 Board #73 May 29 2:00 PM - 3:30 PM**

#### **Hsp Responses To Chronic Muscle Overload In Rat And Mouse Hindlimb Muscle**

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The importance of heat shock proteins (Hsps) in muscle structure and function continues to be elucidated and data support a major role in muscle adaptation to increased loading. To date, the only functional overload (FO, removal of major synergists) studies investigating Hsps have utilized rats. The availability of transgenic mouse models, however, warrants determination of the Hsp responses in mouse muscles to further elucidate specific factors modulating Hsp expression during chronic FO.

**PURPOSE:** The purpose of this study was to examine species, time, and muscle dependent changes in Hsp25, Hsp20,  $\alpha$ -crystallin, and Hsp90a in response to FO in the rat and mouse soleus and plantaris.

**METHODS:** Protein levels of the Hsps were quantified with Western analysis in the rat or mouse soleus and plantaris after 3 or 7 days of FO. Two-way ANOVAs were used to assess main effects of days of FO, muscle, and their interaction.

**RESULTS:** Baseline levels of all Hsps were higher in soleus than plantaris in rats, whereas only baseline Hsp20 was higher in soleus than plantaris in mice. Baseline Hsp25

and Hsp90a levels were higher in the mouse than rat plantaris. Baseline Hsp20 and ab-crystallin levels were lower in the mouse than rat plantaris and soleus. ab-crystallin levels in plantaris were higher than pre-FO at 3 and 7d or 7d post-FO in mice and rats, respectively. Hsp20 levels in the rat plantaris were higher than pre-FO at 7d post-FO. Hsp25 and Hsp90 levels in both muscles and species were higher than pre-FO at both time points, except for Hsp25 in the mouse soleus at 3d.

**CONCLUSIONS:** Muscle-specific baseline Hsp expression was different between species and the effects of chronic overloading on Hsp content appear to be Hsp and muscle specific. Hsp25 and Hsp90 showed the most consistent response, i.e., higher post-FO compared to pre-FO at almost all time points in both muscles. Hsp20 was the least responsive to FO, whereas ab-crystallin was affected specifically in the plantaris muscle. These results suggest that in both rats and mice the effects of FO on Hsp protein levels are muscle specific and time dependent and that the mouse is an appropriate model to investigate regulation of Hsp expression in response to FO.

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**2680 Board #74 May 29 2:00 PM - 3:30 PM**

**Exposure To Pressure Stimulus Suppresses Myogenin Expression In Differentiating L6 Myoblasts**

Noriteru Morita<sup>1</sup>, Kenji Iizuka<sup>2</sup>, Yoshiki Fujisawa<sup>3</sup>, Takuji Machida<sup>3</sup>, Masahiro Horiuchi<sup>4</sup>, Isao Kambayashi<sup>1</sup>, Masahiko Hirafuji<sup>3</sup>, Koichi Okita<sup>4</sup>.

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(No relationships reported)

When skeletal muscle contracts during exercise and/or physical activity, elevated intramuscular pressure is generated in the contracted muscular tissues. We previously reported that artificial pressure stimulus without deformation of cell shape enhanced glucose uptake and energy metabolism associated with protein synthesis in L6 myoblasts. The pressure-induced metabolic activation and protein synthesis are supposed to be related to some myogenetic responses of the pressurized myoblasts.

**PURPOSE:** The purpose of the present study was to examine the effects of elevated pressure on myogenetic responses in L6 skeletal myoblasts.

**METHODS:** L6 myoblasts were cultured with growth medium containing 10% fetal calf serum and seeded onto new dishes 3 days before experiment (~40% confluent). On the previous day (~95% confluent), culture media was changed to differentiation medium supplemented with 2% horse serum and the cells were cultivated for 24 h. After incubation, atmospheric pressure at 160 mmHg to the cells was applied for 3 h daily for 3 days; and the control cells were kept under normal pressure condition at the same time. For protein and mRNA analyses, cells were harvested on the first, second and third day after pressurization or control treatment.

**RESULTS:** The number of fused myoblasts by morphological measurement of Giemsa-stained cells reduced compared with control cells after 3 days pressurized cells. Myogenin protein levels in the pressurized cells were lowered at day 1 (30%, p<0.05) and day 3 (54%, p=0.09) compared with the control cells. Myogenin mRNA levels significantly decreased at day 1 (72%, p<0.05) and day 3 (62%, p<0.05) compared with the control cells. Unexpectedly, myostatin mRNA content in the pressurized cells was 62% lower than that in the control cells at day 2 (vs control, p<0.05). In intracellular signaling, pressure application increased phosphorylated ERK (2.7-fold, p<0.01) and JNK (1.9-fold, p<0.01), but not affected p38 MAPK phosphorylation at day 1.

**CONCLUSIONS:** These results suggest that elevated intramuscular pressure may suppress myogenic differentiation from myoblasts to myotubes in contracted skeletal muscles. Further studies are needed to clarify functional implications of the pressure-induced metabolic activation (e.g., proliferation) in skeletal myoblasts.

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**2681 Board #75 May 29 2:00 PM - 3:30 PM**

**Effects Of Clenbuterol On Pgc-1, Foxo1 And Atrogin-1 In Presenile Rats**

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(No relationships reported)

Clenbuterol is one of the beta-2 adrenergic receptor agonists with powerful muscle anabolic and lipolytic effects and is prohibited to use as doping drug for athletes, but it is one of candidates of counter measure for sarcopenia with aging. Since previously we have reported that clenbuterol induced the muscular hypertrophy in young male rats and the transition of muscle fiber type from slow to fast-type (JAP 91(1), 85-90, 2001). However, the effects of clenbuterol on aged animals muscles were not clear yet and the side effects should be cleared.

**PURPOSE:** This study investigated the different effects of clenbuterol on the molecular adaptation system of muscles between young and presenile rats.

**METHODS:** In the present study, clenbuterol was subcutaneously administered in 30wks male Sprague-Dawley rats (PCLE: n=6) during 2 weeks. The effects of clenbuterol on slow-twitch soleus (SOL) and fast-twitch EDL muscles were examined using western blotting and reverse-transcription polymerase chain reaction (RT-PCR) analysis of the mRNAs of beta-2 adrenergic receptor, IGF-1, MyoD, PGC-1a, FOXO1, Atrogin-1, and wwp1.

**RESULTS:** The muscle wet weights did not change in both SOL and EDL muscles of presenile rats, but heart increased significantly. The PGC-1a (-22 %) and FOXO1 (-19%) mRNAs decreased significantly in SOL. The Atrogin-1 (+16%) increased in only SOL and wwp1 increased in both SOL (+11%) and EDL (+7%) muscles. The beta-2 adrenergic receptor (-7%), MCT1 (-7%), and MyoD (-8%) mRNAs decreased significantly in EDL by clenbuterol. However, the protein contents of MCT1, MyoD were no change.

**CONCLUSIONS:** These results suggest that the clenbuterol showed different effects on presenile rats skeletal muscles from young rats via complicated mechanism both of protein synthesis by IGF-1 and proteolysis by PGC-1a, FOXO1, and ubiquitination with aging. It is necessary to carry out more detail experiments to explain the specific adaptation mechanism and to get a useful counter measure for the treatment of sarcopenia.

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**2682 Board #76 May 29 2:00 PM - 3:30 PM**

**Nandrolone Decanoate Administration And Growth-related Signaling During Muscle Recovery From Myotoxin-induced Injury**

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(No relationships reported)

Androgens can induce muscle mass accretion and regulate protein turnover. Although androgen administration has the potential to enhance muscle recovery from injury, androgen regulation of muscle regeneration is not well understood. Signaling through the IGF-1/PI3 kinase pathway is a known regulator of muscle fiber growth. Activation of Akt (PKB) by growth factor signaling induces protein synthesis and attenuates protein degradation.

**PURPOSE:** To determine the effect of nandrolone decanoate (ND), a synthetic testosterone, on the activation of the IGF-1/PI3 kinase pathway during tibialis anterior (TA) muscle recovery from injury.

**METHODS:** Castrated C57 BL6 mice were placed into 4 treatment groups; uninjured control (Con; n=6), Uninjured with nandrolone decanoate administration (Con+ND; n=6), bupivacaine-induced injury (Inj; n=6) and bupivacaine-induced injury with nandrolone decanoate administration (Inj +ND; n=6). Muscles were examined after 5 and 14 days of recovery. Akt activity was determined by western blot analysis. The ratio of phospho (ser473) to total forms of the protein was used as activity.

**RESULTS:** At 5 days of recovery, injured muscle increased Akt activity by 6.8 fold (p=.001) while nandrolone decanoate administration in uninjured muscle increased Akt activity 5.5 fold (p=.002). There was no significant interaction between injury and nandrolone decanoate administration at 5 days of recovery. However, at 14 days of recovery there was a significant interaction between injury and ND. There was an 8 fold increase (p= <.001) in Akt activation in the Inj+ND group compared to control. ND administration alone in uninjured muscle increased Akt activity 3.5 fold (p=.001) compared to control. Injured muscle without ND had no increase in Akt activity at 14 days.

**CONCLUSION:** Akt activity is increased 5 days after injury, without a further activation by ND administration. However, at 14 days of recovery, there is an additive induction

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**2683 Board #77 May 29 2:00 PM - 3:30 PM**

**Creatine Attenuates Overload-induced Heat Shock Protein Upregulation In Fast Fiber Subpopulation Of Young Rats**

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(No relationships reported)

We have previously shown Heat Shock Protein (HSP) 70 expression to be upregulated in overloaded plantaris muscle and that this upregulation is attenuated in aging muscle [#1763 MSSE 40(5): S294]. This HSP70 upregulation may be due to an overload-induced depletion of energy.

**PURPOSE:** This research investigated whether (1) creatine supplementation alters HSP production in overloaded muscle, and (2) this response is altered in aging muscle.

**METHODS:** Young (17 wk) and older (90 wk) F344 rats were subjected to one of four conditions: 1) control (YC, OC); 2) creatine supplementation (YCr, OCr); 3) surgical overload (YS, OS); or 4) overload + creatine (YScr, OSCr). Rats in creatine groups received creatine solution (4.45g/L, 5% dextrose in drinking water), *ad libitum*. Rats in overload groups underwent bilateral surgical ablation of the gastrocnemius muscle to promote compensatory hypertrophy in synergist muscles. Four weeks post-surgery, serial cross-sections of the plantaris muscle were immunohistochemically assayed for myosin heavy chains (MHC) and HSP70. MHC staining properties of individual fibers were compared to discern muscle fiber types. Pixel density was used to assess HSP70 staining intensity. Cross-sectional area (CSA) was measured on at least 50 fibers per fiber type. Group comparisons were made using a two-way ANOVA. Significant interactions were determined with Tukey's post hoc tests.

**RESULTS:** Fiber CSA was significantly larger in YCr and YScr groups, relative to YC. Creatine alone had no effect on the CSA of fibers in older rats, regardless of fiber type. However, fiber CSA was significantly larger in type I and IIA fibers of OSCr than of OC or OCr groups. Creatine alone had no effect on HSP70 content in any fiber types, regardless of age. However, type IIA fibers in YScr animals had significantly lower HSP70 content than in YS ( $P < 0.05$ ). HSP70 content did not differ in type IIA fibers between YScr, YC, or YCr. Creatine also did not affect HSP70 expression in any of the aging groups, regardless of fiber type.

**CONCLUSION:** These data suggest creatine alone does not alter muscle HSP70 content, but may prevent overload-induced HSP70 upregulation in faster-twitch fibers of young rats. This indicates an interaction between energy stores and HSP content. The data also imply an age-related loss of responsiveness to creatine.

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**2684 Board #78 May 29 2:00 PM - 3:30 PM**

**Insulin Administration Associated To Strength Training: Effects On Skeletal Muscle Of Rats**

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(No relationships reported)

**PURPOSE:** The present study aimed to investigate the strength training effects, associated to insulin administration, on skeletal muscle growth of rats.

**METHODS:** Male Wistar rats (90 days of age) were separated into 4 groups ( $n=10$ /group): Sedentary Control (SC); Trained Control (TC); Sedentary Insulin Treated (SIT) and Trained Insulin Treated (TIT). Simple commercial insulin, 30mU/100g of body weight (bw), was administered 3 days/week (alternated days), during 12 weeks. The animals belonging to TIT and TC groups performed a strength training program, consisted by jumps in tank with water, carrying overload equivalent to 50% of bw. The training was composed by 4 series of 10 jumps, 1 min of rest between the series, 5 days/week, during 12 weeks. We determined the total protein and DNA contents as well as the protein/DNA ratio and the protein synthesis and degradation rates of the soleus muscle of the animals. At the end of the experiment, we verified the glycaemia of the animals. ANOVA two way, followed by Bonferroni, was used in order to indicate the statistical differences ( $P < 0.05$ ).

**RESULTS:** There was not difference in the glycaemia (mg/dL) when compared all experimental groups ( $SC=105.2 \pm 13.2$ ;  $SIT=103.1 \pm 12.4$ ;  $TC=104.4 \pm 13.8$ ;  $TIT=105.8 \pm 13.6$ ). Muscle protein synthesis rates (pmol/mg.h) were higher in the TIT group ( $71.3 \pm 3.6$ ) if compared to the other groups ( $SC=44.3 \pm 2.1$ ;  $SIT=45.2 \pm 1.6$ ;  $TC=62.3 \pm 2.5$ ). TC also showed significantly higher values if compared to SC and SIT groups. No differences were found between the groups when analyzed the protein degradation rates (pmol/mg.h) ( $SC=271.4 \pm 25.2$ ;  $SIT=268.9 \pm 23.1$ ;  $TC=270.3 \pm 20.9$ ;  $TIT=269.8 \pm 22.4$ ). In addition, an improvement in muscle growth was observed in the TI group in relation to the other groups, as indicated by the total protein (g/100g) and DNA (g/100g) contents and protein/DNA ratio values (Total protein:  $SC=3.3 \pm 0.2$ ;  $SIT=3.4 \pm 0.5$ ;  $TC=4.7 \pm 0.3$ ;  $TIT=5.9 \pm 0.3$  - DNA:  $SC=0.148 \pm 0.03$ ;  $SIT=0.147 \pm 0.04$ ;  $TC=0.153 \pm 0.02$ ;  $TIT=0.169 \pm 0.05$  - Protein/DNA:  $SC=22.3 \pm 0.1$ ;  $SIT=23.1 \pm 0.3$ ;  $TC=30.7 \pm 0.2$ ;  $TIT=35.0 \pm 0.4$ ).

**CONCLUSION:** Taken together, these results suggest that the efficiency of the strength training protocol in promoting muscle growth was improved by insulin treatment in the conditions of the present study.

Supported by CAPES, Fapesp and CNPq (Brazilian Foundations).

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**2685 Board #79 May 29 2:00 PM - 3:30 PM**

**Skeletal Myocyte-specific VEGF Gene Deletion In Adult Mice Leads To Impaired Exercise Capacity Without Evidence Of Capillary Regression Or Altered In Vitro Muscle Contraction**

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(No relationships reported)

Vascular endothelial growth factor (VEGF) is involved in controlling skeletal muscle capillarity, an essential component of exercise capacity.

**PURPOSE:** Determine the mechanisms by which skeletal myocyte VEGF maintains exercise capacity.

**METHODS:** Inducible, skeletal myocyte-specific VEGF gene-deleted mice were generated by crossing *VEGFLoxP* mice with *HSA-Cre<sup>ERT2</sup>* mice (*skmVEGF<sup>-/-</sup>*) in which *cre* recombinase is under control of a human skeletal actin (HSA) sequence and can be conditionally induced with tamoxifen. VEGF levels were measured in several organs and in the gastrocnemius muscle by ELISA, 2 and 7 weeks after tamoxifen delivery to adult (*skmVEGF<sup>-/-</sup>*) and control (*VEGF<sup>+/+</sup>*) mice. Exercise capacity was evaluated by recording the maximum running speed and time to exhaustion. Contractile function in isolated EDL and soleus muscles was assessed by peak force, time to fatigue and the force-frequency relationship.

**RESULTS:** *skmVEGF<sup>-/-</sup>* mice showed 95% and 92% reductions in skeletal muscle VEGF protein 2 and 7 weeks after tamoxifen delivery, respectively, with no reduction in other organs. Two-weeks after tamoxifen, maximum running speed (-10%) and endurance capacity (-47%) were reduced in *skmVEGF<sup>-/-</sup>* mice compared to controls. Seven weeks post-tamoxifen, maximum running speed remained low in *skmVEGF<sup>-/-</sup>* mice, with a non-significant trend towards lower endurance capacity. Body and muscle weights, muscle cross-sectional areas, peak force or time to fatigue and capillary to fiber ratios were not different between *skmVEGF<sup>-/-</sup>* mice and *VEGF<sup>+/+</sup>* at either time point. Analysis of skeletal muscle force-frequency relationships also did not reveal any difference at 2 weeks in the EDL or soleus, though by 7 weeks a significant right shift in the force-frequency curve was observed in the EDL.

**CONCLUSION:** Mice with VEGF-deficient skeletal myocytes exhibit a limitation to exercise that does not stem from an inability of the muscle to contract or the number of capillaries that supply muscle fibers.

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2686 Board #80 May 29 2:00 PM - 3:30 PM

**The Effect Of Physical Activity Status On Markers Of Skeletal Muscle Protein Turnover**

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(No relationships reported)

Paraplegia results in significant skeletal muscle atrophy. We have previously shown that chronic paraplegia and a chronic increase in physical activity both downregulate the mammalian target of rapamycin (mTOR) pathway, a key regulator of muscle protein synthesis. Recent work has identified a novel SIRT1-p53 pathway that is capable of regulating cell proliferation and muscle protein synthesis independent of mTOR.

**PURPOSE:** To determine whether physical activity or inactivity alters the SIRT1-p53 pathway in skeletal muscle.

**METHODS:** Soleus muscle was collected from 4 male Sprague-Dawley sedentary rats (Control), 5 male rats exposed to 9 weeks of free access to running wheels (Active), and 6 male rats 10 weeks following complete T(4)-T(5) spinal cord transection (Inactive). Peak running distance for the Active rats was 6.3±0.7 km/day. We utilized immunoblotting methods to measure the phosphorylation status of p53 and the total protein abundance of silent information regulation 2 homolog 1 (SIRT1) and FoxO3a.

**RESULTS:** Preliminary data show that the total protein content of SIRT1, an upstream regulator of both p53 and FoxO3a, was ~35% lower in the Inactive rats with no differences between the Active and Control groups. The phosphorylation of p53 on Ser15 was increased (an indicator of enhanced p53 activity) in the Inactive group as compared to the Active and Control rats indicating a suppression of muscle protein synthesis. Phosphorylation of p53 was the lowest in the Active group. Total FoxO3a protein appears to be reduced in the Inactive rats as compared to the Control rats which may suggest a downregulation of proteolysis with severe physical inactivity.

**CONCLUSIONS:** Severe physical inactivity, in the form of chronic paraplegia, appears to downregulate SIRT1, which has been shown to activate p53, resulting in a suppression of muscle protein synthesis. Future work is needed to determine whether exercise rehabilitation can improve muscle protein turnover by restoring cell signaling in situations associated with severe physical inactivity or other muscle wasting conditions.

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2687 Board #81 May 29 2:00 PM - 3:30 PM

**Implications Of Angiogenic Factors And Thrombospondin-1 Underlying Capillary Regression In Chronically Unloaded Rat Soleus Muscle**

Hidemi Fujino<sup>1</sup>, Akihiko Ishihara<sup>2</sup>, Shinichiro Murakami<sup>1</sup>, Hiroyo Kondo<sup>3</sup>, Hui Zhong<sup>4</sup>, Roland R. Roy<sup>4</sup>, V Reggie Edgerton, FACSM<sup>4</sup>. <sup>1</sup>Himeji Dokkyo University, Himeji, Japan. <sup>2</sup>Kyoto University, Kyoto, Japan. <sup>3</sup>Suzuka University of Medical Science, Suzuka, Japan. <sup>4</sup>University of California, Los Angeles, Los Angeles, CA.

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(No relationships reported)

Capillary regression is induced by chronic unloading of skeletal muscles. The mechanisms involved, however, are not fully understood. At least two independent mechanisms can be considered, i.e., adaptations in the levels of specific angiogenic factors such as vascular endothelial growth factor (VEGF) and angiopoietin, and of thrombospondin-1 (TSP-1), an inhibitor of angiogenesis that induces apoptosis in endothelial cells.

**PURPOSE:** The aim of present study was to determine the responses of pro- and anti-angiogenic factors in rat soleus capillaries after 2 weeks of hindlimb unloading (HU).

**METHODS:** Male Wistar rats (8-9 weeks of age) were assigned randomly into a control or HU group. Frozen transverse sections from the soleus mid-belly were stained for alkaline phosphatase which is present in the capillary endothelium. Apoptotic endothelial cells were identified by von Willebrand factor and DNA fragmentation (TUNEL) using immunofluorescent staining. VEGF, KDR, Flt-1, angiopoietin-1 (Ang-1), Ang-2, Tie-2, HIF 1 alpha, and TSP-1 mRNAs were determined by TaqMan probe-based real-time PCR reactions.

**RESULTS:** The capillary-to-fiber ratio was 23% lower in HU than control rats. TUNEL-positive endothelial cells were observed only in HU rats and TSP levels were higher in HU than control rats, suggesting capillary regression with vascular endothelial cell apoptosis. mRNA levels of angiogenic factors VEGF and Ang-1, their receptors, and HIF 1 alpha were lower in HU than control rats whereas Ang-2 levels were unaffected. As a result, the Ang-2/Ang-1 ratio increased, suggesting that the vasculature was destabilized. Ang-2 expressed in the absence of VEGF also results in vessel regression.

**CONCLUSIONS:** These data indicate that a decrease in angiogenic factors and an increase in TSP-1 expression may play an important role in capillary regression associated with chronic unloading.

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**F-27 Free Communication/Poster - Neural Control of Movement II**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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2688 Board #82 May 29 3:30 PM - 5:00 PM

**Neuromuscular Control During A Drop Jump Between Healthy Women And Women With Semitendinosus-gracilis Acl Reconstruction**

Elena Roman, Gloria D. Colon, Luis A. Rivas, Marizabel LaPuerta, Lourdes Reus, Heidi Venegas, Alexis Ortiz. University of Puerto Rico Medical Sciences Campus, San Juan, Puerto Rico. (Sponsor: William Micheo, FACSM)

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(No relationships reported)

Women with anterior cruciate ligament (ACL) reconstruction have shown neuromuscular compensatory strategies to maintain the stability of the knee during landing tasks. ACL reconstruction with hamstring-gracilis (SG) autograft is one of the preferred surgical reconstruction options in women.

**PURPOSE:** To compare neuromuscular recruitment strategies of the quadriceps and hamstrings between young women 1-5 years post SG ACL reconstruction and non-injured women.

**METHODS:** Twenty-nine young women (non-injured = 15, SG = 15) performed five trials of a double-legged drop jump from a 60-cm height box. Participants had five bipolar Ag pre-amplified surface EMG electrodes on the skin over the vastus medialis, vastus lateralis, rectus femoris, medial and lateral hamstrings on the dominant leg for the non-injured women and in the reconstructed leg for women with ACL reconstruction. EMG data was collected at 1kHz. A dynamic normalization procedure was used while subjects performed multiple tuck jumps over five seconds. Data from all the quadriceps and hamstring muscles were averaged to represent each muscle group, respectively.



Rectified and normalized EMG activities for the quadriceps, hamstrings and quadriceps/hamstring co-contraction (CCR) ratio were the variables of interest. The CCR was calculated as the EMG activity of the less active muscle divided by the most active muscle as a representation of dynamic knee stability. ANOVA were used for group comparisons on the average of five trials for all three variables.

**RESULTS:** Non-injured women exhibited as twice as much normalized neuromuscular activity for the quadriceps (non-injured:  $27.56 \pm 38.35$ ; SG:  $13.49 \pm 3.25$ ) and hamstrings (non-injured:  $14.41 \pm 11.92$ ; SG:  $7.69 \pm 3.16$ ) and similar CCR (non-injured:  $56.88 \pm 20.19$ ; SG:  $54.58 \pm 17.90$ ). However, these differences were not statistically significant for quadriceps ( $p=0.22$ ), hamstrings ( $p=0.07$ ) and quadriceps/hamstrings CCR ( $p=0.76$ ) variables.

**CONCLUSIONS:** It appears that women with SG ACL reconstruction possess similar neuromuscular activation patterns that women without knee surgery. Nonetheless, some of these differences could be related to the high variability presented by the non-injured subjects. NIH Grants G12RR03051 and 1P20 RR11126, and NSCA Foundation supported this project.

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**2689 Board #83 May 29 3:30 PM - 5:00 PM**

**Comparison Of Landing Mechanics During A Drop Jump In Semitendinosus-gracilis Acl-reconstructed Females And Noninjured Females**

Carmen E. Capo-Lugo, Luis Rivas, Elena Roman, Gloria Colon, Marizabel LaPuerta, Heidi Venegas, Alexis Ortiz. *University of Puerto Rico-Medical Sciences Campus, San Juan, Puerto Rico.* (Sponsor: William Micheo, FACSMM)

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(No relationships reported)

Women with different types of anterior cruciate ligament (ACL) reconstruction have shown similar landing mechanics as non-injured women. ACL reconstruction using the Semitendinosus-gracilis (SG) graft is one of the preferred options for ACL reconstruction in women.

**PURPOSE:** To compare knee valgus between non-injured women and women with SG ACL reconstruction during a 60-cm double-legged drop jump.

**METHODS:** Twenty-nine females 21-35 years of age (non-injured =15, weight:  $60.25 \pm 10.63$  Kg, height:  $161.24 \pm 6.70$  cm; SG = 15, weight:  $67.20 \pm 11.46$  Kg, height:  $166.92 \pm 8.44$  cm) participated in this investigation. Participants performed 5 trials of a double-legged drop jump from a 60-cm height box. The double-legged landing task involved landing from the 60-cm drop box and immediately jumping vertically as high as possible (countermovement jump). Reflective markers were attached over bony prominences of both legs according to the model embedded in the software. A static trial was used to estimate each subject's joint centers. Five infrared cameras (120 Hz) were used to capture the trajectory of reflective markers during the drop jump. Knee valgus was defined as the minimum distance between markers placed at the lateral femoral epicondyles during the ground contact phase. The ground contact phase was defined as the moment of initial contact until the participant cleared both feet from the floor during the maximal vertical jump push-off. The average valgus from five trials was used for analysis using an Analysis of Variance (ANOVA) to compare knee valgus among groups.

**RESULTS:** The ANOVA revealed no statistically significant differences ( $p=0.842$ ) between groups for knee valgus during the ground contact phase of the drop jump.

**CONCLUSION:** Young women with SG ACL reconstruction presented similar knee valgus as young women without knee surgery on a 60-cm double-legged drop jump. It appears that young women who undergo ACL reconstruction with SG autograft do not experience long term landing mechanics deficits that could predispose them to re-injury. NIH Grants G12RR03051 and 1P20 RR11126, and NSCA Foundation supported this project.

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**2690 Board #84 May 29 3:30 PM - 5:00 PM**

**Isometric Thigh Muscle Torque Does Not Change From Early Follicular To Post- Ovulatory Phases**

Melissa M. Montgomery, Sandra J. Shultz, FACSMM. *The University of North Carolina at Greensboro, Greensboro, NC.*

(No relationships reported)

Changes in circulating sex hormones during the menstrual cycle may interact with the muscle in a way that may alter its force-producing capability. While some studies report increased knee flexor / extensor torques around ovulation, others do not. Few studies obtained hormone concentrations to confirm cycle phase.

**PURPOSE:** To compare maximal voluntary isometric contraction (MVIC) torque of the knee flexors (KF) and extensors (KE) between the early follicular (EF) and early (EL) and late (LL) luteal phases as confirmed by serum hormone concentrations. It was expected that MVIC torques would increase from EF to EL once estradiol peaked and prior to significant exposure to progesterone.

**METHODS:** 51 physically active females were measured daily for serum estradiol (E2) and progesterone (P4) for 6 days following onset of menses and 8 days following evidence of ovulation for 2 consecutive months. In the third month, subjects provided a blood sample and performed KF and KE MVICs on one day during menses and one day post-ovulation. To ascertain the time of testing in the luteal phase for each female, E2 and P4 concentrations obtained on the luteal MVIC test date were aligned with their hormone profiles of the previous 2 months. Subjects were then grouped as being tested during an anovulatory cycle (AN = peak P4 <3 ng/mL), during EL (post ovulation through the first 3 days of the P4 rise), or during LL (near or post P4 peak). Repeated measures ANOVA compared groups on mean normalized KF and KE MVICs (Nm/kg) between their early follicular and luteal tests.

**RESULTS:** The timing of the luteal test could be reliably determined in 44 females ( $163.4 \pm 6.5$  cm,  $60.1 \pm 8.3$  kg,  $21.5 \pm 2.6$  yrs); 9 AN (E2=  $95.1 \pm 74.6$  pg/mL, P4=  $1.1 \pm 0.6$  ng/mL), 14 EL (E2=  $113.0 \pm 36.6$  pg/mL, P4=  $7.0 \pm 2.7$  ng/mL) and 21 LL (E2=  $133.9 \pm 42.1$  pg/mL, P4=  $13.5 \pm 6.2$  ng/mL). Results revealed no difference in MVIC torque between the follicular and luteal phases ( $p=0.265$ ), or between phases by group ( $p=0.765$ ) or muscle ( $p=0.869$ ), or group by muscle ( $p=0.134$ ). KE was greater than KF MVIC ( $2.31 \pm 0.06$  vs.  $1.73 \pm 0.06$  Nm/kg;  $p<.001$ ).

**CONCLUSIONS:** KE and KF MVIC torque in physically-active females did not change from the early follicular phase (when E2 and P4 were at their nadirs) to times in the luteal phase that followed an unopposed E2 rise, or combined E2 and P4 rise.

Supported by NIH-NIAMS Grant R01- AR53172

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**2691 Board #85 May 29 3:30 PM - 5:00 PM**

**Sensorimotor Control Of Collegiate Football Players**

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(No relationships reported)

Shoulder instability is one of the most common injuries among athletes participating in contact sports, such as football. Previous research has shown that this instability adversely affects the function of the sensorimotor system potentially leading to a pathological cycle of soft tissue damage, diminished sensorimotor control, and shoulder dysfunction. Although, previous research has investigated the effects of participating in overhead sports, such as baseball, softball, and tennis on sensorimotor control, currently there are no data detailing such effects among football players.

**PURPOSE:** To determine if differences exist in shoulder sensorimotor control between a group of collegiate football players and a control group.

**METHODS:** Forty-five Division I collegiate football players (age= $20.0 \pm 1.0$  years, height= $186.7 \pm 5.4$  cm, mass= $103.4 \pm 15.0$  kg) and 70 male control subjects with no previous experience in collision sports (age= $21.0 \pm 1.9$  years, height= $177.6 \pm 9.1$  cm, mass= $76.2 \pm 14.1$  kg) participated. All subjects had no recent history of upper extremity injury or neurological disorder. Each subject performed 3, 30 second upper extremity balance trials on each arm. The balance trials were conducted in a single arm push-up position with the test arm in the center of a force platform (Advanced Mechanical Technology, Inc., Newton, MA) and their feet on an unstable surface. The trials were averaged and the differences in radial area deviation (anterior-posterior and medial-lateral sway) between groups were analyzed using independent t-tests ( $P<.05$ ).

**RESULTS:** The football players had significantly more radial area deviation of the dominant ( $P=.02$ ) and non-dominant arms ( $P=.03$ ) when compared to the control group.

**CONCLUSIONS:** Our results suggest football players may have decreased sensorimotor control of the shoulder compared to individuals with no contact sport experience. Such decreases in sensorimotor control may be due to the frequent impacts to the shoulder during football participation. As such, football players may benefit from exercises which target the sensorimotor system. Our findings may also be beneficial in the evaluation and treatment of various shoulder injuries among football players.

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**2692 Board #86 May 29 3:30 PM - 5:00 PM**

**Interference To Force Accuracy With A Mechanical Disturbance To The Contralateral Hand During Bilateral Tasks**

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(No relationships reported)

Concurrent, bilateral movement control is commonly required in daily life including sports activity, but unconscious interferences to the ipsilateral hand with mechanical disturbances to the contralateral hand are not well known.

**PURPOSE:** We examined the interference between hands when a mechanical disturbance was applied to a hand during bilateral muscle contractions that maintained steady digit forces.

**METHODS:** Fifteen right-handed subjects controlled bilateral static force with their thumb and index finger. In a neutral pinching posture for both hands, subjects produced static force in the directions of digit flexion and extension in separate trials. The force direction during a trial was the same for both hands. Visual feedback of the target (10% of maximal force) and produced force was provided for each hand. Subjects were asked to match their force to the target as accurate and steady as possible for 10 s in each hand. In each force direction, the task was performed with (3 trials) and without (3 trials) a mechanical disturbance applied to the left hand 5 s after the onset of trial. The mechanical disturbance was induced by a linear actuator as rapid lateral displacement of the left-hand manipulandum (10 cm in 600 ms) against which the left digits produced force. The mean force in the right hand was calculated for the 2-s period immediately after the disturbance (from 5<sup>th</sup> to 7<sup>th</sup> s). As an index of accuracy, the relative deviation of the mean force from the target (error ratio) was compared between force directions and between disturbance conditions.

**RESULTS:** The error ratio in the right hand was significantly ( $P < 0.05$ ) higher in the extension direction ( $5.7\% \pm 4.3\%$ ) compared with the flexion direction ( $3.3\% \pm 2.4\%$ ) without the disturbance. With the mechanical disturbance to the left hand, the error ratio in the right hand increased more than 2 times ( $P < 0.05$ ), reaching  $16.2\% \pm 11.1\%$  in the extension and  $8.55\% \pm 3.92\%$  in the flexion directions.

**CONCLUSION:** The accuracy during bilateral force control was influenced by force direction and a mechanical disturbance to the contralateral hand. The results suggested that accuracy in a hand was lower in the force direction that is produced less frequently in daily life and was unconsciously reduced with a mechanical disturbance to the contralateral hand probably due to divided attention.

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**2693 Board #87 May 29 3:30 PM - 5:00 PM**

**Effectiveness Of Immediate Video Feedback On Wheelchair Propulsion Training For Patients With Spinal Cord Injuries**

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(No relationships reported)

Studies have shown video feedback to enhance motor skill learning in healthy individuals since it allows learners not only to visualize themselves but also to evaluate discrepancies so erroneous performance can be corrected. However, effectiveness of video feedback on wheelchair training in early rehabilitation for spinal cord injury (SCI) patients has not been determined.

**PURPOSE:** To examine effects of real-time video feedback on level wheelchair propulsion training for people with SCI.

**METHODS:** Twenty-eight patients, matched on age, gender, wheelchair seat width and SCI level were randomly assigned to either video feedback (VG, mean<sub>age</sub> = 33.9+10.3 yrs) or control (CG, mean<sub>age</sub> = 29.6+10.4 yrs) groups. Two reflective markers were attached on the right 3<sup>rd</sup> metacarpophalangeal joint and wheel axle. Both groups received one 30-min propulsion training during which their performance of wheelchair propulsion were recorded by video cameras from the sagittal plane. After each task, the VG observed their own performance via video motion analysis software and received feedback from a therapist to correct errors while the CG received feedback normally given during rehabilitation. Pushrim kinematics and number of strokes (NS) were obtained and compared between four different times: baseline, post-training, retention and transfer tests. A mixed-model ANOVA (2 groups x 4 times) and Bonferroni pos hoc test ( $p < .05$ ) were employed to determine statistical differences.

**RESULTS:** No significant difference in kinematic variables and NS were found between VG and CG. However, NS of both groups in post-training decreased 50% as compared to baseline. Pushing angles significantly increased in both groups during post-training (CG=78.2°, VG=82.6°), retention (CG=80.1°, VG=83.4°) and transfer tests (CG=76.3°, VG=86°), compared to baseline (CG=68.8°, VG=72.9°). In VG, significantly increased cycle time during post-training (1.92 s) and retention test (1.93 s) was found, compared to baseline (1.12 s).

**CONCLUSIONS:** Wheelchair propulsion training improves stroke efficiency by increasing contact and total push angles in both groups. Although no significant differences between two groups are found, real-time video feedback seems helpful in terms of motivation and performance correction.

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**2694 Board #88 May 29 3:30 PM - 5:00 PM**

**Response Of Lumbar Muscles To Release Of The Trunk After Passive Cyclic Trunk Flexion-extension**

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(No relationships reported)

Previous literature has indicated a modified response of the lumbar paraspinal (LP) muscles after fatigue and sustained passive trunk flexion, but not during cyclic trunk movement. LP response latencies are important to understand the etiology of injury to the trunk-spine system.

**PURPOSE:** To observe LP muscle response times to quick releases performed after passive cyclic trunk flexion-extension (TF-E) exercise.

**METHODS:** Participants were 4 men ( $23 \pm 3$  yrs,  $176 \pm 6$  cm, and  $82 \pm 6$  kg) with no back or lower extremity dysfunction. Participants sat on a backless chair positioned on a platform and abutted against a metal frame with a wooden backing. Thighs were perpendicular to the floor and the feet were positioned flat on the platform. An isokinetic dynamometer was positioned 80cm behind the participants with the axis aligned 10 cm higher than the participants' L5-S1 level. The attachment arm of the dynamometer was secured to a harness around the chest. The attachment arm was offset 20 deg from vertical to maintain gravitational moment  $> 0$ . Participants were taken through TF-E passively until released near end range of trunk extension. These were performed before and after two trials of 30 reps of cyclic passive TF-E. Participants were instructed to remain relaxed during sessions and respond naturally to the release. Surface electromyography (EMG) signals were collected from LP muscles bilaterally using Ag-AgCl gel electrodes. An elgon was positioned on the attachment arm and time synchronized with the EMG. Response time to the quick release and the 200 ms leading up to this event were analyzed. Repeated measures ANOVA (time) was used to analyze response times. A two factor (release block x time) ANOVA was performed to compare the 200 ms lead period in 10ms increments prior to the quick release. Alpha was set at 0.05.

**RESULTS:** There were no significant differences in response times of the LP muscles between release blocks (left LP:  $0.25 \pm 0.1$  s,  $0.22 \pm 0.2$  s,  $0.25 \pm 0.1$  s; right LP:  $0.16 \pm 0.03$  s,  $0.18 \pm 0.1$  s,  $0.22 \pm 0.1$  s, respectively,  $p > 0.05$ ). LP activation 200 ms prior to quick release was significantly different between blocks ( $p < 0.05$ ), but not over time.

**CONCLUSIONS:** Neither cyclic TF-E nor anticipatory activity influenced LP myoelectric response to the quick release. Greater numbers of participants are needed to verify these observations.

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**2695 Board #89 May 29 3:30 PM - 5:00 PM**

**Is Lower Plantarflexor Steadiness In The Elderly A Source Of Larger Postural Sway During Quiet Standing?**

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Postural instability due to aging results in larger and faster postural sway in the elderly compared to the young. At the same time, the force fluctuation during isometric constant force exertion has been reported to be larger in the elderly as well. It is hypothesized that the larger force fluctuation causes the larger and faster postural sway in the elderly.

**PURPOSE:** To investigate the noise component in the postural control system using our newly developed methodology by which a neural-mechanical control scheme can be identified using quiet standing data, and to compare the noise component between the elderly and the young.

**METHODS:** Twenty-three young ( $27.3 \pm 4.7$  yrs) and twenty-two elderly ( $66.5 \pm 4.9$  yrs) subjects were asked to stand still on a force platform to acquire data for 30 s. The fluctuation of the body angle, the electromyogram of the right soleus muscle, and the ankle torque were measured. A postural control model was build, which consisted of a neural controller (a proportional-derivative controller), a neural feedback delay of 80 ms, the torque generation process (2nd order filter), and a mechanical controller (stiffness and small damping). In the first procedure, the natural frequency of the torque generation process and the stiffness were optimized using the measured muscle activity and postural sway as the inputs and the ankle torque as the output of the model. In the second procedure, the gains of the neural controller were optimized using the identified variables in the first procedure and the measured postural sway as the input and the ankle torque as the output of the model. The noise torque component was identified as the residual between the measured torque and the torque accounted for by the model.

**RESULTS:** The model fitting was quite good with percentage fits of  $98.9 \pm 0.5$  % and  $98.4 \pm 0.6$  % for the elderly and the young, respectively. The coefficients of variation of the noise torque components were significantly different between the elderly ( $1.8 \pm 0.7$  %) and the young ( $1.3 \pm 0.7$  %) ( $p = 0.017$ ). These values closely matched with the force fluctuation during isometric force exertion reported in the literature.

**CONCLUSIONS:** More erroneous torque control accompanied with constant force exertion in the elderly compared to the young may be a cause of larger and faster postural sway in the elderly.

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**2696 Board #90 May 29 3:30 PM - 5:00 PM**

**Test-retest Reliability Of Quadriceps Voluntary Activation**

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**PURPOSE:** To examine the test-retest reliability of quadriceps voluntary activation using both the interpolated twitch technique (ITT) ratio and the central activation ratio (CAR).

**METHODS:** 10 healthy active individuals (4 females, 6 males; age  $27.2 \pm 2.8$  yrs; mass  $69.9 \pm 12.4$  kg; height  $1.73 \pm 0.07$  m) completed two sessions separated by at least 24 hours and within 1 week. Participants were seated on the isokinetic dynamometer with hips and knees at  $90^\circ$  and the lower leg secured to the dynamometer arm. Stimulation electrodes were placed over the proximal vastus lateralis and distal vastus medialis. While resting, the amperage of a 400V square wave pulse (duration 100  $\mu$ s) was progressively increased to obtain a plateau in the resting twitch torque. Once this was determined participants performed two practice isometric maximal voluntary contraction (MVC) followed by 5 test MVCs. A stimulus was delivered approximately 1-2s into the MVC (superimposed twitch), when a plateau in torque was noted. A second stimulus was delivered to the relaxed muscle following the MVC (potentiated twitch). The %VA was determined using the torque values of the MVC, superimposed and potentiated twitches in the following formulas:

$$ITT = (1 - (\text{superimposed} / \text{potentiated})) * 100\%$$

$$CAR = (MVC / (MVC + \text{superimposed})) * 100\%$$

The test-retest reliability of ITT and CAR was evaluated using the intraclass correlation coefficient (ICC type 2, 1) and the standard error of measurement (SEM). The SEM was then used to calculate the minimal detectable change (MDC) at the 95% confidence interval (95%CI).

**RESULTS:** Based on paired t-tests, there was no significant difference in %VA on day 1 vs day 2 for either ITT ( $95.9 \pm 3.1$  % vs  $95.2 \pm 3.3$  %) or CAR ( $98.7 \pm 1.6$  % vs  $98.7 \pm 1.3$  %) ( $p > 0.05$ ). %VA calculated based on CAR was significantly higher than %VA calculated based on ITT ( $p < 0.01$ ). The ICCs for ITT was 0.81 (95%CI: 0.40-0.95) and CAR was 0.92 (95%CI: 0.74-0.98). The MDC at the 95%CI for ITT was 5.64% and for CAR was 3.74%.

**CONCLUSIONS:** ITT ratio and CAR demonstrate excellent test-retest reliability. Based on the MDC, the percentage of voluntary activation for 95% of young healthy participants would change by less than 5.64% (using ITT ratio) and 3.74% (using CAR) upon repeated testing. Therefore we can be confident that changes greater than these are true changes in voluntary activation.

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**2697 Board #91 May 29 3:30 PM - 5:00 PM**

**Balance And Strength Changes Following Injury Prevention Protocol In Female Soccer Players**

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(No relationships reported)

The prevention of sports injuries is characterised by a wide spectrum of approaches with multimodal programs most often advocated, evaluated based on epidemiology but typically failing to clarify which aspect of the intervention program contributed to the reduction in injury incidence.

**PURPOSE:** To quantify the effects of a multimodal injury prevention program previously shown to reduce injury incidence.

**METHODS:** Female collegiate soccer players ( $n=9$ ) completed the F-MARC 11 injury prevention program in addition to their soccer training over a duration of 6 weeks, whilst an age and training-age matched control group ( $n=9$ ) completed an equivalent amount of soccer training. Pre- and post-intervention, all players were assessed for isokinetic strength of the knee flexors and extensors in both concentric and eccentric mode at speeds of 1.05, 3.14 and 5.23  $\text{rad}\cdot\text{s}^{-1}$ , and dynamic posturography using sensory organisation and unilateral sway tests. Between group comparisons were made using repeated measures ANOVA, with significance accepted at  $p \leq 0.05$ .

**RESULTS:** Post-intervention, the F11 group displayed a significant increase in the somatosensory and vestibular contributions to balance during the sensory organisation test. The F11 group also displayed a significant post-intervention decrease in sway velocity during a unilateral stance test, for both eyes open and eyes closed conditions. No changes were observed for the

control group. There was no change in peak concentric or eccentric torque for either knee flexors or extensors post-intervention, irrespective of movement speed. There was however a significant change in the angle of peak torque for eccentric knee flexors at the slowest test speed. The control group showed no changes in isokinetic parameters.

**CONCLUSION:** The F11 injury prevention program created a change in the relative contributions to dynamic balance, with an increase in both the somatosensory and vestibular ratios, and no change in the visual ratio. Whilst peak torque was unaffected, there was evidence of a shift in the angle of peak eccentric hamstring torque at the slowest test speed post-intervention. Injury reduction might therefore be attributed to those exercises involving dynamic single-legged balance, enhancing movement control rather than maximal strength.

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**2698      Board #92      May 29      3:30 PM - 5:00 PM**  
**Interference From Divided Attention With Additional Motor Or Cognitive Task To Motor Accuracy**

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(No relationships reported)

Accuracy of motor output has often been studied for single unilateral tasks in laboratory settings. It is possible that accuracy of motor output may be interfered with an additional task due to divided attention.

**PURPOSE:** The purpose of the study was to examine the influence of divided attention with an additional motor or cognitive task on accuracy of isometric force matching with a hand muscle.

**METHODS:** Ten healthy right-handed adults ( $27.1 \pm 4.0$  yrs) performed a unilateral motor task with the right hand, a cognitive task, a bilateral motor task with both hands, and a concurrent motor-cognitive task in a randomized order. The motor tasks involved steady low-intensity isometric contraction of the first dorsal interosseus in the right or both hands. Abduction force of the index finger was recorded from both hands. In the unilateral motor task, subjects received visual feedback of force and were instructed to match and maintain 5% and 10% of their maximal voluntary contraction (MVC) force as accurate and steady as possible by abducting the index finger of the right hand. The bilateral motor task used the same protocol as the unilateral task but with both hands concurrently. The cognitive task involved arithmetic and memory. The concurrent motor-cognitive task corresponded to the concurrent performance of the unilateral motor and cognitive tasks. The abduction force for the steady 10-s period in the right hand was used for analyses. As an index of accuracy, the relative deviation of mean force from the target (error ratio) was calculated and averaged across 4 trials in each task.

**RESULTS:** The error ratio in the right hand tended to increase with an additional task at 5% MVC ( $8.8 \pm 4.9\%$  during the unilateral motor task,  $11.9 \pm 8.8\%$  during the bilateral motor task, and  $10.9 \pm 5.7\%$  during the motor-cognitive task) and at 10% MVC ( $7.6 \pm 3.8\%$  during the unilateral motor task,  $8.4 \pm 6.8\%$  during the bilateral motor task, and  $9.1 \pm 5.4\%$  during the motor-cognitive task), but these changes did not reach statistical significance.

**CONCLUSIONS:** Divided attention with an additional motor or cognitive task induced little interference to motor accuracy during a low-intensity motor task with simple steady isometric contraction of a hand muscle.

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**2699      Board #93      May 29      3:30 PM - 5:00 PM**  
**The Influence Of Ankle Instability On The Kinetics Of Gait Termination**

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Chronic ankle instability (CAI) is a common occurrence after an ankle sprain. Yet, some people (copers) maintain dynamic activities without recurrent injury. Alterations in both feed-forward and feedback control exist in CAI patients but little is known about alterations in copers. Understanding differences between copers and CAI patients may help elucidate the mechanism of CAI.

**PURPOSE:** To examine control differences among controls, CAI, and copers during gait termination (GT).

**METHODS:** Twenty controls ( $20.85 \pm 1.6$  yr), 20 with CAI ( $20.5 \pm 1.0$  yrs) and 20 copers ( $21.9 \pm 2.9$  yrs) participated. Copers and CAI patients had a previous moderate ankle sprain but copers resumed all pre-injury activity without limitation or recurrent injury while CAI patients had recurrent sprains. Each subject was tested bilaterally (each limb as the lead and brake limb) during ten planned and ten unplanned GT trials. An auditory signal cued subjects to stop during randomly selected trials (unplanned GT) and catch trials ensured that anticipation of the auditory signal did not occur. Ground reaction forces, collected at 1200Hz, from two adjacent force plates were used to calculate the maximum propulsion (lead limb) and braking forces (brake limb). A 3x2x3 mixed model (group [control, CAI, coper], limb [involved/uninvolved], and task [planned GT, unplanned GT, catch]) MANOVA examined differences among force variables.

**RESULTS:** Both control and coper subjects produced significantly less propulsive force than the CAI group (CAI:  $11.2 \text{ N}$  > healthy and  $9.9 \text{ N}$  > copers). Subsequently, braking forces were higher for CAI patients than controls ( $45.5 \text{ N}$  greater) or copers ( $26.8 \text{ N}$  greater).

**CONCLUSION:** CAI patients did not reduce their propulsive forces during GT trials (planned and unplanned) to the same extent as controls or copers and relied on greater braking forces to stop forward momentum. This indicates an altered motor program and slower neuromuscular response in CAI patients during GT. Further, both feed-forward and feedback neuromuscular control alterations appear to exist in CAI subjects. Copers, however, produce similar movement patterns as controls suggesting a return to normal neuromuscular control or successful compensation pattern which may represent a potential coping mechanism.

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**2700      Board #94      May 29      3:30 PM - 5:00 PM**  
**Gender And Age-related Training Adaptations In Maximal Motoneuron Firing Rate**

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(No relationships reported)

**PURPOSE:** To investigate potential age and gender differences in the training-related adaptations in muscular force and maximal motor unit firing rates.

**METHODS:** A total of 60 subjects; 30 young (mean age  $21.9 \pm 3.1$  years) and 30 older (mean age  $72.9 \pm 4.6$  years) individuals participated in the study, with equal numbers of males and females in each group. All subjects completed two testing sessions, separated by 2 weeks. During each testing session measures of maximal voluntary contraction (MVC) force of the dorsiflexors and maximal motor unit firing rates in the tibialis anterior were obtained. During the two week interval between testing sessions, individuals in the control group were asked to carry out their normal daily activities, while individuals in the training group were asked to participate in a total of 6 isometric strength training sessions (3 per week).

**RESULTS:** At baseline there were no differences in MVC force ( $p=.15$ ), or maximal firing rate ( $p=.44$ ) between the training and control groups. However MVC force was lower in older subjects than young ( $p=.002$ ) and lower in females than in males ( $p<.001$ ) at baseline. The trained group showed a significant 17.8% increase in MVC force ( $p<.001$ ) following training, while the control group showed little change (2.2% increase) ( $p<.001$ ). There was no significant Day\*Gender ( $p=.56$ ), or Day\*Age ( $p=.76$ ) interaction, suggesting that young and older males and females showed similar changes in MVC force in response to training. The maximal motor unit firing rate was lower at baseline in older than in young subjects ( $p=.002$ ), and lower in females than in males ( $p=.05$ ). The maximal motor unit firing rate increased 14.2% in the trained group across



the two days ( $p=.001$ ), while the firing rates in the control group showed a slight 4.3% increase. There was no significant Day\*Gender ( $p=.69$ ), or Day\*Age ( $p=.20$ ) interaction, suggesting that young and older males and females showed similar changes in maximal motor unit firing rate in response to training.

**CONCLUSIONS:** Although overall, older individuals and females had lower MVC force and lower maximal motor unit firing rates than young and male subjects, respectively, they show similar adaptations in MVC force and maximal motor unit firing rate following training.

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**2701 Board #95 May 29 3:30 PM - 5:00 PM**

**A Protocol For Measuring The Effect Of Cycling On Neuromuscular Control Of Running In Triathletes**

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(No relationships reported)

**PURPOSE:** The direct effects of cycling on neuromuscular control during running in triathletes are unknown. In this paper we outline and test a new protocol for investigating the influence of cycling on neuromuscular control during running in highly-trained triathletes. **METHODS:** We conducted three experiments investigating a) the repeatability (i.e. between-day reliability) of the protocol, specifically three-dimensional kinematic and electromyographic (EMG) measures of neuromuscular control, b) the ability of the protocol to investigate the direct influence of cycling on neuromuscular control during running independent of fatigue in highly-trained triathletes (by evaluating indicators of fatigue from EMG and force data), and c) the ability of the protocol to provide a sufficient control, or baseline, measure of neuromuscular control during running in highly-trained triathletes. **RESULTS:** Kinematic and electromyographic (EMG) measures of neuromuscular control during running showed moderate to high repeatability (mean coefficients-of-multiple-correlation (CMC) for repeatability of EMG and kinematics were  $0.816 \pm 0.014$  and  $0.911 \pm 0.031$ , respectively). There was no evidence that the protocol resulted in neuromuscular fatigue in highly-trained triathletes. The protocol provided a sufficient control, or baseline, measure of neuromuscular control during running for highly-trained triathletes (CMC for stability was  $0.827 \pm 0.023$ , and  $0.862 \pm 0.054$  for EMG and kinematics, respectively).

**CONCLUSION:** This protocol provides repeatable measures of neuromuscular control during running and can be used to differentiate any direct influence of cycling on neuromuscular control during running from the effects of a) fatigue, b) altered running speed, c) kinematic variations (the selection of an alternate, but not necessarily less efficient or less skilled, movement pattern), and d) continued running (changes in neuromuscular control that would occur during continued running irrespective of any prior cycling).

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**2702 Board #96 May 29 3:30 PM - 5:00 PM**

**Sex Differences In Brain Activation During Submaximal Isometric Contractions Of The Lower Extremity**

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(No relationships reported)

Women can sustain isometric contractions for a longer duration than men but the influence of sex differences in brain activation on performance is not known.

**PURPOSE:** To compare brain activity in healthy young women and men during submaximal isometric contractions of the ankle dorsiflexor muscles using functional magnetic resonance imaging (fMRI).

**METHODS:** Fifteen young adults (9 women, 6 men 18-40 years of age) performed three sets of isometric contractions at 10%, 30%, 50% and 70% of maximal voluntary contraction force for 16 s at each intensity with the right ankle dorsiflexor muscles while lying supine in a 3.0 T MRI scanner. Subjects received force feedback during the contractions via a rear-projection visual display system. fMRI was used to quantify the blood oxygenation level dependent (BOLD) contrast (T2\* weighted imaging) overlaid on a T1 weighted anatomical image for each subject. An 8-channel array Radio Frequency receive head coil was used to obtain 36 sagittal plane slices (thickness = 4 mm) across the entire brain volume using an echo-planar imaging sequence (64 x 64 matrix, 240 x 240 mm<sup>2</sup> field of view, TE = 25 ms, TR = 2000 ms, flip angle = 77°).

**RESULTS:** Using voxelwise analysis to determine the differences in brain activation in men versus women, men demonstrated significantly greater intensity in the BOLD signal [whole brain corrected  $P < 0.01$ , ( $t = 2.817$ ), cluster size = 534  $\mu$ l] in the following areas compared with women: left cerebellum (2 distinct regions), right postcentral gyrus, right parietal lobe, left middle cingulate cortex, left middle temporal gyrus, right inferior frontal gyrus, and right superior temporal gyrus.

**CONCLUSIONS:** Men demonstrated a greater intensity of brain activity in motor and sensorimotor areas in the cortex compared with women. Sex differences in functional neural networks are present during submaximal isometric contractions of the lower extremity muscles despite men and women sustaining contractions of similar relative intensity. The more intense brain activation in men reflects a greater central drive to perform the same relative task for men compared with women.

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**2703 Board #97 May 29 3:30 PM - 5:00 PM**

**Effect Of Functional Isometric Squats On 40 Yard Dash In Males: Post-activation Potentiation Pilot Study**

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(No relationships reported)

Functional Isometrics is a form of weight training where a person lifts greater than 100% of their 1 repetition maximum (1RM) near the end of their range of motion moving the weight a short distance until the weight meets an immovable object, then pushing/holding the weight for 3-5 seconds. This technique has been used to hyper-stimulate the nervous system theoretically leading to one's ability to exert increased muscular force and power. This type of response is known as a Post-Activation Potentiation (PAP) effect.

**PURPOSE:** To investigate if trained males who performed a functional isometric squat at 150% of their 1RM for 5 seconds would increase counter movement vertical jump (CMJ) height.

**METHODS:** Five trained (experienced weight trainers: lift > 4 days/week) (age: 23.2±2.4 yrs, mass: 87.9±12.1 kg, ht: 180.0±10.0 cm) males participated in the study. Day 1: Forty Yard Dash was first determined using Speed Trap II timing device. Next, individual 1RM (1RM 143.6±35.6 kg) in the back squat was determined. Lastly, ½ squat heights were determined and subjects were allowed to practice the functional isometric squat technique using only the bar. Day 2: Subjects reported back to the testing area three to five days after initial testing. After an appropriate dynamic warm-up, subjects performed a five second functional isometric squat with 150% of their 1RM squat (150% 1RM: 215.5±38.8 kg). Immediately at the end of the five second squat, subjects walked 50 feet out of the building to the sprint area, sat and rested for 4 minutes. At the end of the rest period, subjects performed the 40-Yard dash.

**RESULTS:** A paired samples t-test revealed post-FI 40-Yard time was significantly ( $t(5) = 3.19$ ,  $p = 0.033$ ) shorter than pre-FI 40-Yard dash. Subjects decreased their 40-Yard dash time by mean of 0.28±0.20 seconds.

**CONCLUSIONS:** The results of this study suggest that a 5 second FI squat at 150% of dynamic squat 1RM is sufficient to elicit a significant PAP effect in trained males as measured by 40-Yard dash.

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**2704 Board #98 May 29 3:30 PM - 5:00 PM**

**Ischemia Increases Central Drive From The Motor Cortex During Submaximal Exercise In Healthy Adults**

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The central nervous system may play a significant role in skeletal muscle fatigue in some conditions. Central fatigue could arise from spinal and supraspinal inputs, including motor cortex activation. Previous studies have shown that muscle activity measured by EMG increases at a faster rate during sustained submaximal contractions when the muscle is ischemic compared to a non-ischemic condition.

**PURPOSE:** To estimate motor cortical activity using functional magnetic resonance imaging (fMRI) during sustained submaximal handgrip muscle contractions performed with and without forearm ischemia.

**METHODS:** Eight healthy adults ( $27 \pm 13$  (SD) yrs old, 7 male) were positioned supine with a pressure cuff placed around their upper arm. The subjects performed 3 min isometric contractions at 15% of MVC with and without cuff occlusion (cuff inflated 80 Torr above systolic blood pressure). During the contractions, the subjects had direct visual feedback of force and MR images were acquired at 3T with an 8-channel head coil. Echo planar imaging was used for functional scans (TR=2000 ms, TE=35 ms, FOV=22 cm, matrix=64x64) and were overlaid on a high-resolution anatomical scan (fast GRE, TR=4.4 ms, TE=1.1 ms, TI=500 ms, FOV=22 cm). The rate of increase in motor cortex activity during the final 90 s of the contractions was estimated by the slope of the signal intensity (SI) using a linear regression analysis.

**RESULTS:** During the contractions, the SI of the images was characterized by reaching a plateau during the initial period (~90 s) followed by either maintaining a steady state level or a progressive increase. During the final 90 s of the contractions, the slope of SI was greater ( $p < 0.03$ ) in the ischemic ( $4.7E-05 \pm 1.4E-05$  SI/s, mean $\pm$ SE) than the non-ischemic condition ( $1.1E-05 \pm 1.5E-05$  SI/s).

**CONCLUSIONS:** The findings of this study indicate that motor cortex activity increases at a faster rate during ischemic submaximal exercise compared to the non-ischemic condition. Furthermore, the results support the notion that fMRI can be utilized to measure central drive during isometric skeletal muscle contractions. This may have valuable implications for studying central fatigue during athletic performance and in certain populations, such as individuals with chronic fatigue syndrome.

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**2705      Board #99      May 29      3:30 PM - 5:00 PM**  
**Relationships Among The M-wave, H-reflex, Twitch Torque, And The Mechanomyographic Responses During Standard Recruitment Curves**

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**PURPOSE:** To examine the relationships among the M-wave, H-reflex, twitch torque (TT), and MMG responses recorded during standard recruitment curves.

**METHODS:** Six men (mean  $\pm$  SD age =  $25.0 \pm 1.7$  yrs; body mass =  $81.1 \pm 6.3$  kg; height =  $179.9 \pm 5.9$  cm) and 8 women ( $23.4 \pm 1.8$  yrs;  $64.1 \pm 4.6$  kg;  $169.9 \pm 5.8$  cm) lied prone on an isokinetic dynamometer with their left foot secured to the ankle attachment to measure plantar flexion TT. Self-adhering stimulating electrodes (1 cm x 1 cm) were taped in the popliteal fossa and over the patellar tendon. Pre-amplified bipolar surface electromyographic (EMG) electrodes were placed over the soleus muscle, while a miniature accelerometer was placed proximal to the EMG electrodes to record MMG. Five constant-current stimuli (1 ms pulse duration, 100-400 V) were delivered percutaneously to the tibial nerve at incremental intensities (1 - 99 mA). Individual recruitment curves were established, which included the TT, M-wave, H-reflex, and MMG response at each intensity. The sum of the H-reflex and the M-wave (Sum<sub>H-M</sub>) was also computed.

**RESULTS:** There were correlations ( $P < 0.05$ ) between TT and MMG (95% confidence interval for  $r = 0.78-0.98$ ), M-wave and MMG ( $r = 0.62-0.96$ ), Sum<sub>H-M</sub> and MMG ( $r = 0.84-0.98$ ), TT and M-waves ( $r = 0.58-0.95$ ), and Sum<sub>H-M</sub> and TT ( $r = 0.89-0.99$ ). H-reflexes were not related ( $P > 0.05$ ) to any of the other variables. The average Z-score-transformed correlation coefficients involving the M-wave ( $r = 0.85-0.87$ ) were less than ( $P < 0.05$ ) the average coefficients involving TT, MMG, and Sum<sub>H-M</sub> ( $r = 0.93-0.97$ ).

**CONCLUSION:** These findings indicated that the MMG responses during a standard recruitment curve were more related to TT and Sum<sub>H-M</sub> than the M-waves or H-reflexes. Since the MMG signal is not confounded by stimulus artifact, does not require a ground electrode, involves only one sensor, and tracks the TT response better than the M-wave, the MMG signal may be useful for determining the maximal twitch force and corresponding stimulus intensity when torque or force measures are not feasible. However, validation and reliability studies will be necessary to test this hypothesis.

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**2706      Board #100      May 29      3:30 PM - 5:00 PM**  
**Spinal Mechanisms Contributing To Rate Of Force Development**

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(No relationships reported)

The neuromuscular system's ability to quickly generate force is important during fast movements and injury prevention. Rate of force development (RFD) is a common measure of this ability. However, it is unknown to what extent spinal control mechanisms contribute to RFD.

**PURPOSE:** To identify contributions of spinal control mechanisms to RFD.

**METHODS:** RFD of isometric plantarflexion was measured from 37 participants (19 male and 18 females) on a Biodex System 3 dynamometer with the ankle of the dominant leg secured at 90°. H-reflex, intrinsic pre-synaptic inhibition (IPI), and extrinsic pre-synaptic inhibition (EPI) recruitment curves were obtained from the soleus. IPI testing used the paired pulse conditioning protocol where two stimuli are delivered to the tibial nerve at the same intensity 100 ms apart. EPI was assessed through common peroneal nerve conditioning with 100 ms between the conditioning and test reflexes. Recurrent inhibition (RI), a form of post-synaptic inhibition, was assessed by setting stimulus 1 (S1) to 25% of  $M_{max}$  and stimulus 2 (S2) to  $M_{max}$ . Ten trials of both S1 alone and S1 followed 10 ms later by S2 were counterbalanced. Neural drive ( $V_{max} \cdot M_{max}$ ) was assessed by a  $M_{max}$  stimulation to the tibial nerve during an isometric maximum voluntary contraction (iMVC) of the soleus. Five trials with 60 seconds rest between each were collected. Additionally, three trials of iMVC with 60 seconds rest between each were collected to assess RFD. Standard multiple regression was used to determine the contribution of the independent variables to RFD. The independent variables were sex, the first derivative of the H-reflex, IPI, and EPI, RI (S1+S2/ S1), and  $V_{max} \cdot M_{max}$ .

**RESULTS:** The regression analysis revealed the model significantly predicted RFD ( $r^2 = 0.643$ ,  $p < 0.001$ ). The significant independent variables were sex ( $b = -0.564$ ,  $p < 0.001$ ), V-wave ( $b = 0.502$ ,  $p = 0.001$ ), and IPI ( $b = -0.450$ ,  $p = 0.016$ ).

**CONCLUSION:** Sex was a significant contributor, with males having greater RFD. Increased  $V_{max} \cdot M_{max}$  also significantly contributed. IPI, a measure of influence of reflex activation history and thought to reflect modulation of Ia afferent inflow from the muscle spindles significantly contributed to RFD. Based on the results, RFD is a result of increased neural drive, modulation of muscle spindle feedback, and sex differences.

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**2707      Board #101      May 29      3:30 PM - 5:00 PM**  
**Gain Of Visual Feedback And Brain Activation During Submaximal Contractions Of The Lower Extremity**

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(No relationships reported)

Gain of the visual feedback influences the performance of a submaximal isometric contraction but the role of brain activation is not known.

**PURPOSE:** To compare brain activation patterns when the gain of the visual force feedback was altered during performance of submaximal isometric contractions at various

intensities.

**METHODS:** Nine young adults (3 males, 6 females, 20 - 40 years) attended two experimental sessions to perform three sets of isometric contractions at 10%, 30%, 50% and 70% of maximal voluntary contraction force for 16 s at each intensity with the right ankle dorsiflexor muscles while lying supine in a 3.0 T magnetic resonance imaging (MRI) scanner. Subjects received visual feedback during the contractions via a rear-projection visual display system and were required to track a horizontal target line on the display screen. During one of the sessions (*control*) the gain of the visual feedback was not altered and the target line for the different contraction intensities was relative to the height of the screen. In the other session (*gain*), the gain of the force feedback was varied so that the target line for the different contraction intensities was always in the center of the visual display screen. Functional MRI was used to quantify the blood oxygenation level dependent (BOLD) contrast (T2\* weighted imaging) overlaid on a T1 weighted anatomical image for each subject. An 8-channel array Radio Frequency receive head coil was used to obtain 36 sagittal plane slices (thickness = 4 mm) across the entire brain volume using an echo-planar imaging sequence (64 x 64 matrix, 240 x 240 mm<sup>2</sup> field of view, TE = 25 ms, TR = 2000 ms, flip angle = 77°).

**RESULTS:** When all intensities were combined, voxelwise analysis demonstrated a significant increase in BOLD activity during the *gain* condition [whole brain corrected  $P < 0.01$ , ( $t = 2.859$ ), cluster size = 534  $\mu$ l] in the right paracentral lobule ( $xyz = -8.5, 35.8, 50.4$ ) compared with the *control* condition.

**CONCLUSIONS:** The right paracentral lobule processes sensorimotor signals related to the lower extremities and appears to have an important role in modulating performance of submaximal isometric contractions at various intensities when the gain of the visual force feedback is altered.

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## **F-28 Free Communication/Poster - Physical Activity and Chronic Disease**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### **2708 Board #102 May 29 2:00 PM - 3:30 PM**

#### **Physical Activity And Cardiovascular Risk Markers In South Asians Living In England**

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(No relationships reported)

South Asians (SA) living in England (originating from India, Bangladesh and Pakistan) have a higher incidence of diabetes and coronary heart disease compared with the white population. The role of physical activity in reducing cardiovascular disease (CVD) risk among SA remains poorly understood.

**PURPOSE:** To examine the association between physical activity and CVD risk markers in a representative sample of SA and whites living in England.

**METHODS:** Participants were 13,851 healthy (no history of CVD) men and women (3,550 SA, 10,301 white;  $45 \pm 17$  yrs old) drawn from the Health Survey for England. CVD risk factors included fasting glucose (fGL) and triglycerides (FTG), glycosylated haemoglobin (HbA1c), C-reactive protein (CRP), fibrinogen, cholesterol (C), waist circumference (WC), and mean arterial blood pressure (MAP). Self-reported questionnaires were employed to estimate physical activity levels. Participants were deemed to be sufficiently active if they reported at least 450 MET-min per week.

**RESULTS:** In comparison with whites, the SA were less likely to meet the physical activity guidelines (odds ratio = 0.41, 95% CI, 0.38 to 0.45). In general linear models that were adjusted for age and gender, SA had higher levels of fGL, FTG, HbA1c, CRP, and lower HDL-C compared with whites. In comparison with inactive SA, the active SA demonstrated lower FTG (adjusted beta, -0.19, 95% CI, -0.35 to -0.04,  $P=0.02$ ), HbA1c (-0.09, -0.18 to -0.01,  $P=0.03$ ), CRP (-0.48, -0.10 to 0.01,  $P=0.05$ ), WC (-1.59, -2.38 to -0.81,  $P=0.001$ ), MAP (-1.97, -3.29 to -0.66,  $P=0.003$ ), and greater HDL-C (0.08, 0.05 to 0.11,  $P=0.001$ ). Similar associations were observed in physically active whites compared to the sedentary.

**CONCLUSIONS:** Physical activity is associated with some important CVD risk markers in an at risk SA population. Physical activity should be promoted in SA living in England.

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### **2709 Board #103 May 29 2:00 PM - 3:30 PM**

#### **Effect Of A Stretching Program On The Autonomic Modulation In Hemodialysis Patients: Pilot Study**

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(No relationships reported)

**PURPOSE:** To determine the effect of a stretching program over the autonomic modulation in chronic renal patients on hemodialysis.

**METHODS:** An intradialysis exploratory descriptive pilot study was performed executing stretching exercises for one month every other day. The sample consisted of 3 men ( $53 \pm 13.2$  yrs) and 4 women ( $26 \pm 5.7$  yrs) who signed an informed consent. They were evaluated by means of a heart rate variability registry, a challenge of the autonomic nervous system, and stretching tests. The registry was divided into three phases with a 21 minute duration: an initial one in supine position, an orthostatic challenge, and a final one in supine position again. At the end of the month, the patients were re-evaluated.

**RESULTS:** The standard deviation of the RR intervals showed the same tendency but in an opposite direction in women ( $29.9 \pm 11.1$  ms before vs  $23.7 \pm 12.6$  ms after), with respect to men ( $15.3 \pm 6.0$  ms before vs  $22.5 \pm 5.0$  ms after). The same result occurred with the total spectral power in women ( $2764.8 \pm 1108.5$  ms<sup>2</sup>/Hz before vs  $1574.2 \pm 1123.8$  ms<sup>2</sup>/Hz after) with respect to men ( $1162 \pm 437.4$  ms<sup>2</sup>/Hz before vs  $1646 \pm 220.2$  ms<sup>2</sup>/Hz after). The 30:15 index, which was abnormal in all at the beginning of the intervention ( $0.9 \pm 0.03$ ), showed an increment in all patients and was normalized in one young female (1.05). The net differences of the high frequency index ( $-5.9 \pm 7.9$  ms<sup>2</sup>/Hz before vs  $3.9 \pm 8.9$  ms<sup>2</sup>/Hz after) in the entire sample could indicate some degree of neurovegetative modification.

**CONCLUSION:** This study concludes the existence of an autonomic dysfunction in chronic renal patients confirmed by the differences in the 30:15 index, and the tendency towards a modification in parasympathetic reactivity by means of a stretching program.

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### **2710 Board #104 May 29 2:00 PM - 3:30 PM**

#### **Impact Of Progressive Resistance Training On Lipids And Lipoproteins In Adults**

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(No relationships reported)

Previous randomized controlled trials have yielded conflicting results regarding the effects of progressive resistance training (PRT) on lipids and lipoproteins in adults.

**PURPOSE:** Use the meta-analytic approach to examine the effects of PRT on lipids and lipoproteins in adult humans.

**METHODS:** Randomized controlled trials > 4 weeks dealing with the effects of PRT on lipids and lipoproteins in adult humans > 18 years of age and published between January 1, 1955 and July 12, 2007 were included. Primary outcomes included total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), ratio of total cholesterol to

high-density lipoprotein cholesterol (TC/HDL-C), non-high-density lipoprotein cholesterol (non-HDL-C), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG). A random-effects model was used for analysis with data reported as means and 95% confidence intervals.

**RESULTS:** Twenty-nine studies representing 1329 men and women (676 exercise, 653 control) were included. Statistically significant improvements were found for TC (-5.5 mg/dl, -9.4 to -1.6), TC/HDL-C (-0.5, -0.9 to -0.2), non-HDL-C (-8.7 mg/dl, -14.1 to -3.3), LDL-C (-6.1 mg/dl, -11.2 to -1.0) and TG (-8.1 mg/dl, -14.5 to -1.8) but not HDL-C (0.7 mg/dl, -1.2 to 2.6). Changes were equivalent to -2.7%, 1.4%, -11.6%, -5.6%, -4.6%, and -6.4%, respectively, for TC, HDL-C, TC/HDL-C, non-HDL-C, LDL-C, and TG.

**CONCLUSION:** Progressive resistance training reduces TC, TC/HDL-C, non-HDL-C, LDL-C and TG in adults.

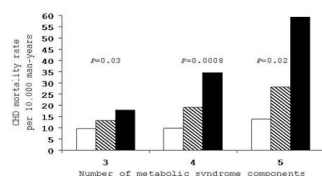
Supported by Grant-in-aid #0755207B from the American Heart Association.

**2711 Board #105 May 29 2:00 PM - 3:30 PM**  
**Maximal Exercise ECG Responses And Mortality Among Men With Metabolic Syndrome**

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 (No relationships reported)

An abnormal ECG during maximal exercise testing is a powerful predictor of mortality in asymptomatic men. However, the relationship between exercise ECG (E-ECG) responses and the risk of mortality in men with metabolic syndrome (MS) is not well-studied.

**Figure 1.** Age- and examination year-adjusted CHD mortality rates by E-ECG results and number of MetS components in 5191 men with MetS. White bars represent the normal ECG, striped bars the equivocal ECG, and black bars the abnormal ECG. The p values are for a test of linear trend across ECG groups. The number of men (and CHD deaths) in the normal, equivocal, and abnormal ECG groups were 4349 (57), 549 (13), and 414 (18) in those with 3 MetS components; 2058 (21), 286 (8), and 215 (16) in those with 4 components; and 577 (9), 91 (4), and 52 (4) in those with 5 components, respectively.



**PURPOSE:** Our purpose was to evaluate the relationship between abnormal E-ECG responses and mortality in a large

population of asymptomatic men with MS.

**METHODS:** Participants were 9191 men (mean age 46.9) who met the criteria of having MS. All completed a maximal exercise treadmill test (years 1979 to 2001) and were without a previous cardiovascular disease (CVD) event or diabetes at baseline. Main outcomes were mortality from all-causes, CHD, and CVD. Cox regression analysis was used to quantify the mortality risk according to E-ECG responses.

**RESULTS:** During an average follow-up of 14 years, 633 deaths (242 CVD; 150 CHD) were identified. E-ECG test results were a strong predictor of CHD mortality risk (HR, 95% CI: 1.62, 1.02-2.56 for equivocal ECG and 2.45, 1.62-3.69 for abnormal ECG,  $p_{\text{trend}} < 0.0001$ ). After adjusting for risk factors, men with equivocal and abnormal E-ECG tests had a 40% and 91% higher CHD death risk ( $p_{\text{trend}} = 0.004$ ), a 14% and 75% higher risk of CVD death ( $p_{\text{trend}} = 0.003$ ), and a 24% and 24% higher risk of all-cause death ( $p_{\text{trend}} = 0.04$ ) than men with a normal E-ECG test, respectively. We also observed positive graphical trajectory for CHD mortality rates across E-ECG categories within 3, 4, or 5 MS components ( $P$  for trend  $< 0.05$ , respectively; see Figure 1).

**CONCLUSIONS:** Among men with MS, an abnormal E-ECG response was associated with a higher risk of all-cause, CVD, and CHD mortality. These findings underscore the importance of E-ECG tests as a determinant of cardiovascular outcomes.

**2712 Board #106 May 29 2:00 PM - 3:30 PM**  
**Physical Fitness And Nine-year Mortality In 70-year-old Population**

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 (No relationships reported)

**PURPOSE:** Since little is known about relationship between physical fitness ability and mortality among very elderly people, we evaluated this association in a Japanese population of 70-year-old community residents.

**METHODS:** In 1998, 600 (306 males and 294 females) individuals who were 70 years old resided in the Niigata Prefecture of Japan underwent physical fitness tests including hand-grip strength, isometric leg extensor strength, leg extensor power, stepping rate, and one-leg standing time with eyes open. In 2007, 367 (181 males and 186 females) who were 79 years old underwent physical fitness tests longitudinally. During 9-year follow-up period, 70 individuals (55 males and 15 females) died. Physical fitness ability was compared between individuals who underwent physical fitness tests (alive group) or individuals who were dead (dead group) during 9-year follow-up period.

**RESULTS:** The mean values for hand-grip strength at 70 years age for individuals who were alive and dead during 9-year follow-up period were  $39.7 \pm 5.6$ ,  $38.2 \pm 5.7$  kg for men, and  $24.6 \pm 3.8$ ,  $23.7 \pm 3.1$  kg for women, respectively. The mean values for isometric leg extensor strength for the two groups were  $1.21 \pm 0.29$ ,  $1.10 \pm 0.24$  kg/kg body mass for men, and  $0.86 \pm 0.25$ ,  $0.78 \pm 0.29$  kg/kg body mass for women, respectively. The mean values for leg extensor power for the two groups were  $14.8 \pm 3.4$ ,  $13.2 \pm 3.4$  watt/kg body mass for men, and  $9.1 \pm 2.7$ ,  $7.7 \pm 3.1$  watt/kg body mass for women, respectively. The mean values for the stepping rate for the two groups were  $80.7 \pm 14.0$ ,  $77.1 \pm 14.8$  times per 10 seconds for men, and  $71.0 \pm 12.4$ ,  $62.9 \pm 13.1$  times per 10 seconds for women, respectively. The mean values for the one-leg standing time with their eyes open for the two groups were  $75.4 \pm 42.5$ ,  $65.3 \pm 46.4$  seconds for men,  $52.9 \pm 44.0$ ,  $41.6 \pm 43.8$  seconds for women, respectively. All measurements regarding physical fitness were significantly higher for men than for women. In men and women, the leg extensor power and knee extensor strength were significantly higher in the alive group than the dead group.

**CONCLUSIONS:** This study suggests that isometric leg extensor strength and leg extensor power are useful predictors for assessing mortality in the future.

**2713 Board #107 May 29 2:00 PM - 3:30 PM**  
**Role Of Endurance And Inspiratory Resistive Diaphragmatic Breathing Training In Improving Asthmatic Symptomatology**

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The growing incidence and costs of asthma has resulted in a considerable financial- and health-burden that demands alternative and more cost-effective pulmonary rehabilitation treatment options.

**PURPOSE:** To compare endurance training (ET), inspiratory resistive diaphragmatic breathing training (IDT) and combined endurance and inspiratory resistive diaphragmatic



breathing training (ET+IDT) on asthmatic symptomatology.

**METHODS:** Eighty-eight inactive, moderate-persistent asthmatics were assigned to either a control group (CG) (n = 22), ET group (n = 22), IDT group (n = 22) or ET+IDT group (n = 22). The forced vital capacity (FVC), forced expiratory volume in one second (FEV<sub>1</sub>), forced expiratory volume in one second/forced vital capacity ratio (FEV<sub>1</sub>/FVC), peak expiratory flow (PEF), maximal voluntary ventilation (MVV), maximal oxygen consumption (VO<sub>2max</sub>) and medication usage was assessed pre- and post-training. The ET patients walked/jogged at 60% of their individual age-predicted maximal heart rate, IDT patients performed both inspiratory resistive breathing and diaphragmatic breathing for three sets of five to 10 repetitions at a 1:2 second inspiration to expiration ratio, three sets of 10 to 15 repetitions at a 2:4 ratio and three sets of 15 to 20 repetitions at a 3:6 ratio. The ET+IDT patients performed 15 minutes of walking/jogging and diaphragmatic breathing for two sets of each of the repetitions and ratios utilized by the IDT group.

**RESULTS:** ET, IDT and ET+IDT significantly (P<0.05) increased FVC, FEV<sub>1</sub> and PEF, while significantly decreasing medication usage. IDT and ET+IDT were effective at increasing FEV<sub>1</sub>/FVC. VO<sub>2max</sub> and MVV increased significantly following ET and ET+IDT training. Post-hoc analysis revealed that the ET+IDT was the most effective at improving VO<sub>2max</sub>, FVC, FEV<sub>1</sub>, FEV<sub>1</sub>/FVC, PEF and MVV.

**CONCLUSIONS:** These findings support the inclusion of ET+IDT for moderate-persistent asthmatics to improve asthmatic symptomatology due to ET+IDT's low risk and cost while allowing a patient to gain the unique benefits of both modes of exercise.

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**2714 Board #108 May 29 2:00 PM - 3:30 PM**  
**Exercise And Type 2 Diabetes And Metabolic Syndrome**

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(No relationships reported)

**PURPOSE:** To review and quantify the effects of different modes of exercise training on measures of glucose control, body composition, and disease-related complications in individuals with metabolic syndrome or type 2 diabetes.

**METHODS:** The online databases PUBMED, SPORTDiscus, CINAHL and SCOPUS were searched for RCTs exploring the effects of progressive resistance training (PRT), aerobic exercise, or combined aerobic and PRT in adult type 2 diabetic or metabolic syndrome populations. Studies involving a mixed diet and exercise approach were included if the exercise component of the intervention could be quantified in terms of frequency, intensity, and duration. Selected studies were assessed for methodological quality using a modified version of the Downs and Black Checklist, and ranked according to levels of evidence. Statistical analyses and meta-analyses were conducted where feasible.

**RESULTS:** An initial literature search conditionally identified 30 RCTs for inclusion. Results are presented separately for metabolic syndrome and type 2 diabetic populations. Preliminary data suggest that both forms of exercise, in combination as well as alone, have beneficial effects on diabetic outcomes. There is limited data upon which to formulate conclusions regarding the efficacy of exercise on study outcomes in individuals with metabolic syndrome.

**CONCLUSIONS:** There is a lack of consistency among studies in the classification system used to identify participants with metabolic syndrome. This may partially explain the limited amount of studies upon which to formulate conclusions in the metabolic syndrome population. The area of exercise in type 2 diabetes is much better developed, with several new RCTs conducted since the last major review of this topic. Evidence-based conclusions regarding a dose-response relationship between exercise and study outcomes are forthcoming.

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**2715 Board #109 May 29 2:00 PM - 3:30 PM**  
**Correlates Of Physical Activity In Men And Women With Osteoarthritis: Findings From Australia**

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(No relationships reported)

Osteoarthritis (OA) is the leading cause of pain and disability in Australia, and physical activity is a preferred treatment for OA symptoms. However, most people with OA are not engaging in health-enhancing activities recommended to relieve symptoms. Understanding the modifiable factors associated with these activities is necessary to encourage participation.

**PURPOSE:** To examine the correlates of leisure-time physical activity (LTPA), strength training, and stretching exercises among individuals with OA.

**METHODS:** As part of a mail survey, 485 individuals, aged 68.0 (SD=10.6) years, with hip or knee OA were asked about current use of 17 therapies for OA relief as well as about demographic, health-related and psychological factors. Associations with each activity outcome were examined in a multivariable logistic regression model, separately for men and women.

**RESULTS:** Having the use of a walking aid was associated with LTPA in men and women (p<0.05). In men, attempting to lose weight and using massage therapy were associated with participation in both strength training and stretching exercises (p<0.05). In women, attempting to lose weight and taking an OA self-management program were associated with participation in strength training (p<0.05), and taking an OA self-management program, using orthotics in shoes, and the perceived benefits of physical activities were associated with stretching exercises (p<0.05).

**CONCLUSION:** This is the first study to show that use of certain OA therapies is associated with participation in physical activities. Acknowledging the limitations of the cross-sectional design, the findings indicate important channels, such as OA self-management programs for women and massage therapists for men, for promoting activity. They also indicate the perceived need for aids, like walking aids and orthotics, for participation in health-enhancing activities.

*Supported by Australian NHMRC Program Grant #301200*

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**2716 Board #110 May 29 2:00 PM - 3:30 PM**  
**Exercise And Global Well Being In Community Dwelling Adults With Fibromyalgia**

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(No relationships reported)

The effects of exercise on the range of problems experienced by those with fibromyalgia are not well known.

**PURPOSE:** Use the meta-analytic approach to determine the effects of exercise on global well-being in community-dwelling adults with fibromyalgia.

**METHODS:** Studies were included if they met the following criteria: (1) randomized controlled trials with the unit of assignment at the participant level, (2) adults > 18 years of age, (3) an exercise-only intervention group (aerobic, strength training, or both), (4) community accessible exercise interventions > four weeks, (5) a non-intervention control group, (6) English-language studies, (7) published and unpublished (master's theses and dissertations) studies, (8) studies published between January 1, 1973 and August 29, 2007, and (9) data for the overall score from the Fibromyalgia Impact Questionnaire (FIQ) available. A random-effects model and Hedge's standardized effect size (g), adjusted for small sample sizes, was used to pool results according to either per-protocol or intention-to-treat analyses.

**RESULTS:** Of the 1,025 studies screened, 7 representing 8 groups and 14 outcomes in 470 (280 exercise, 190 control) primarily female participants, 18 to 73 years of age were included. Both per-protocol and intention-to-treat analyses resulted in statistically significant (small to moderate) improvements in global well-being (per protocol, g and 95% confidence interval, -0.39, -0.70 to -0.09; intention-to-treat, -0.34, -0.53 to -0.14). No statistically significant heterogeneity was observed for either analysis (per protocol, I<sup>2</sup> = 36.8%, p = 0.16; intention-to-treat, I<sup>2</sup> = 0%, p = 0.53).

**CONCLUSION:** Exercise improves global well-being in community-dwelling adults with fibromyalgia.

**2717 Board #111 May 29 2:00 PM - 3:30 PM**  
**Assessment Of Cardiovascular Disease Risk Factors In College Students.**

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Few studies have examined the prevalence of modifiable cardiovascular disease (CVD) risk factors in young adults attending college.

**PURPOSE:** To assess the determinants of modifiable CVD risk factors in college students.

**METHODS:** Participants were 192 (70% female; age:  $19.6 \pm 1.3$  yr) college students enrolled in a healthy lifestyles class, who completed a health assessment and an online survey during the Fall 2007 or Spring 2008. The health assessment included measured height (cm), weight (kg) and calculated body mass index ( $\text{kg/m}^2$ ). Seated blood pressure was assessed via automated cuff. Total and high density lipoprotein cholesterol were assessed after a non-fasting venous blood draw. Meeting physical activity recommendations (yes, no) and smoking (yes, no) were assessed via survey. All CVD risk factors were dichotomized based on the American College of Sports Medicine risk stratification criteria. For analysis, total number of CVD risk factors were summed and categorized as 0, 1, or  $\geq 2$ . To assess the determinants of CVD risk factors in study participants, the following exposure variables were assessed via survey: gender, age (18, 19, 20,  $\geq 21$  yr), major (Kinesiology, other), and grade point average (No,  $<3.0$ ,  $3.0-3.5$ ,  $>3.5$ )(GPA). To assess the impact of each exposure variable on CVD risk factors, multiple logistic regression was used to determine adjusted odds ratios and 95% confidence intervals (CI).

**RESULTS:** Our results indicated that 7% of our sample were hypertensive, 9% were smokers, 16% were dyslipidemic, 26% were overweight, and 51% were physically inactive. This resulted in 35% having 0 risk factors, 44% having 1 risk factor, and 21% having  $\geq 2$  risk factors. Compared to participants with a GPA of  $\geq 3.5$ , those with a GPA of  $<3.0$  were 9.5 (95%CI: 1.8-49.8) times more likely to have 1 risk factor and 23 (3.7-144.7) times more likely to have  $\geq 2$  risk factors. Non-kinesiology majors were 3.3 (1.5-7.4) times more likely to have 1 risk factor. Males were 4.4 (1.4-14.3) times more likely to have  $\geq 2$  risk factors. Discussion: Results show a larger than expected percentage of college students with  $\geq 2$  CVD risk factors. Results also showed a potential association between academic performance and CVD risk factors.

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**2718 Board #112 May 29 2:00 PM - 3:30 PM**  
**Cardio-respiratory Fitness Affects Glucose Control And Thus Cardiovascular Disease Risk In Postmenopausal Women.**

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Increased glucose levels above a threshold of 4.9 mmol/L are associated with a greater risk of cardiovascular disease (CVD). The menopause has been associated with impaired glucose control, including poor glucose tolerance, increased glycosylated haemoglobin (HbA1C) and fasting insulin concentration. The positive effect of increased cardio-respiratory fitness (CRF) upon glucose control in postmenopausal women (PM-women) is unclear.

**PURPOSE:** To determine the effects of CRF upon glucose control in PM-women.

**METHODS:** CRF was assessed via Bruce treadmill test in 79 sedentary-to-moderately active and 10 marathon running (MR) PM-women. Sedentary-to-moderately active women were classified into low, medium or high CRF levels according to  $\text{VO}_2$  peak. MR were a separate group. Assessment of glucose control included analysis of fasting venous glucose and insulin (thus the homeostasis model assessment (HOMA)) and HbA1c concentrations. The following additional CVD risk factors were assessed: body composition (skinfold analysis/waist and hip circumferences, BMI and body mass), flow mediated dilation (reactive hyperaemia) as an index of endothelial function, total cholesterol, high and low density lipoproteins, triglycerides and high sensitivity C-reactive protein (hsCRP). CRF level differences in glucose control variables were analysed via ANCOVA (all other variables as covariates), and multiple regression assessed which variables best predicted glucose control variables.

**RESULTS:** Fasting plasma glucose concentration was the only glucose control variable to differ between CRF levels with the MR group having significantly lower concentrations (4.1 mmol/L) than all other CRF levels (low CRF 5.7; medium CRF 5.5; high CRF 5.5 mmol/L). Additionally, MR women were the only group to have a glucose concentration less than 4.9 mmol/L (threshold for CVD risk). CRF was found to be the strongest predictor for glucose concentration. Conversely, body mass, waist circumference and hsCRP were the strongest predictors of insulin concentration and HOMA, whereas CRF had little predictive influence.

**CONCLUSION:** Very high levels of CRF similar to marathon runners may be required to lower glucose concentration in PM-women to levels below the threshold for increased risk of CVD.

Supported by a Heart Research UK grant 2508/06/08

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**2719 Board #113 May 29 2:00 PM - 3:30 PM**  
**Depressive Symptoms Do Not Reduce The Benefits Of Physical Activity On Recurrent Cardiovascular Disease Events**

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(No relationships reported)

**PURPOSE:** To examine prospectively whether depressive symptoms attenuate the benefits recreational physical activity on the risk of recurrent CVD in a population based sample of primary incident MI survivors.

**METHODS:** Cases (1063 men, 430 women) 35-69 yrs old were recruited from 12 of 15 Western New York hospitals and completed an interviewer-administered survey and clinic exam (mean 4 months post-MI). Recreational physical activity (RPA) was assessed using the Stanford 7-day physical activity recall and depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D). A score of  $\geq 16$  on the CES-D was used to define depression. Recurrent events (RE) included non-fatal and fatal CVD (ICD9 390-450) and revascularizations (ICD9 36-39). Age and sex-adjusted Cox regression models were used to examine the effect of depression on the association between RPA and RE.

**RESULTS:** During a mean follow-up period of 2.4 yrs a total of 314 RE occurred. Depression was associated with an increased risk of recurrent events (HR 1.34 95%CI 1.02-1.75), whereas RPA had a protective effect on RE (HR 0.63 95%CI 0.50-0.79). The protective effect of RPA on RE remained after adjustment for age and sex (HR 0.66 95% CI: 0.52-0.83). Further adjustment for the presence of depressive symptoms did not change the association between RPA and RE (HR = 0.66, 95% CI: 0.52-0.83).

**CONCLUSIONS:** Depressive symptoms did not reduce the protective effect of RPA on recurrent events in this population-based prospective study of MI survivors. These findings have important implications for MI survivors since depression is common in CHD patients.

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**2720 Board #114 May 29 2:00 PM - 3:30 PM**  
**The Risk For Cardiometabolic Disease In An Ethnically Diverse Sample Of Canadians**

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(No relationships reported)

There is a growing body of evidence suggesting that there are ethnic based differences in the risk for cardiometabolic disease. In fact, ethnic-specific guidelines have recently been advocated for waist circumference and BMI to reflect the increased risk in varied ethnic groups for diabetes, the metabolic syndrome, and cardiovascular disease.

**PURPOSE:** To evaluate the risk for cardiometabolic disease in an ethnically diverse cohort of Canadians.

**METHODS:** We assessed self-report physical activity and direct measures of height, weight, blood pressure, lipid profile, blood glucose, and waist girth. The study sample consisted of Caucasian (n = 3563), Asian (n = 447), First Nations/Aboriginal (n = 287), South Asian (n = 223), South or Central American (n = 28) and Other (n = 105).

**RESULTS:** As a population there was a high prevalence of physical inactivity (45%), overweight and obesity (via BMI; 63%), central obesity (via waist girth; 35%), and hypertension (21%). There were clear ethnicity-based differences in the prevalence of risk factors for cardiometabolic disease. Persons of Aboriginal descent were at the greatest risk for central obesity (67%), abnormal blood glucose levels (17%), diabetes (8%) and overweight and obesity (79%). Moreover, they had the highest overall risk score with 69% being classified as moderate to high risk for cardiometabolic disease. Caucasians were at the greatest risk for elevated blood pressure (26%) and hypertension (22%). Individuals of Asian descent demonstrated the greatest risk for physical inactivity (54%). South Asian people demonstrated the greatest risk of high total cholesterol to HDL ratios (52%) and elevated total cholesterol levels (44%). South or Central Americans were at the greatest risk for low HDL levels (37%) and high total cholesterol (18%). With respect to CVD risk, Aboriginal, Asian, and South Asians individuals generally exhibited abnormalities in glucose, blood pressure, and dyslipidemia at a BMI values that were below a BMI of 30.

**CONCLUSIONS:** Within this population, significant differences in health risk indicators exist between ethnic groups. Persons of Aboriginal descent appear to be particularly susceptible to increased risk.

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**2721 Board #115 May 29 2:00 PM - 3:30 PM**

**Objectively Measured Physical Activity And Perception Of Physical Abilities Among Youth With And Without Diabetes**

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**PURPOSE:** To describe physical activity (PA) of youth with and without diabetes and to examine the relationship between PA and perception of physical abilities in a sample of African-American, Hispanic, and non-Hispanic white youth participating in the SEARCH Case-Control Study.

**METHODS:** Diabetes cases and non-diabetic controls were recruited from healthcare providers. Complete data were available on 310 youth with type 1 diabetes, 50 youth with type 2 diabetes, and 128 non-diabetic control youth aged 10-20 years. Pedometers were used to objectively measure PA over 7 days. Participants with  $\geq 3$  valid days (1000 to 29999 steps) were included; the mean number of steps per day was calculated for each participant. Youth reported their physical abilities using the Self-Description Questionnaire (SDQ). This scale assessed self-concept regarding abilities in performing physical activities, sports, and games. Scores from the SDQ were standardized to population T-scores. Spearman correlation coefficients were calculated.

**RESULTS:** Mean steps per day were  $6944 \pm 3466$  in the total population and  $7332 \pm 3376$ ,  $4869 \pm 3229$  and  $6813 \pm 3497$  for type 1, type 2 and control youth, respectively. Males had more steps per day than females ( $7886 \pm 3522$  vs.  $6201 \pm 3239$ ). Non-Hispanic white youth had more steps per day ( $7356 \pm 3372$ ) than Hispanic ( $6942 \pm 3854$ ) and African-American youth ( $5481 \pm 3212$ ). Positive correlations were found between PA and physical abilities in the crude analyses ( $r=0.30$ ,  $p < .001$ ;  $r=0.31$ ,  $p=.03$ ;  $r=0.31$ ,  $p < .001$ ) for type 1, type 2, and control youth, respectively. After adjustment for sex, race/ethnicity, socioeconomic status, insulin use, diabetes duration, BMI z-score, and comorbidities, correlations remained significant for type 1 ( $r=0.28$ ,  $p < .001$ ) and control youth ( $r=0.23$ ,  $p=.01$ ). For type 2 youth the correlation was slightly attenuated but lost statistical significance due to limited power ( $r=0.28$ ,  $p=.09$ ).

**CONCLUSION:** Levels of PA were well below the recommended step counts of 12000 and 15000 steps per day for females and males, respectively, in this population of youth with and without diabetes. Youth with type 1 diabetes had higher PA levels than youth with type 2 diabetes and control youth. There is a moderate, positive correlation between PA and perception of physical abilities.

Funded by NIDDK Grant R01 DK59184.

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**2722 Board #116 May 29 2:00 PM - 3:30 PM**

**Leisure-time Physical Activity And Vascular Endothelial Function In Adolescents**

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(No relationships reported)

Exercise training improves vascular endothelial function in high-risk adolescents. The effect of leisure-time physical activity on endothelial function in healthy adolescents is unknown.

**PURPOSE:** To study the association of leisure-time physical activity and brachial artery endothelial function in adolescents.

**METHODS:** Physical activity habits and brachial artery flow-mediated endothelial function were assessed in 483 13-year-old adolescents participating in an atherosclerosis prevention study (STRIP). Endothelial function was examined with ultrasound and physical activity with a validated self-administered questionnaire. A leisure-time physical activity index (PAI; MET h/wk) was calculated by multiplying weekly mean leisure-time exercise intensity, duration and frequency [mean $\pm$ SD PAI: boys  $31.2 \pm 23.0$  MET h/wk, girls  $24.0 \pm 20.9$  MET h/wk; P(gender difference) $<0.001$ ]. Maximum flow-mediated dilatation (FMDmax; %) and total FMD response [the area under the dilatation curve 40-180 sec after hyperemia (FMDauc; % x s)], were used as measures of endothelial function.

**RESULTS:** In boys, FMDmax and FMDauc were directly associated with PAI in regression analyses adjusted for brachial artery diameter (FMDmax:  $P=0.020$ , FMDauc:  $P=0.0055$ ). The associations remained significant also after further adjustments for BMI, HDL-cholesterol, LDL-cholesterol, triglycerides, hs-C-reactive protein and systolic blood pressure. The similar association was not found in girls. A difference of  $\sim 50$  MET h/wk corresponding to  $\sim 10$  h of moderate intensity activity weekly between sedentary and active boys was associated with  $\sim 1$  % unit difference in FMDmax.

**CONCLUSIONS:** Leisure-time physical activity is directly associated with brachial artery FMD responses in 13-year-old boys. This confirms that physical activity beneficially influences endothelial function in healthy male adolescents. Lack of association in girls may be explained by their overall lower physical activity level. Indeed, girls and boys having the same leisure-time physical activity level have an identical FMDmax response.

Supported by the Finnish Ministry of Education, the Finnish Cultural Foundation and the Juho Vainio Foundation.

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**2723 Board #117 May 29 2:00 PM - 3:30 PM**

**Associations Between Objectively-measured Physical Activity And Clustered Cvd Risk In Adolescents: Nhanes 2003-**

2006

Felipe Lobelo<sup>1</sup>, Russell R. Pate, FACSM<sup>2</sup>, Angela D. Liese<sup>2</sup>, Rebecca Meriwether<sup>2</sup>, William Riner<sup>2</sup>, Michael Pratt, FACSM<sup>3</sup>. <sup>1</sup>EIS Officer - Centers for Disease Control and Prevention, Atlanta, GA. <sup>2</sup>University of South Carolina, Columbia, SC. <sup>3</sup>Centers for Disease Control and Prevention, Atlanta, GA.  
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Cardiovascular disease (CVD) is accelerated by the clustering of CVD risk factors/metabolic syndrome, which in adults is strongly associated to physical activity (PA). However, this association has not been well studied in adolescents.

**PURPOSE:** To assess the association between clustered CVD risk and objectively-measured PA in a population-based sample of U.S. adolescents.

**METHODS:** Complete data on PA and CVD risk were available for 983 adolescents (mean age  $15.3 \pm 2.3$  years; 47.4% female) in the 2003-2004 and 2005-2006 NHANES cohorts. PA was measured with an ActiGraph AM-7164 accelerometer. At least 10 hours/day on 4 days were required for a valid record. Mean mins/day of moderate-to-vigorous physical activity (MVPA) and the proportion achieving the recommended 60 mins/day were calculated. A standardized CVD clustering score (MetSyn) relative to the International Diabetes Federation pediatric metabolic syndrome definition was constructed using age group- and gender-standardized values for waist circumference (WC), mean arterial blood pressure, fasting glucose, HDL-cholesterol and triglycerides. Positive scores indicate higher CVD risk. A second score was calculated without WC (MetSyn-WC) to assess the confounding effect of adiposity. Regression analyses were used to assess the associations between PA (independent variable) and MetSyn (dependent variable) while adjusting for monitor wear time, age, gender, race/ethnicity and socio-economic status as well as WC.

**RESULTS:** MVPA quintiles (Q) were <10, 11-21, 22-32, 33-52 and 53+ mins. MetSyn ranged from -3.04 to 1.87, with a mean of -1.37 (0.63). After adjusting for socio-demographic factors, a negative association was found between MetSyn and MVPA quintiles ( $p=0.009$ ) but it weakened after further adjustment by WC ( $p=0.06$ ). The mean MetSyn value for the first Q of MVPA differed from all the other Q ( $p<0.04$ ). Lower MetSyn and MetSyn-WC values were found for youth meeting vs. not meeting the MVPA recommendation ( $p=0.02$  and  $p=0.03$ , respectively).

**CONCLUSIONS:** A negative graded association was found between MVPA and MetSyn among U.S. adolescents. The association weakened after further adjustment by WC. MetSyn is lower in adolescents meeting the MVPA recommendations but those accumulating at least 11 mins of MVPA/day already exhibit lower MetSyn values.

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**2724 Board #118 May 29 2:00 PM - 3:30 PM**

**Assessing Quality-of-life, Roles, And Bmi In Type 2 Diabetes Patients Participating In Supervised Exercise**

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Nearly two-thirds of American adults are overweight (~127 million) or obese (~69 million); type 2 diabetes and obesity are often comorbid. West Virginia ranks third in obesity (~30% rate). Type 2 diabetes may adversely affect exercise participation and quality-of-life (QOL) in patients who self-report exercise.

**PURPOSE:** To examine the relationship of demographics, exercise, QOL and roles in type 2 diabetes patients engaged in structured exercise.

**METHODS:** Volunteers were recruited through the Human Performance Lab (HPL) at WVU (Morgantown, WV). Participants completed several inventories: Impact-of-Weight-on-Quality-of-Life-Lite (IWQOL-Lite) Scale; Role Checklist (RC), and; Satisfaction-with-Life Scale (SLS). We hypothesized that participation in structured exercise enhances roles and improves QOL measures in patients with type 2 diabetes.

**RESULTS:** No statistical inventory differences were found between supervised and unsupervised groups; thus, exercisers were combined into one group ( $n=37$ ) for additional analysis. Mean BMI for the combined group was  $31.9 \pm 7.9$ , indicating these patients were obese. Comparison between two independent sample means indicated the combined exercise group had higher IWQOL-Lite scores ( $p<0.05$ ) and lower BMI ( $p<0.05$ ) versus a non-exercise reference sample. BMI was negatively correlated to QOL instrument scales of Physical Function ( $r=-0.67$ ,  $p<0.001$ ); Self-Esteem ( $r=-0.59$ ,  $p<0.001$ ); Sexual Life ( $r=-0.62$ ,  $p<0.001$ ); Public Distress ( $r=-0.73$ ,  $p<0.001$ ); Work ( $r=-0.62$ ,  $p<0.001$ ), and; Total Score ( $r=-0.64$ ,  $p<0.001$ ). Three negative correlations existed between gender and these SLS areas: ideal life ( $r=-0.37$ ,  $p=0.03$ ); excellence of life conditions ( $r=-0.34$ ,  $p=0.04$ ), and; acquisition of important things in life ( $r=-0.33$ ,  $p=0.05$ ).

**CONCLUSIONS:** QOL measures were not different between self-reported and supervised exercisers. Compared to a type 2 diabetes reference sample, combined exercisers had higher QOL scores and lower BMI, indicating exercise had a beneficial effect on QOL and BMI regardless of exercise condition. QOL scores and BMI demonstrated a similar inverse relationship in both exercise and non-exercise conditions. Future research should examine the magnitude of exercise training effects upon QOL, SLS, and RC scores in patients with type 2 diabetes.

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**F-29 Free Communication/Poster - Physical Activity and Public Health: Youth**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**2725 Board #119 May 29 3:30 PM - 5:00 PM**

**Patterns Of Physical Activity In Less, Moderately And Highly Active Children**

Harriet Koorts<sup>1</sup>, Calum Mattocks<sup>1</sup>, Andy Ness<sup>2</sup>, Kevin Deere<sup>2</sup>, Steven N. Blair, FACSM<sup>3</sup>, Chris Riddoch<sup>1</sup>. <sup>1</sup>University of Bath, Bath, United Kingdom. <sup>2</sup>University of Bristol, Bristol, United Kingdom. <sup>3</sup>University of South Carolina, Columbia, SC.

(No relationships reported)

Little is known about how the types and patterns of physical activity vary between children of different activity levels. Knowing how more active children achieve their higher activity levels can inform the design of interventions to promote physical activity.

**PURPOSE:** The aim of this study was to assess how children of different activity levels differ in the types of physical activities they participate in, and the time of day they do this on school and non school days.

**METHODS:** A cross-sectional analysis using 3800 children (1794 males, 2006 females) participating in the Avon Longitudinal Study of Parents and Children (ALSPAC). The mean (SD) age of the children was 13.8 (0.19) years. Physical Activity was measured using an accelerometer, worn over a 7-day period. Children were categorised into gender-specific tertiles of activity (T1 = less active, T2 = moderately active, T3 = highly active), using both counts/min and min/d of moderate to vigorous activity (MVPA), using a cut-point of 3600 counts/min. Time of day and type of activity were assessed using an adapted version of the Previous Day Physical Activity Recall questionnaire (PDPAR). Activities were grouped as; 'housework', 'outside activities', 'TV', 'active job', 'sports' and 'travel'. The proportion of activity occasions within the tertiles, were analysed using the Chi squared test. Results for counts/min and MVPA were similar.

**RESULTS:** Based on counts/min, differences were seen for sports participation; T1 (26%) T2 (33.4%) T3 (40.5%) ( $X^2 = 185.79$ ,  $p<0.001$ ). These differences were observed on school days T1 (26.4%) T2 (33.7%) T3 (39.9%) ( $X^2 = 117.49$ ,  $p<0.001$ ), and non school days T1 (25.6%) T2 (32.5%) T3 (41.9%) ( $X^2 = 54.66$ ,  $p<0.001$ ). Overall, the least active children engaged in TV activities more often than moderately and highly active children, T1 (35.0%) T2 (33.1%) T3 (31.9%) ( $X^2 = 17.32$ ,  $p<0.001$ ). These differences were not observed on



school days, T1 (34.5%) T2 (32.8%) T3 (32.7%) ( $\chi^2 = 3.96$ ,  $p > 0.05$ ) or non school days alone, T1 (34.3%) T2 (33.2%) T3 (32.4%) ( $\chi^2 = 2.46$ ,  $p > 0.05$ ). The remaining activity behaviours showed no differences.

**CONCLUSIONS:** Sports participation and TV activities vary according to differences in children's total physical activity levels. These results have implications for the design of physical activity interventions for children.

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**2726 Board #120 May 29 3:30 PM - 5:00 PM**  
**Energy Cost Of Physical Activity In Children**

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The estimated energy imbalance associated with childhood obesity is ~100 kcal/day<sup>-1</sup>. However, population-based physical activity interventions capable of resolving this imbalance have yet to be developed.

**PURPOSE:** The purpose of this study was to directly measure the energy cost of selected children's games that could be incorporated into a school-based intervention to address the energy imbalance.

**METHODS:** Third grade children (15 boys, 13 girls) were recruited from elementary schools to complete games selected on the basis of intensity, safety and enjoyment. We recruited equal samples of normal weight (BMI < 85<sup>th</sup> %ile) and overweight (BMI ≥ 85<sup>th</sup> %ile) children. Following a 3-hour fast, resting metabolic rate (RMR) was assessed using a hand-held O<sub>2</sub> analyzer after which they ate a standardized 150 kcal snack. All children performed one treadmill activity (2.5 mph @ 0% grade) and up to 10 randomly chosen children's games for 6 min with 3-min rest periods. The games were adapted from the CATCH PE program and the investigator's previous experience. Energy expenditure (EE) was measured with a portable respiratory gas exchange system and RMR was subtracted to determine physical activity EE (PAEE). Enjoyment of each game was assessed on a 9-point Likert scale using the Facial Affective Scale (FAS).

**RESULTS:** All the activities were classified as moderate to vigorous intensity ( $X \pm SD = 5.0 \pm 1.3$  METs, AEE =  $4.1 \pm 1.2$  kcal/min<sup>-1</sup>, respectively). The children judged most games as enjoyable with an average FAS score of  $7.3 \pm 2.0$  and PAEE was not significantly associated with FAS ( $p > 0.05$ ). Boys had a higher PAEE than girls ( $4.14 \pm 1.20$  vs.  $4.04 \pm 1.30$  kcal/min<sup>-1</sup>, respectively) and overweight children had a higher PAEE than children with a normal BMI ( $4.43 \pm 1.08$  vs.  $3.85 \pm 1.30$  kcal/min<sup>-1</sup>) ( $p < 0.0001$ ).

**CONCLUSIONS:** The energy expenditure of the measured activities differed between boys and girls and between normal weight and overweight children and was not related to enjoyment. However, all activities elicited a PAEE of at least 100 kcal in a 30-min period regardless of gender, weight status or enjoyment of the game. All 30 selected children's games measured in this study could be effectively used in a physical activity intervention designed to reduce the energy gap associated with childhood obesity.

Supported by: Boston Children's Hospital

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**2727 Board #121 May 29 3:30 PM - 5:00 PM**  
**Tracking Of Physical Activity Patterns From Late Childhood To Young Adulthood**

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Physical activity is a critical component of a healthy lifestyle throughout the lifespan and has been shown to be positively related to a variety of health outcomes. Despite these benefits and the speculation that activity levels during childhood tracks into adulthood, little is known about tracking of physical activity patterns due to the paucity of prospective data linking childhood and adult physical activity.

**PURPOSE:** To investigate trends and tracking of physical activity from late childhood into young adulthood.

**METHODS:** Between 1991 and 1993, 253 subjects (chronologically aged (CA) 8 to 15 years) were recruited into a mixed-longitudinal study examining the role of physical activity (PA) on body composition development during childhood and adolescence. In 2007, 169 participants remained in the study (CA 23 to 30 years). Biological age (BA) was calculated as years from peak height velocity. PA was assessed using the PAQ C/A/AD questionnaires. For this analysis subjects' required measurements in childhood and adulthood. PA was correlated at three, six, nine, and 12 year intervals. Paired-samples t-tests were used to find differences in PA levels between time points.

**RESULTS:** Physical activity was found to decrease ( $p < 0.05$ ) after 10 years of age reaching a plateau between 15 and 17 years ( $p > 0.05$ ). When aligned by BA PA peaked prior to PHV and declined thereafter ( $p < 0.05$ ), before reaching a plateau at a BA of +4 years. Males were more active than females between the ages of 10 and 16 years ( $p < 0.05$ ); however, no PA differences between genders were found at any BA ( $p > 0.05$ ). Interage CA correlations ranged from  $r = 0.31$ - $0.69$ ,  $0.17$ - $0.67$ ,  $-0.04$ - $0.5$  and  $-0.21$ - $0.4$  at three, six-, nine- and 12-year intervals, respectively. Correlations of BA intervals ranged from  $r = 0.05$ - $0.81$  ( $p < 0.05$ ) over the same interval lengths.

**CONCLUSION:** PA decreases with increasing CA and BA age, plateauing at 16 and 18 years (4 years after PHV) respectively for males and females. Tracking of PA was low to moderate and decreased in sensitivity with increasing interval time. These results suggest that high childhood PA does not predict high adult PA. Maintenance of PA throughout childhood, adolescence and young adulthood may be most beneficial for adult PA levels and positive health outcomes.

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**2728 Board #122 May 29 3:30 PM - 5:00 PM**  
**Effect Of Adult Leader Participation On Physical Activity In Children**

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(No relationships reported)

Participation in physically active games is one way to increase energy expenditure in children. However, researchers have not determined whether adult leader participation (LP) in games can impact children's physical activity (PA) levels.

**PURPOSE:** This study examined the effects of LP or No LP on sedentary, moderate-to-vigorous PA (MVPA), and vigorous PA (VPA) levels in children during active games.

**METHODS:** Children ( $n = 14$ ) in grades 4-6 (Male = 42.8%, White = 50%, Overweight/Obese = 42.8%) participated in four active games (adopted from the evidence-based Coordinated Approach to Child Health) across two consecutive days. Each day, children participated in two 16-minute games. Children received verbal encouragement every minute from an adult leader. Each game was divided into four minute intervals alternating between LP or No LP. LP was counter-balanced across two days. Each child wore an Actigraph GT1M accelerometer. Time spent in MVPA, VPA, and sedentary behavior was determined by Freedson's MET prediction equation. Body fat was measured using Dual-Energy X-Ray Absorptiometry and children were categorized as normal weight (< 85<sup>th</sup> percentile) or overweight/obese ( $\geq 85^{\text{th}}$  percentile) according to body fat percentile curves adjusted for age and gender. Data were analyzed using a condition (LP or No LP) by game repeated-measures ANCOVA.

**RESULTS:** Children participated in MVPA 52.3% of game time across all games. There were no differences in MVPA, VPA and sedentary behavior by gender, weight status, or ethnicity ( $p > 0.05$ ). LP and No LP conditions were not different for MVPA ( $F = 0.76$ ,  $p = 0.40$ ), VPA ( $F = 0.42$ ,  $p = 0.53$ ), or sedentary behavior ( $F = 0.30$ ,  $p = 0.59$ ).

**CONCLUSIONS:** These results show no effect of LP on PA in children during active games. It may be that LP could not increase PA because the children were already

exhibiting high levels of MVPA. Alternatively, the verbal encouragement provided under both conditions (LP and No LP) may have negated the effect of LP. Future studies should examine whether LP can increase the amount of PA in children during other physical activity contexts, such as free-play.

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**2729 Board #123 May 29 3:30 PM - 5:00 PM**  
**Compliance With 30,60 And 90 Minutes Of Moderate To Vigorous Physical Activities**

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(No relationships reported)

Along the last years several recommendations for physical activity (PA) in children and youth have been proposed, and current recommendations call for at least 60 min-d-1 of moderate-to-vigorous physical activities (MVPA), daily or nearly every days of the week, as part of their lifestyle. Recently Andersen et al. (2006) suggested that current guidelines of at least 1 h/day of PA of at least moderate intensity could be an underestimation of the activity necessary to prevent clustering of risk factors in younger children, recommending that 90 min of daily activity might be necessary for children to prevent insulin resistance, which seems to be the central feature for clustering of cardiovascular disease risk factors.

**PURPOSE:** The aim of this study was to compare the fulfillment between boys and girls of 30, 60 and 90 minutes of MVPA during almost every days of the week.

**METHODS:** A random sample of 210 (12-18 years) boys (n, 80; age,  $15.11 \pm 1.63$ ; weight,  $62.4 \pm 14.3$ ; height,  $168.6 \pm 11.1$ ; BMI,  $21.7 \pm 3.6$ ) and girls (n, 130; age,  $14.8 \pm 1.8$ ; weight,  $53.7 \pm 9.5$ ; height,  $159.1 \pm 6.6$ ; BMI,  $21.2 \pm 3.3$ ) was evaluated. BMI was calculated and PA levels were evaluated with accelerometers (GT1M, MTI Actigraphs). The activity monitor was used as instrument to objectively measure daily PA. The study was conducted during at least 7 consecutive days.

**RESULTS:** Our results reveal that there's a difference between boys and girls in the compliance of 60 and 90MVPA ( $p < 0.05$ ), but not for 30MVPA. When comparing results in the different "recommendations" (30,60 and 90 MVPA) we can observe that 80% and 70% (boys and girls) accomplish for more than 5 days/week (d.w-1) of 30MVPA, but for the current guidelines (60 min.) we detect that 52 and 23% reach that recommendation for more than 5 d.w-1, and 30 and 61% does less than 3 d.w-1 of MVPA. For 90MVPA only 22.9 and 9.6% of boys and girls do more than 5 d.w-1, but 84 and 56% of girls and boys don't achieve 90MVPA in less than 3 d.w-1.

**CONCLUSIONS:** The prevalence of youth meeting the "guidelines" of 90MVPA for at least 5 d.w-1 is very small, although when comparing for the current recommendations of 60MVPA for at least 5 d.w-1 youth from this sample seems to achieve results similar to other studies, although for girls the percentage achieving for that recommendation is quite small.

Supported from MCTES/FCT: Project PTDC/DES-72424-2006

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**2730 Board #124 May 29 3:30 PM - 5:00 PM**  
**Spartners For Heart Health: Baseline Cardiovascular Disease Risk Factors Compared To Pediatric Recommendations**

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(No relationships reported)

Currently there is concern about the cardiovascular disease (CVD) risk factor profiles of children, which is related to poor diet quality and a sedentary lifestyle. In an effort to maintain or promote a desirable CVD risk factor status, a multi-level school-based intervention, (S)Partners for Heart Health, was developed to promote physical activity and healthy nutrition in 5th grade students.

**PURPOSE:** To compare baseline CVD risk factors with national pediatric recommendations in 5th grade students participating in the (S)Partners for Heart Health pilot study.

**METHODS:** Participants included 146 (60 M, 86 F,  $10.6 \pm 0.4$  yrs) fifth grade students from three rural schools in central Michigan. CVD risk factors were assessed prior to initiating the intervention. Height and weight were measured and used to calculate BMI ( $\text{kg}/\text{m}^2$ ). Percent body fat (%BF) was measured by bioelectrical impedance. Blood samples were obtained via fingerstick in the non-fasted state and assayed for total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and C-reactive protein (CRP). Resting blood pressure (BP) was measured in accordance with standard procedures. Maximal oxygen consumption ( $\text{VO}_{2\text{max}}$ ) was estimated from performance on the PACER test.

**RESULTS:** The mean BMI ( $19.9 \pm 4.3 \text{ kg}/\text{m}^2$ ) approximated the 65th percentile, and 17.9% were overweight and 20.7% were obese. The estimated %BF was  $23.6 \pm 8.6$  and 28% were overfat using FITNESSGRAM standards. The mean  $\pm$  SD and % not meeting pediatric recommendations, respectively, of CVD risk factors were as follows: TC:  $149.1 \pm 25.9 \text{ mg}/\text{dL}$ , 20.3%; HDL:  $45 \pm 10.4 \text{ mg}/\text{dL}$ , 26.5%; TC:HDL ratio:  $3.5 \pm 1.2$ , 38.5%; CRP:  $1.5 \pm 3.0 \text{ mg}/\text{L}$ , 11.1% (adult standards), systolic BP:  $102 \pm 9.4$ , diastolic BP:  $67 \pm 6.9$ , 6.9%. The estimated  $\text{VO}_{2\text{max}}$  was  $44.8 \pm 4.6 \text{ ml}/\text{kg}/\text{min}$  and 48% of males and 35% of females did not meet FITNESSGRAM recommendations.

**CONCLUSIONS:** The baseline results from this school-based intervention in mid-Michigan indicate that childhood overweight and obesity (39% of sample) and other CVD risk factors are a public health issue. These data justify the need for effective school-based CVD prevention interventions that promote physical activity, healthy nutrition, and cardiovascular health in children.

Supported by Blue Cross Blue Shield of Michigan Foundation

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**2731 Board #125 May 29 3:30 PM - 5:00 PM**  
**Healthy + Active = Forever Fit, Year One**

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**PURPOSE:** The purpose of this study was to reform physical education curriculum and instructional strategies to integrate the tenets of social cognitive theory as a means of modifying physical activity behaviors. This study established baseline measures of physical fitness, physical activity engagement, self-efficacy and intent to be physically active among 1600 students enrolled in high school physical education and to quantify the effect of reformed curricula. Intact class cohorts were assigned to health education (control) and physical education (treatment) groups.

**METHODS:** Pre/post measures were collected using Fitnessgram, 3-day physical activity recall (Weston et al., 2002), and surveys. Systematic observations of physical education classes, heart rate, and curriculum evaluation data were also collected.

**RESULTS:** Participants specifically identified physical education teachers as reasons for the increases in positive beliefs about physical activity. Minutes in MVPA during physical education rose from 19 to 27 minutes. Individual's intent and belief in the importance of physical activity was significantly higher ( $p < .01$ ) than the control group.

**CONCLUSIONS:** Reformed physical education curricula can change physical activity behaviors through attitudinal and physiological proxies.

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**2732 Board #126 May 29 3:30 PM - 5:00 PM**  
**The Effectiveness Of A School Wide Intervention To Change Physical Activity Levels In High School Students**

Koren L. Fisher<sup>1</sup>, Sarah N. Oosman<sup>1</sup>, Karen E. Chad<sup>1</sup>, M Louise Humbert<sup>1</sup>, Cathy Kryzanowski<sup>2</sup>. <sup>1</sup>University of Saskatchewan, Saskatoon, SK, Canada. <sup>2</sup>Saskatchewan in motion, Regina, SK, Canada.  
(No relationships reported)

Saskatchewan *in motion* is a partner-based provincial initiative aimed at increasing physical activity for health, social, environmental and economic benefits. Given the rise in the prevalence in overweight and obesity among youth, engaging schools in this initiative has been an ongoing priority. An *in motion* high school is one that values and actively promotes the health benefits of physical activity and supports opportunities for students and staff to be physically active on a regular basis. Schools that adopt the *in motion* strategy commit to providing a minimum of 30 minutes of PA every day for every student purpose: To evaluate the impact of a 5-month school-wide PA intervention among high school students.

**METHODS:** A total of 339 students in grades 9-12 from 2 urban and 2 rural schools in a prairie province in Canada participated in the study. One urban (n=124) and one rural school (n=46) participated in the *in motion* initiative while the remaining urban (n=140) and rural (n=29) schools did not. Self-reported PA was assessed with the IPAQ and data were collected at the beginning of the initiative (January) and the end of the school year (May). Compliance to the *in motion* initiative was assessed using teacher records and logs.

**RESULTS:** There were no significant differences in PA scores from Time 1 to Time 2 in the urban *in motion* school. PA scores at the rural *in motion* school increased significantly from Time 1 to Time 2 (4,600.6 vs. 7,661. MET min/wk; p<.01). Among rural boys, participation in vigorous PA significantly increased (3,354.7 vs. 5,616.0 MET min/wk; p<.01), while among rural girls participation in moderate PA (821.5 vs. 1,655.8 MET min/wk; p<.05) and walking (1,000.2 vs. 2,021.7 MET min/wk; p<.05) was significantly higher.

**CONCLUSION:** The results suggest that the *in motion* initiative was effective at increasing PA levels among rural high school students. While boys increased their PA through vigorous activities, girls tended to increase their PA through low to moderate PA. Future research exploring gender differences and understanding more fully why such initiatives are more effective in rural vs. urban schools will enable programmers to further tailor such health promotion initiatives for high school students.

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**2733 Board #127 May 29 3:30 PM - 5:00 PM**  
**The Effectiveness Of In Motion Schools On Physical Activity Levels Of Elementary School Age Children**

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(No relationships reported)

Physical activity (PA) is critical for attaining optimal health, social, environmental and economic benefits. It has been suggested that forming partnerships with schools, families, communities and workplaces is critical to enhancing the health of children. Saskatchewan in motion is a province-wide initiative which has built such alliances in its effort to increase PA for individuals of all ages, including child and youth populations. Schools that adopt the *in motion* strategy are committed to providing a minimum of 30 minutes of PA every day for every student.

**PURPOSE:** To examine the impact of the *in motion* schools initiative on PA levels of students.

**METHODS:** Five schools within the province of Saskatchewan, Canada participated in the study, which included a total of 228 students in grades 4, 6, and 8. One urban (n=72) and two rural schools (n=50) participated in the *in motion* initiative while the remaining urban (n=53) and rural (n=53) schools served as the comparison group. The PAQ-C was used to assess self-reported PA and data were collected at the beginning (September) and the end (May) of the school year. *In motion* schools implemented the 30-minute PA initiative following the first data collection while non-*in motion* schools did not change their regular PA regimes. Compliance to the *in motion* initiative was assessed using teacher records and logs.

**RESULTS:** Overall, PA scores increased among students in *in motion* schools (p<.05) but remained unchanged among those in non-*in motion* schools. When stratified by gender, the increase in PA scores in the *in motion* classrooms was significant for males (p<.05) but not females. There were no differences in PA scores between urban and rural schools in either the *in motion* or non-*in motion* classrooms.

**CONCLUSION:** The results suggest that the *in motion* initiative was effective at increasing PA levels among students, regardless of whether they were enrolled in a rural or urban *in motion* school. However, further research is needed to examine why the *in motion* intervention was more effective in engaging male students in PA and to further identify potential barriers to engaging female youth in PA. :

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**2734 Board #128 May 29 3:30 PM - 5:00 PM**  
**The Effects Of Community Free Swimming On Engagement And Moderate-to-vigorous Physical Activity In Young People**

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( A. Pringle, This research was undertaken as part of a larger scale evaluation of community physical activity interventions Supported by funding from the Department of Health, Sport England and Natural England, Contracted Research.)

UK participation rates for moderate-to-vigorous physical activity (MVPA) in young people are low and free swimming has been proposed as an intervention to address inactivity.

**PURPOSE:** To examine the effect of a community-based free swimming (FS) pilot intervention on MVPA in young people (5-17years) in Southwest England.

**METHODS:** FS provided a series of programmed aquatic activities in community venues, including diving, water-based youth clubs and play sessions. Participants also received a free swim pass for casual swimming. Health practitioners e.g., General Practitioners and School Nurses could refer inactive young people to FS interventions. After ethical clearance participants completed demographics and MVPA using a validated, population-specific, 7-day self-report. Measurement occurred pre- and post-intervention up to 24 months. Following data cleaning, pre- versus post-intervention median MVPA scores (MET-minutes/week) were calculated. Using UK guidelines, participants were allocated to MVPA categories (sedentary-lightly-moderately-highly active). Cross-tabulation established MVPA change in three categories (reversal, stability and progression).

**RESULTS:** FS interventions attracted 1144 participants; 242 completed the evaluation (females 57.4%, N=139). For participants at pre-intervention 136 (56.1%) were not meeting guidelines (females 58%, N=79), compared with 47.1% (N=114) post-intervention (females 52.6%, N=60). At post-intervention, improvement in at least one MVPA category was reported by 64.7% (N=88) (females 59%, N=52), who were sedentary or lightly-active (N=136) at pre-intervention. 52.9% (N=128) met minimum physical activity guidelines post-intervention (females, 61.7% N=79).

**CONCLUSIONS:** FS engaged participants not meeting MVPA guidelines. Comparing pre- with post-intervention MVPA categorization, there was a decrease in the number participants not meeting guidelines. Over half of all participants were meeting physical activity guidelines post-intervention. Despite the limitations of low reporting rates, FS may be an effective community intervention for helping young people increase their MVPA category and for meeting the MVPA guidelines.

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**2735 Board #129 May 29 3:30 PM - 5:00 PM**  
**Derivation Of Aerobic Fitness Cutpoints For Adolescents Using Receiver Operator Characteristic (ROC) Curve Analyses**

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Although it is widely acknowledged that aerobic fitness is important for the health of children and adolescents, there remains no universally accepted classification system. The criterion-referenced standards for aerobic fitness in FITNESSGRAM are widely accepted but these standards were developed using adult risk profiles extrapolated by age.

**PURPOSE:** The purpose of this study was to develop age- and gender-specific aerobic fitness standards in youth using receiver operator characteristic (ROC) curves - a graphical procedure that facilitates consideration of both specificity (Se) and sensitivity (Sp).

**METHODS:** We combined data for aerobic fitness, anthropometrics and metabolic syndrome variables of 8 to 18 year olds across 2 cross-sectional waves of NHANES (1999-2000 and 2001-2002). Age-, gender- and race-specific distributions of aerobic fitness were first developed using LMS statistical procedures to depict the nature of the growth-related distributions (i.e., centiles) for boys and girls. Z-scores derived from the LMS procedure were then used in the ROC analyses to derive the optimal threshold to define risk. The ROC analyses were conducted to determine the aerobic fitness levels that best discriminate between youth with or without metabolic syndrome (defined as having 3 or more risk factors based on age-modified cutpoints of the ATP III criteria).

**RESULTS:** The resulting ROC curves showed large values for area under the curve (AUC) in both boys (87.4) and girls (77.2). The optimal threshold value from the ROC plots yielded good diagnostic characteristics for both boys (Se=86.8%; Sp=82.9%) and girls (Se=90.1; Sp= 61.3%). In girls, the ROC derived health-related standards decline from 40 ml/kg/min to 38 ml/kg/min between 12 to 18 years old. In boys, values increase from approximately 44 ml/kg/min to 49 ml/kg/min. The ROC derived health-related standards are higher (~2-5 ml/kg/min) than the current FITNESSGRAM values but the patterns were consistent.

**CONCLUSIONS:** The generally high AUC values and high Se / Sp values demonstrate that the aerobic fitness criteria have good utility for detecting risk of metabolic syndrome. A unique advantage of the proposed ROC-derived standards is that the sensitivity and specificity are equivalent across the entire adolescent age range.

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**2736 Board #130 May 29 3:30 PM - 5:00 PM**  
**Family Physical Activity As A Predictor Of Aerobic Capacity In Schoolchildren**

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(No relationships reported)

**PURPOSE:** Ascertaining factors that relate to aerobic capacity in youth are important as low values track into adulthood and become a risk factor for cardiovascular disease. The purpose of the present study was to investigate whether the frequency of physical activity (PA) with adult family members was associated with aerobic capacity in schoolchildren.

**METHODS:** After gaining institutional ethics approval and parental consent, 2611 English schoolchildren (1439 boys) aged 10.0-15.9 years were recruited. Weekly PA with adult family members was assessed by questionnaire with the following options: "never" (never), "1 time in a week" (once), "2 or 3 times in a week" (sometimes), "4 or 5 times in a week" (often), or "every day" (daily). Aerobic capacity was assessed by the FITNESSGRAM PACER test and lower PACER "Healthy Fitness Zone" cut-offs were used to categorize participants as either: "unfit" or "fit". Binary logistic regression was used to calculate odds ratios (OR) for being classified as unfit for each category of PA. A  $p < 0.05$  indicated statistical significance (SPSS 16.0 for Windows).

**RESULTS:** The frequencies for activity with adult family members categories were: never, 16.8%; once, 22.1%; sometimes, 33.1% often; 13.3%, and daily, 14.7%. 560 participants (21.4%) were classed as "unfit". Frequency of PA with adult family members was a significant, univariate predictor for fitness classification ( $p < 0.05$ ). Using daily as the reference category (OR = 1), participants were more likely to be classified as "unfit" if they reported being active with adult family members: sometimes (OR = 1.4, 95% CI: 1.1, 1.8), once (OR = 2.0, 95% CI: 1.4, 2.8), or never (OR = 2.8, 95% CI: 2, 4.1).

**CONCLUSION:** The frequency of weekly family PA was significantly associated with aerobic capacity in a dose response manner. Further research into the underlying mechanisms of this association by way of multivariate analyses is warranted. Encouraging family PA may be a potential target for intervention to improve aerobic capacity in youth.

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**2737 Board #131 May 29 3:30 PM - 5:00 PM**  
**School Day Physical Activity Levels In Children: Active Commuting Day Vs Non-active Commuting Day**

Andy J.w. Smith, Jim McKenna, Stephen P. Cobley, Duncan Radley, Jonathan Long. *Leeds Metropolitan University, Leeds, United Kingdom.*  
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(No relationships reported)

Previous studies have found that children who actively commute to school are more active throughout that day. It is not known whether the increase is because more active children actively commute or that the active commute causes an increase in activity.

**PURPOSE:** To compare active vs non-active commuting to school on total daily MVPA within the same children.

**METHODS:** All children in school years 4 (ages 8-9), 8 and 10 within a provincial city in the UK were selected and only those who (a) returned a complete data set and (b) who actively commuted to school between 1-4 days per week were used for the analysis ( $n=1377$ , 674 females). A 7-day diary recorded MVPA (mins) in 5 school day segments; (1) before school; (2) walking/ cycling to/ from school; (3) in school; (4) before/ after school clubs and (5) after school. Paired sample t-tests identified differences between the segments and total daily MVPA on active commuting ( $n=3909$ ) versus non-active commuting school days ( $n= 2976$ ).

**RESULTS:** Total daily MVPA was significantly higher on active commuting days ( $99.4 \pm 86.3$ .) compared to non-active commuting days ( $63.3 \pm 89.9$ ,  $p < 0.001$ .). Even when the contribution of active commuting ( $16.2 \pm 16.6$ ) was removed, significantly more minutes of MVPA were undertaken on an active commuting day compared to a non-active commuting days ( $83.1 \pm 82 \text{ min}$  v  $63.3 \pm 89.9 \text{ min}$ ,  $p < 0.001$ ). This resulted from significantly more minutes of MVPA being accumulated on active commuting days across the remaining four segments of the day; before school ( $4.6 \pm 9.9$  v  $3.04 \pm 8.9$ ,  $p < 0.001$ ), school day ( $31.1 \pm 30.2$  v  $20.7 \pm 31.3$ ,  $p < 0.001$ ), before/ after school clubs ( $9.9 \pm 26.4$  v  $6.36 \pm 27.8$ ,  $p < 0.001$ ), after school ( $37.6 \pm 52.4$  v  $33.3 \pm 66.9$ ,  $p < 0.05$ ).

**CONCLUSION:** Active commuting on school days leads to an increase in MVPA in the school day. When the same children undertake two different commuting behaviours different physical activity patterns result. This supports the notion that active commuting does increase levels of MVPA at other points during the school day.

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**F-30 Free Communication/Poster - Physical Activity Surveillance**

MAY 29, 2009 1:00 PM - 6:00 PM  
ROOM: Hall 4F

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**2738 Board #132 May 29 2:00 PM - 3:30 PM**  
**Addressing The Digital Divide In Web-based, Physical Activity Surveillance**

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Health information and access to it are available in various forms, most recently through the Internet and health related web-sites. The difficulty in accessing and being able to navigate



these resources is commonly referred to as a 'digital divide'. Numerous public health issues are addressed via the Internet including physical activity (PA). The Internet may offer a means of large-scale PA assessment. The web-based, Women's Injury Study (WIN) utilizes the Internet in tracking PA. While validity of self-reported (SR) PA is of utmost importance, it must be verified that access to and use of the website is not compromised by age, computer skills, education, income, or race.

**PURPOSE:** To determine if an individual's level of Internet usage skills and demographic variables are related to percentage of (SR) PA Internet logging.

**METHODS:** For this observational study, 902 women completed weekly, Internet-based PA logs and reported steps accumulated via a pedometer and any musculoskeletal injuries incurred. Variables (age, race, education, income, and computer skills) were analyzed to determine relations to participants reporting  $\geq 75\%$ , or 3 out of 4 weeks, of logging per month. Bivariate correlations and logistic regressions (LR) were used to analyze relations between demographic variables and computer skills for logging adherence.

**RESULTS:** Bivariate correlations, while statistically significant for computer skills, income, and race, individually accounted for less than 4% of variation in Internet logging percentage. Logistic regressions with all variables in the model indicated that age (OR=1.02, 95%CI = 1.01-1.03), computer skills (OR=1.82, 95%CI =1.05-3.17; Good M = 92%  $\pm$ 11; Not-Good M = 86%  $\pm$ 22), and race (OR=.64, 95%CI = .46-.90; White M = 92%  $\pm$ 12; Non-White M = 87%  $\pm$ 16) were related to higher PA logging. Thus, older individuals, those with better computer skills, and Whites were more likely to log their PA behaviors online.

**CONCLUSIONS:** It is important to consider a digital divide when PA behaviors are obtained via the Internet. While correlations are relatively low, collectively, these confounders could influence the ability to have randomly representative samples of PA variables.

*Sponsored by NIH Grant R01 AR052459-01*

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**2739 Board #133 May 29 2:00 PM - 3:30 PM**  
**Physical Activity And Separation From The Military**

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The benefits of physical activity (PA) on physical and psychological health are well known. Data from national sources such as the Behavioral Risk Factor Surveillance System surveys provide important information for surveillance and assessment of trends across time and space. However, these kinds of surveys specifically exclude military personnel; no studies have described PA levels in former military personnel shortly after separation from the military. Nevertheless, military personnel and veterans are a particularly interesting population in which to evaluate PA levels because they represent a large population compelled by the circumstances of military service to maintain higher levels of PA and fitness, who can help us understand why individuals who performed a great deal of physical activity at one point in their lives become inactive or less active later in life.

**PURPOSE:** To examine the association between separation from the military and PA, overall and in subgroups defined by various demographic, service, and health-related characteristics.

**METHODS:** Data on military status and physical activity were collected from 55,021 Millennium Cohort Study participants who completed both a baseline and follow-up questionnaire approximately three years later (follow-up response rate = 71.4%). Of these individuals, approximately 10% separated from the military during the follow-up period. Data on usual duration, frequency, and ability to participate in vigorous PA were collected during the follow-up assessment.

**RESULTS:** Over half (54%) of those who separated from the military reported being inactive in terms of vigorous-intensity PA compared to an inactivity prevalence of about 32% in those still in active duty. Differences by various demographic, service, and health-related characteristics are presented.

**CONCLUSIONS:** The cross-sectional nature of the data precludes a causal interpretation, but strongly suggests a substantial reduction in vigorous PA among those recently separated from the military. If these associations are determined to be causal, interventions aimed at active duty personnel or veterans should be developed to encourage PA maintenance in order to prevent the adverse health consequences associated with inactivity and weight gain.

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**2740 Board #134 May 29 2:00 PM - 3:30 PM**  
**Effect Of Temporal Domain On Self-reported Walking Behaviors In The California Health Interview Survey**

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Surveillance of regular physical activity (PA) in health surveys provides key information for tracking prevalence and trends over time. However, many aspects of question design can influence the validity and reliability of such instruments.

**PURPOSE:** This study assessed the effect of temporal domain on questions concerning walking behavior (i.e., obtaining self-reports of either (a) number of days or (b) number of times walked per week).

**METHODS:** A subsample (n=6332) of the 2005 California Health Interview Survey (CHIS) were asked about leisure and transportation walking behaviors independently, using questions in both temporal domains. Respondents were asked the number of days or times they walked for both leisure and transportation in the past 7 days, and the usual amount of time spent per day or episode. Question order was randomized by temporal domain. Minutes walked per week (mean $\pm$ SE) and adherence to PA guidelines (i.e., minimum 150 min/wk) were assessed overall and by age, race/ethnicity, and education.

**RESULTS:** Minutes of leisure walking per week remained stable across temporal domain (days = 71.4 $\pm$ 2.5 min; times = 73.4 $\pm$ 2.4 min), but transportation walking was divergent (days = 70.4 $\pm$ 3.2 min; times = 52.5 $\pm$ 2.6 min). The pattern of higher reported transportation walking from the days domain was consistent across age, race/ethnicity, and education subgroups, with the exception of respondents with less than a high school education (days = 62.9 $\pm$ 4.7 min; times = 63.2 $\pm$ 4.7 min). Adherence to guidelines for leisure walking was stable across temporal domain (days = 14.9 $\pm$ 0.6%; times = 14.9 $\pm$ 0.6%), but varied as a function of domain for transportation walking (days = 10.4 $\pm$ 0.6%; times = 7.8 $\pm$ 0.5%). Concerning within-respondent effects, a large order effect (i.e., dependent on whether number-of-days versus times was asked first) was observed for reports based on days for transportation walking (days first = 87.8 $\pm$ 2.9 min; times first = 52.3 $\pm$ 2.5 min). In contrast, order effects for transportation walking in the times domain, and for leisure walking (in either domain) were less pronounced.

**CONCLUSION:** Temporal domain of PA questions within the CHIS survey influenced self-reported transportation walking time and resulting adherence estimates, with higher estimates reported based on "days" than "times" questions.

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**2741 Board #135 May 29 2:00 PM - 3:30 PM**  
**Five Year Physical Activity Changes Among Older Men In The Mros Study**

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**PURPOSE:** To describe the change in self-reported physical activity (total, leisure, household, occupational) among men aged 65+ years over a 4-5 year follow-up period, and

to identify socio-demographic and health factors that predict change in physical activity among older men.

**METHODS:** This prospective cohort study enrolled ambulatory community dwelling men (n=5995), 65 yrs or older, at 6 US clinical centers. Using the Physical Activity Scale for the Elderly (PASE), the men self-reported the intensity, frequency, and duration of their leisure, paid and volunteer occupational, and household activities over the past 7 days. Only men with PASE data at baseline and visit 2 were analyzed (n=5161). Linear regression models were built to examine the associations between change in total and subscale PASE scores (outcomes) and socio-demographic and health conditions measured at baseline.

**RESULTS:** The analytic cohort was 90% Caucasian, mean age 73.1 ± 5.5 yrs, median of 3 health conditions, 3% smoked, and 13% lived alone at baseline. Mean follow-up was 4.5 years. Total, leisure, occupational, and household physical activity scores declined (-19.5 ± 68.0, -3.0 ± 37.5, -6.3 ± 34.1, -10.2 ± 44.3, respectively; p<0.01). On average, total PASE scores decreased with age; -16 ± 72 for <70, -16 ± 67 for 70-74, -21 ± 67 for 75-79, and -30 ± 61 for 80+ yr olds. Declines in total physical activity were primarily attributed to occupational changes in 65-70 yr olds and household changes in 70+ yr olds. Participants exhibited a greater decline in physical activity if they lived alone (b=-12.9, SD=2.9), smoked cigarettes (b=-8.8, SD=5.6), or reported poor or very poor health (b=-17.3, SD=8.6) at baseline. Change in PASE scores was negatively associated with number of self-reported health conditions (b=-1.9, SE=0.4, p<0.01); a greater decline in PASE change scores was observed for older men with more health conditions. Significant predictors of change in PASE scores after adjusting for baseline PASE scores were living alone, age, smoking, and overall health status (p<0.01 for all).

**CONCLUSIONS:** All domains of physical activity declined with age especially among older men who reported health conditions, lived alone or smoked. Efforts are needed to identify interventions aimed to reverse the negative physical activity trends in older men.

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**2742 Board #136 May 29 2:00 PM - 3:30 PM**

**Recreational Activity Participation In African American, Hispanic, And White Adults: North Texas Healthy Heart Study**

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**PURPOSE:** To determine if there were disparities in self-reported recreational activity participation in middle-aged and older African American, Hispanic and white adults.

**METHODS:** 200 men and women (75 African American, 75 Hispanic, 50 white) who enrolled in the North Texas Healthy Heart Study (NTHHS) completed the Modifiable Activity Questionnaire (MAQ). The average number of self-reported recreational activities was compared among groups with a one-way ANOVA and a Scheffe post-hoc test. Racial/ethnic differences in percentages of respondents participating in individual activities were compared overall and by sex with a chi-square test.

**RESULTS:** Overall, 89% of all respondents reported participating in at least one recreational activity, with no differences among racial/ethnic groups. However, whites reported a significantly greater number of activities (3.2±2.0) than African Americans (2.2±1.7) or Hispanics (2.1±1.8) (p≤0.001). Walking was the most popular activity reported (65%); jogging was also reported by 21% of respondents. There were no racial/ethnic differences in participation for walking or jogging. More whites reported gardening/yard work (66%) than did Hispanics (25%) or African Americans (24%) (p≤0.05). More whites (18%) and Hispanics (17%) reported swimming than did African Americans (5%) (p≤0.05). More white women reported participation in tai chi, horseback riding and strength training, while more African American women reported participation in volleyball. More white men reported hiking for recreation while more Hispanic men reported stairmaster use. However, these sex-related analyses were limited by a small number of participants in some groups.

**CONCLUSION:** Whites in the NTHHS reported participating in a greater number of recreational activities than African Americans and Hispanics. There was no racial/ethnic difference in the percentage of participants who reported walking, the most popular activity. There were racial/ethnic differences in the percentage of participants in other activities such as gardening and swimming. A larger sample size is needed to fully evaluate other noted trends in recreational activity participation. This information will prove important for activity programming decisions in this population.

Funding by NIH P20 MD001633

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**2743 Board #137 May 29 2:00 PM - 3:30 PM**

**Lifestyle Factors In A Rural Population Of Madeira: Is There A Familial Association**

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The parental influence on health and lifestyle of children and adolescents results from a combination of hereditary factors and the family lifestyle. Despite the genetic contribution to the development of some health problems, the factors related to lifestyle, because they are modifiable, play a vital role in the prevention of disease and risk factors.

**PURPOSE:** The purpose of the study was to examine the association between parents' lifestyle and their children regarding physical activity (PA), consumption habits (food, tobacco and alcohol), overweight, abdominal obesity (AO) and hypertension.

**METHODS:** Participants in this study were 176 students (86 M), 153 mothers aged 42.3 ± 6.1 years and 69 fathers aged 45.3 ± 8.4 years. Subjects were assessed for level of physical activity, food intake, tobacco and alcohol consumption, weight, height, waist circumference and blood pressure. Central obesity in students was classified according to the thresholds by Katzmarzyk et al. (2004), and for their parents, with the IDF (2006) criteria. Obesity was categorized according to Cole et al. (2000), in the children, and WHO (2002), in the adults. Hypertension in children was defined using the Task Force Definition (NHBP, 1996), and in their parents, according to the IDF (2006) definition.

**RESULTS:** Of all young participants, 17.0% were overweight (OW) and 2.3 % were obese (OB), whereas 31.4% of their mothers were OW, 28.1% OB, and 49.2% of fathers were OW and 12.7% OB. The prevalence of hypertension was 70.3% for fathers, 64.5% for mothers and 38.1% for their offsprings. For AO, 23.8% of the fathers had a risk, compared to 52.3% of mothers and 24.0% in the children. There were no risks associated with BMI and hypertension between mothers and fathers or between any of the parents with their children. Conversely, for there was a significant risk between mothers and their children (OR=2.48; CI 95%: 1.16-5.30). As for PA, tobacco and food consumption, there were significant risks between mothers and fathers but not between parents and children.

**CONCLUSIONS:** There were higher associations between both parents' lifestyles than between either parent and their children. For the latter, the only significant risk found was for AO.

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**2744 Board #138 May 29 2:00 PM - 3:30 PM**

**Geographic Distribution Of Physical Activity Patterns In Older Japanese Adults: The Nakanojo Study**

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Previous investigations have shown associations between neighborhood attributes and habitual physical activity. However, studies to date have not dealt with this issue in terms of the geographic distribution of physical activity in the individual. We hypothesized that if the neighboring environment impacted physical activity, the geographic distribution of physical

activity patterns should be similar in both sexes. To test this possibility, we targeted older people. We reasoned that their physical activity would be particularly susceptible to neighborhood characteristics, given that most of them are no longer employed and thus spend much of their time in their immediate locality.

**PURPOSE:** To examine similarities in the geographic distribution of physical activity patterns between older men and women.

**METHODS:** Participants were 582 men (aged 72.9±5.8 years) and 643 women (aged 73.4±6.0 years) residing in Nakanojo (150 km northwest of Tokyo; level terrain, annual rainfall 1.3 m, mean summer and winter daytime temperatures 26 and 4°C, respectively). Activity patterns were assessed using the physical activity questionnaire for elderly Japanese (PAQ-EJ). Grid lines were created by geographic information system (GIS) every 100 m both horizontally and vertically across the study area, and the mean PAQ-EJ score (MPA) was then calculated for male and female participants living within 500-m radius of each grid point. Pearson's correlation coefficients assessed the relationship between men's and women's MPA in a given location, correlation coefficients also being weighted to adjust for differences in the number of participants within each circle.

**RESULTS:** Weak but significant relationships between men's and women's MPA were found both in Pearson's ( $r=0.205$ ,  $p<0.01$ ) and weighted ( $r=0.247$ ,  $p<0.01$ ) correlation coefficients.

**CONCLUSIONS:** These results suggest that location-specific characteristics may affect men and women similarly, neighborhood attributes influencing an older individuals' habitual physical activity level.

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**2745 Board #139 May 29 2:00 PM - 3:30 PM**  
**A Minimum Variance Estimate In The Doubly Labeled Water Technique--Role Of Optimal Sampling**

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(No relationships reported)

The doubly labeled water technique (DLW) is used to estimate free living energy expenditure in a variety of settings.

**PURPOSE:** The purpose of this investigation was to optimize the sampling scheme so as to minimize the estimate variance.

**METHODS:** DLW uses two stable isotopes, oxygen-18 ( $^{18}\text{O}$ ) and deuterium ( $^2\text{H}$ ), which can exist in a water form consumed by a subject. The elimination of the isotopes from the body is characterized by monoexponential functions. The difference in the two elimination rates yields an estimate of  $\text{CO}_2$  production ( $\text{rCO}_2$ ) in the body. The  $\text{CO}_2$  production rate (with fractionation ignored) is given by  $\text{rCO}_2 = (k_0\text{NO} - k\text{DND})/2$  where  $\text{NO}$  and  $\text{ND}$  are the body pool sizes obtained as  $\text{NO} = 1/I\text{O}$   $\text{ND} = 1/I\text{D}$ . The rate constants ( $k$ ) and the intercepts ( $I$ ) are associated with the monoexponential elimination curves as obtained by linear regression when the elimination data are transformed by natural logarithms.

**RESULTS:** Because the rate constant and intercept enter as an inverse product, an error in intercept, can cancel an error in the rate constant if the errors are of an optimal proportion as given by  $\text{DI}_0 = -1/k_0 \text{D}k_0$ . Using Monte Carlo simulation, the optimal proportion can be achieved by an optimal sampling scheme. Compared to a typical sampling scheme of days 2, 5, 9, an optimal sampling scheme of days 9, 13, 17 reduces the variance by half. Schemes beyond days 10,14,18 increase the variance.

**CONCLUSION:** A Monte Carlo simulation demonstrates an optimal sampling scheme exists. This optimal scheme can be used to guide future experimental designs for the DLW.

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**2746 Board #140 May 29 2:00 PM - 3:30 PM**  
**Predicting Free-living Activity Energy Expenditure With Hip And Wrist Accelerometry Versus Doubly Labeled Water**

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While accelerometry-based activity monitors (AMs) have been validated to predict activity energy expenditure (AEE) in controlled lab settings, their use for predicting free-living AEE is not well established.

**PURPOSE:** The purpose of this study was to compare the ability of hip- and wrist-worn AMs to predict free-living AEE in overweight and obese adults as compared with AEE from the doubly labeled water (DLW) technique.

**METHODS:** 28 subjects (20 women, 8 men; Mean±SD: 44±14 yrs age, 31.6±3.7 kg/m<sup>2</sup> BMI) wore the hip AM while a subset of 23 subjects (18 women, 5 men; 45±14 yrs age, 30.2±7.4 kg/m<sup>2</sup> BMI) also wore the wrist AM for seven complete days. AM output from both hip and wrist monitors were converted into average AEE over the 7-day period (AEE<sub>HP</sub> and AEE<sub>WR</sub>, respectively; kcals/day) using established 1R- and 2R-algorithms. Wrist AM data were also transformed with a smoothing algorithm prior to the AEE transformation (smoothed AEE<sub>WR</sub>). Direct measures of AEE (AEE<sub>DLW</sub>, kcals/day) were derived from total daily energy expenditure (TDEE) using the DLW technique after adjusting for measured resting metabolic rate (RMR) and the thermic effect of food (TEF), where  $\text{AEE}_{\text{DLW}} = \text{TDEE} - \text{RMR} - 0.1(\text{TEF})$ . 3-factor repeated measures ANOVA and correlations were used to compare 1R and 2R estimates of AEE<sub>HP</sub> with AEE<sub>DLW</sub>, while 1R and 2R estimates of both AEE<sub>WR</sub> and smoothed AEE<sub>WR</sub> were compared with AEE<sub>DLW</sub> ( $\alpha=0.05$ ).

**RESULTS:** 1R and 2R estimates of AEE<sub>HP</sub> (Mean±SE: 749±98 and 876±118, respectively) were similar to AEE<sub>DLW</sub> (782±88) but correlated poorly ( $r=0.31$ - $0.32$ ;  $P=0.11$ ). In contrast, using the subset of subjects, 1R and 2R estimates of AEE<sub>WR</sub> (3243±176 and 3119±174, respectively) differed significantly from AEE<sub>DLW</sub> (881±95;  $P<0.001$ ) but correlated moderately ( $r=0.49$ - $0.53$ ;  $P<0.02$ ). Lastly, 1R and 2R estimates of smoothed AEE<sub>WR</sub> (1076±58 and 1040±58, respectively) were statistically similar to AEE<sub>DLW</sub> and correlated moderately ( $r=0.49$ - $0.57$ ;  $P<0.02$ ).

**CONCLUSIONS:** Mean values of AEE from DLW were predicted accurately with AM-derived measures of AEE<sub>HP</sub> and smoothed AEE<sub>WR</sub>, but only smoothed AEE<sub>WR</sub> also correlated moderately with AEE<sub>DLW</sub>. These results indicate that both hip- and wrist-worn AMs may be capable of predicting free-living AEE for groups of overweight and obese adults, but only the wrist-worn AM rank ordered subjects reasonably well.

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**F-31 Free Communication/Poster - Psychological Factors in Sport**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**2747 Board #141 May 29 3:30 PM - 5:00 PM**  
**Time Of Habitual Training Does Not Alter Circadian Rhythm Of Swim Performance**

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Some studies have found better athletic performance at the usual time of training relative to other times of day. These results could reflect either a change in the circadian system or a non-circadian adaptation that results in better performance at the accustomed time of training. However, other studies have provided equivocal or negative results.

**PURPOSE:** To examine whether the circadian rhythm of swim performance differs between individuals who habitually train at a certain time(s) of day compared to those who do not.

**METHODS:** 25 swimmers were assessed for 50-55 consecutive hr in the laboratory while adhering to a 3-hr ultra-short sleep/wake cycle, a common chronobiological technique. Swimmers performed 6 maximal 200-m swims, with each trial separated by 9 hr. Performances were z-transformed and expressed relative to time of day. The time of habitual training for each swimmer was obtained via questionnaire prior to the study. Estimates of swim performance rhythm amplitude (i.e., range of performance), acrophase (i.e., time of peak performance), and mesor (i.e., fitted mean value) were obtained via cosinor analysis and compared between groups with independent sample *t*-tests. Group data were analyzed via ANCOVA with trial number as a covariate and time of day and habitual training time as fixed factors.

**RESULTS:** Approximately ½ of the swimmers (*n*=12) reported no usual time of training. The half (*n*=13) who had habitual swim times trained daily between 0600-0900 hr, 1600-1800 hr, or at both of these times of day. Those who reported a habitual time of training had lower mesors (i.e., faster swim time; *p*<0.001), but did not have different performance rhythm acrophases or amplitudes compared to those without a specific time of training (*n*=12). No group differences were found in swim performance when analyzed via ANCOVA.

**CONCLUSIONS:** This study found minimal evidence of different swim performance rhythm characteristics between those who habitually trained at a particular time of day versus those who did not. No evidence was found for superior performance that was specific to the usual time of training. However, the data do not discount the possibility that such an advantage might be observed under usual diurnal conditions, due to variations in diet, sleep, rest, and performance preparation.

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**2748 Board #142 May 29 3:30 PM - 5:00 PM**  
**Podcasting Mental Images: Technological Application Of Sport Imagery**

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It is widely accepted that mental training can contribute to increases in sport performance, particularly when it is combined with physical training. Mental training has been shown to be as effective as physical training and that the combination of mental training and physical training can be superior to physical training alone. What is not clear is whether technological applications (specifically podcasting) can enhance the sport imagery experience, thereby enhancing sport performance.

**PURPOSE:** The purpose of this study was to determine if guided imagery via podcasting can significantly increase Free Throw (FT) shooting performance among high school basketball players.

**METHODS:** The study sample included 36 (12 male, 24 female) Oklahoma high school basketball players. Subjects were assigned into three treatment groups (script, computer, iPod) and a control group and were tested in three phases (pretest, treatment, posttest). Treatment consisted of imagery training 3x per week, 5 min. each (1 supervised and 2 unsupervised) and weekly FT testing sessions (25 total, using a predetermined shooting format) for six weeks.

**RESULTS:** A comparison of group means and the grand mean for the six testing sessions indicated that the iPod group (18.1) performed higher than the computer group (16.7) and the script group (16.2). A one-way ANOVA of the posttest indicated that there were significant group mean differences (*p* < 0.05) and a Tukey post hoc test indicated that the true source of the significant group difference was between the iPod group and the control group. A comparison of posttest group means indicated that the iPod group (21.0) was the top performer, followed by the computer group (18.6), the script group (17.1), and the control group (15.8). Overall, the script group had the highest improvement (+ 3.8) while the control group had the lowest improvement (+ 0.7).

**CONCLUSION:** Results suggest that podcasting may be a valid technological application of sport imagery that can improve FT shooting performance among high school basketball players. Future studies need to verify study findings using a larger sample size and a longer study duration.

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**2749 Board #143 May 29 3:30 PM - 5:00 PM**  
**Perceptions Of Collegiate Strength And Conditioning Coaches Regarding Desirable Characteristics**

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The strength and conditioning profession has grown significantly in recent years at the professional, collegiate, and school age levels. Limited research is available describing the background of these professionals. Research has not yet considered what current strength and conditioning coaches believe is required to be an effective coach.

**PURPOSE:** Profile contemporary collegiate strength and conditioning coaches and determine how personal experience impacts perceived importance for success as a professional.

**METHODS:** One hundred fifty-six (34 female, 122 male, mean age = 33 years) full-time strength and conditioning coaches at NCAA Division 1 universities responded to an online questionnaire. Items included education, professional certifications, playing experience, coaching experience, physical activity level, and importance of background on effectiveness as a professional.

**RESULTS:** Descriptive data indicated that most coaches possessed a graduate degree (73%) and those degrees were in an exercise science-related area (67%). The most commonly held certifications were CSCS (78%), USAW (49%), and CSCCa (51%). Many coaches reported collegiate playing experience (54%) and few played sports professionally (14%). Coaches trained in exercise science rated exercise science training as more important than those trained in other areas (*p* < 0.05). Coaches with collegiate athletic experience rated collegiate playing experience as more important than those with no collegiate experience (*p* < 0.05). Coaches rating themselves as muscular indicated physical size as more important than those rating themselves as less muscular (*p* < 0.05).

**CONCLUSIONS:** Findings indicate that the profession is becoming increasingly educated and trained in exercise science-related fields. Findings further indicate that the background of the coach impacts perceptions regarding the importance of specific characteristics related to the quality of a job applicant in their discipline.

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**2750 Board #144 May 29 3:30 PM - 5:00 PM**  
**Physical Education And Sports Teachers' Empathy Skills Analysis In Turkey**

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**PURPOSE:** The purpose of this research was Physical Education and Sports Teachers' who worked in center of Kocaeli, empathy skill's analysis. In this research, test subjects who had age  $x=36,22\pm9,09$ ; year of profession  $x=12,64\pm8,62$ ; level of income  $x=1306,73\pm358,79$  were composed from 103 Physical Education Teachers as volunteer and 101 survey were evaluated.

**METHODS:** In this research, empathetic skill measure was improved by Dokmen (1988) was used. In the analysis of data descriptive statistical techniques, for determination of difference, independent sample *t* test, to determine relation of parameters test of Pearson correlation were fulfilled. The data were test in the SSPS 10,0 program and level of



significance were determined as 0.05.

**RESULTS:** In conclusion of correlation test, a significance relation was found with age between gender, year of profession, in condition if married or not, in condition if having child or not ( $P<0.05$ ). A significance relation was found with the gender between the year of profession ( $P<0.05$ ). A significance relation was found with the year of profession between in condition if married or not, in condition if having child or not, level of sport ( $P<0.05$ ). A significance relation was found with level of income between in condition if married or not ( $P<0.05$ ). A significance relation was found with in condition if married or not between in condition if having child or not ( $P<0.05$ ). A significance relation was not found with empathic skills points between other parameters ( $P>0.05$ ). Among Physical Education Teachers who join this research, empathic points of man  $x=136.52\pm14.87$ ; empathic points of female  $x=133.026\pm18.83$ ; empathic points of married teachers  $x=136.25\pm16.02$ ; empathic points of unmarried teachers  $x=131\pm15.90$ ; empathic points of graduated of university  $x=135.19\pm16.08$ ; empathic points of graduated of master's degree  $x=135.37\pm16.89$  were determined.

**CONCLUSIONS:** Consequently, it could be said that courses must be prepared for improving empathic skill of Physical Education and Sports Teachers

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**2751 Board #145 May 29 3:30 PM - 5:00 PM**

**The Profile Of The Absolute Power Spectrums Of Chinese Elite Boxers Before A Major Competition**

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(No relationships reported)

**PURPOSE:** To assess the profile of the absolute power spectrums of the Chinese elite boxers before a major competition.

**METHODS:** Twenty male Chinese elite boxers (mean age = 20.7 yr) participated in this study. Their electroencephalograms (EEG) and the brain electrical activity mappings (BEAM) were measured by monopolar recording methods two weeks before the Asian Games. The absolute power of four types of band, i.e. D,  $\theta$ ,  $\alpha$  and  $\beta$ , were assessed in different brain regions during 1-min resting, 3-min hyperventilation (HV) and 1-min recovery period.

**RESULTS:** No significant differences were found in the absolute power between left and right brain hemispheres in the three periods. Compared with the resting level, the absolute power of D band in parietal region, occipital region, and all temporal regions was higher in HV period, but no significant differences in all brain regions were found between the resting and recovery periods. Compared with the resting level, the increase in the absolute power of  $\theta$  band was observed in all brain regions in HV period. Complete recovery in  $\theta$  band in recovery period was only observed in central area (resting vs. recovery:  $10.21 \pm 9.77$  vs.  $12.18 \pm 11.25$ , NS) and in middle temporal area (resting vs. recovery:  $10.73 \pm 6.90$  vs.  $13.81 \pm 12.48$ , NS). There were no significant differences in the absolute power of  $\alpha$  band among the three periods. Increased absolute power in  $\beta$  band was observed in all brain regions in HV period compared with that in resting period. Complete recovery in  $\beta$  band in recovery period was only observed in occipital region (resting vs. recovery:  $23.91 \pm 23.90$  vs.  $29.79 \pm 18.31$ , NS).

**CONCLUSIONS:** The brain functions of the left and right brain hemispheres of the Chinese elite boxers were well balanced. The absolute power in different brain regions were not influenced equally by the transient less brain blood flow (i.e. HV test).

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**2752 Board #146 May 29 3:30 PM - 5:00 PM**

**Exploring The Relationship Between Dimensions Of Psychological Need Satisfaction And Intrinsic Motivation In Athletes**

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**PURPOSE:** Research supports the prediction of self-determination theory (SDT: Ryan & Deci, 2002) that psychological functioning, motivation, and well-being are influenced by the degree to which one's needs for competence, autonomy, and relatedness are satisfied. Recently, Sheldon and Niemiec (2006) also found that the balance of need satisfaction is critical. They showed in a series of studies that students who reported greater balance or consistency across the three needs indicated more positive well-being relative to those reporting greater variability in need satisfaction, even when possessing similar levels of overall need satisfaction. Given the potential theoretical and practical implications of their results, determining if the balance of needs satisfaction contributes to our understanding additional outcomes warrants attention. Thus, the purpose of this study was to test whether the balance of need satisfaction predicts intrinsic motivation (IM) above and beyond the individual contributions of the three needs.

**METHODS:** High school athletes ( $N=264$ , 50% female) completed valid and reliable questionnaires assessing their perceived sport competence, autonomy, relatedness, and their IM. Consistent with Sheldon and Niemiec (2006), we calculated the balance of need satisfaction by computing a difference score between each pair of needs and then summing the absolute values of these scores. Thus, a lower score reflects greater balance of need satisfaction.

**RESULTS:** Bivariate correlations among the variables were all in the expected directions, including a negative relationship between balance of need satisfaction scores and IM ( $r=-.40$ ,  $p<.05$ ). A hierarchical regression analysis, with the three needs entered on Step 1 and the balance score entered on Step 2, provided the main test of our research question. Consistent with SDT, perceived competence, autonomy, and relatedness together significantly predicted athletes' IM ( $p<.01$ ,  $R^2=.375$ ). However, the balance score was found to significantly add to the prediction above and beyond the independent contributions of the three needs ( $\Delta R^2=.075$ ).

**CONCLUSIONS:** The results support the basic predictions of SDT, but also highlight the importance of considering balanced need satisfaction as a predictor of achievement-related outcomes.

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**2753 Board #147 May 29 3:30 PM - 5:00 PM**

**Intrinsic And Extrinsic Motivation Differences Between Ncaa Division-iii Championship And Non-championship Football Teams**

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Reasons for participation in NCAA Division III athletics vary greatly. Athletes may participate to increase their knowledge of the sport while others participate for enjoyment or to achieve success. The reasons to participate constitute valuable information for the coaching staff as it may influence coach-player interactions and decision making.

**PURPOSE:** The purpose of this study was to investigate if motivation differences existed between championship and non-championship level NCAA Division III football teams.

**METHODS:** Players ( $N=221$ ) from three NCAA Division III football programs (one championship level and two non-championship level) were recruited. During the previous five seasons the championship level team had a combined record of 54-3 with three NCAA Division III National Championships. The non-championship level teams had a combined record of 23-77 with no NCAA Division III playoff appearances. All players completed the Sport Motivation Scale (SMS) and the results were analyzed using a 2X2 MANOVA to examine differences among the motivation variables for starter vs. non-starter and championship vs. non-championship teams. A one way MANOVA was utilized to examine differences across year in school.

**RESULTS:** Dependent variables included internal motivation to experience stimulation, internal motivation for accomplishment, internal motivation for knowledge, external

motivation for identification regulation, external motivation for introjection regulation, external motivation for external regulation, and amotivation. The interaction between starter status and team was not significant ( $L = 0.996, p > 0.40$ ). Additionally, there were no significant differences in the mean vector scores for starter vs. non-starter ( $L = 0.965, p = 0.378$ ). For team type, however, differences did exist across dependent variables ( $L = 0.898, p = 0.002$ ). For all variables except amotivation, the championship level team had significantly higher scores than the non-championship level teams.

**CONCLUSION:** Members of NCAA Division III championship level football teams have higher motivation to participate in their sport compared to non-championship team members. These results could have an impact on player morale, coaching strategies, and future success in athletic related activities.

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**2754 Board #148 May 29 3:30 PM - 5:00 PM**

**Challenge And Motivation In Introductory And Advanced Triathlon Events: A Pilot Study**

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(No relationships reported)

**PURPOSE:** Participants of introductory and advanced triathlon events were surveyed to determine the role of challenge as it relates to motivation for participation.

**METHODS:** Two events were selected for survey analysis. The introductory event was the Ironman Challenge (IMC), a three-week long triathlon event designed to encourage physical activity and triathlon participation among university staff and students. The advanced event was the 2008 Ironman Coeur d'Alene triathlon (CDA). Survey information was solicited from convenience samples of participants at both events (IMC:  $n = 38$ ; CDA:  $n = 59$ ). The dependent variable of interest was motivation type. Chi squared tests were employed to identify significant trends in motivation within each group.

**RESULTS:** For IMC, there were significantly fewer ( $p < 0.05$ ) individuals who marked "Challenge" ( $n=14$ ) compared to "Other" ( $n=24$ ). Also there was a small, yet statistically significant difference ( $p < 0.05$ ), in the responses of CDA with almost 50% of respondents indicating "Challenge" ( $n=29$ ) as a motivational factor compared to "Other" ( $n=30$ ).

**CONCLUSION:** Participants in each event cited "Challenge" as a significant source of motivation, albeit this trend was more apparent for CDA. In follow up questioning, participants in both groups cited that the motivation of participation yielded positive exercise and physical activity habits. If introductory triathlon events, such as the IMC, can encourage physical activity with motivation sources similar to advanced events, perhaps they can be used to foster healthy habits for individuals who are less active. Further research should explore the effects of other sources of participant motivation, such as a support system, and spirituality, on participation and exercise adherence.

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**2755 Board #149 May 29 3:30 PM - 5:00 PM**

**Psychological Characteristics Of Ultramarathon Participants**

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Despite the widely accepted notion of an exercise dose-response effect on various health outcomes, the psychological consequences of extremely long bouts of physical activity are unclear.

**PURPOSE:** To evaluate life satisfaction, exercise dependence, enjoyment, and affective changes with participation in a running event of 50, 100, or 150 miles.

**METHODS:** Male ( $n = 10$ ) and female ( $n = 10$ ) participants (Mean  $\pm$  SD age =  $40.8 \pm 10.3$  yrs) completed self-reports prior to and immediately following participation in a 50-, 100-, or 150-mile trail run. All participants supplied written informed consent and responses to the Activation-Deactivation Adjective Checklist (AD ACL; Thayer, 1989), Satisfaction with Life Scale (SWLS; Diener et al., 1985), Physical Activity Enjoyment Scale (PACES; Kendzierski & DeCarlo, 1991), and Exercise Dependence Scale (EDS; Hausenblas & Symons Downs, 2002). Baseline values of SWLS and EDS were compared with normative data, and changes in AD ACL were analyzed using repeated measures ANOVA. An independent t-test was used to compare PACES scores between those who completed their event ( $n=10$ ) and those who completed  $\geq 26.2$  mi but did not finish ( $n=10$ ).

**RESULTS:** EDS scores indicated that 80% displayed symptoms of exercise dependence, with 10% at higher dependence risk. Baseline SWLS scores were high to very high (Mean  $\pm$  SD =  $29.8 \pm 3.6$ ) at baseline and slightly, but not significantly, higher post-event (Mean  $\pm$  SD =  $30.3 \pm 3.2$ ), as expected given the global nature of the measure. Pre-post affective changes on the AD ACL were observed, including significantly reduced Energy ( $F=6.8, p < .05$ ) and increased Tiredness ( $F=13.27, p < .01$ ). Increases in Tension ( $F=4.24, p = .06$ ) and decreases in Calmness ( $F=3.98, p = .07$ ) were borderline significant. Athletes completing their planned distance had significantly higher PACES scores than non-finishers ( $t = 2.10, p = .05$ ).

**CONCLUSIONS:** AD ACL changes suggest that extremely long bouts of running negatively influence affective valence, likely due to strong interoceptive cues (Ekkekakis et al., 2008) and sleep deprivation. However, life satisfaction was high and athletes enjoyed their activity, an effect moderated by finisher status. Symptoms of exercise dependence were common, which itself may influence psychological health.

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**2756 Board #150 May 29 3:30 PM - 5:00 PM**

**Temporal Stability And Interrelationships Of Personality Traits And Life Satisfaction In College Athletes.**

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(No relationships reported)

Personality traits are considered stable across time, but individual characteristics may influence this stability. However, there is a paucity of research examining the test-retest reliability of personality traits and the influence of individual characteristics in college athletes.

**PURPOSE:** To determine the role of gender and changes in life satisfaction in test-retest reliability of personality traits in college athletes.

**METHODS:** College athletes ( $N = 65$ ; Age = 20.1 yrs) were sampled from men (Baseball:  $n = 27$ ; Hockey:  $n = 10$ ) and women sport teams (Softball:  $n = 14$ ; Swimming:  $n = 14$ ). Each athlete completed the Eysenck Personality Questionnaire-Revised (EPQ-R) and the Satisfaction with Life Scale (SWLS) in early January (Time 1) and late April (Time 2). The EPQ-R measured the traits of Psychoticism (P), Extraversion (E), and Neuroticism (N), and the SWLS assessed global life satisfaction (LS). Data were analyzed using Pearson correlation coefficients between personality traits as well as life satisfaction at both time points in men and women, separately. Correlations were also calculated between changes in life satisfaction and changes in personality.

**RESULTS:** Test-retest reliability coefficients were significant for P (Men:  $r = .50, p < .005$ ; Women:  $r = .73, p < .001$ ), E (Men:  $r = .55, p < .001$ ; Women:  $r = .85, p < .001$ ), N (Men:  $r = .44, p < .01$ ; Women:  $r = .59, p < .005$ ), and LS (Men:  $r = .59, p < .001$ ; Women:  $r = .56, p < .005$ ). Personality traits were not correlated ( $p > .05$ ) with each other at either time point. N was significantly correlated with LS at time 1 (Men:  $r = -.49, p < .005$ ; Women:  $r = -.39, p < .05$ ) and time 2 (Men only:  $r = -.41, p < .05$ ). Changes in LS were correlated with changes in N (Men only:  $r = -.38, p < .05$ ), and no other correlations between difference scores were significant ( $p > .05$ ).

**CONCLUSION:** Personality traits and life satisfaction were stable over a 4-month period in college athletes, especially for women. As expected, low scores on Neuroticism were associated with life satisfaction. However, Neuroticism in male athletes was more closely related to global life satisfaction than in female athletes. Monitoring factors that potentially affect life satisfaction or Neuroticism would be prudent for college athletes, particularly men, as mental health (or well-being) can influence academic and sport performance.

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**2757 Board #151 May 29 3:30 PM - 5:00 PM**  
**The Comparison Of Elite Disabled Athletes, Former Athletes And Non-athletes On Annual Income, And Highest Level Of Formal Education Attained**

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(No relationships reported)

The Comparison of Elite Disabled Athletes, Former Athletes and Non-Athletes on Annual Income, and Highest Level of Formal Education Attained

**PURPOSE:** The purpose of this study was to compare annual income, employment status, and highest level of formal education attained between current and former elite disabled athletes and disabled non-athletes.

**METHODS:** To obtain subjects from our athletic population 200 surveys with letters of informed consent were mailed-out to Paralympic athletes as well as 200 to the U.S. Association of Blind Athletes. For our non-athletic population 200 surveys with letters of informed consent were mailed-out to each of the following organizations: United Cerebral Palsy, American Council of the Blind, United Spinal Association, and the Amputee Coalition of America. Three groups were formed for comparisons: current athletes (CA) (mean  $\pm$  SD: 32.81  $\pm$  10.38 yrs; n=71), former athletes (FA) (mean  $\pm$  SD: 41.47  $\pm$  12.37 yrs; n=19), and non-athletes (NA) (mean  $\pm$  SD: 51.25  $\pm$  15.1 yrs; n=122). Surveys included straight forward questions on age, athletic status, annual income, and continuous years of employment. A Oneway ANOVA with a Tukey's HSD Post Hoc was used to detect differences between groups.

**RESULTS:** There were no significant differences in annual income between all three groups. Although FA had a higher mean annual income compared to NA (mean  $\pm$  SD: 4.79  $\pm$  3.2; 3.23  $\pm$  2.9 respectively), it did not reach significance ( $p=.111$ ). CA had non-significantly higher levels of formal education compared to NA ( $p = 0.118$ ). Finally, NA reported significantly greater numbers of years of continuous employment compared to CA ( $p \leq 0.05$ ).

**CONCLUSIONS:** Although not significant, an interesting finding was that CA had completed, on average, a higher level of formal education compared to NA. Furthermore, FA demonstrated a non-significantly higher annual income compared to NA. Had we controlled for age, income and education might have shown significant differences between groups. Additionally, the great age discrepancy between groups is probably the reason for the significantly greater continuous years of employment seen in NA compared to CA. Future research should investigate incomes and education levels while controlling for age.

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**2758 Board #152 May 29 3:30 PM - 5:00 PM**  
**Effects Of Music And Watching Television During Exercise On Times Of Volitional Fatigue And Rates Of Perceived Exertion**

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**INTRODUCTION:** Hearing music or watching television during exercise motivates people to maintain the sustained effort and a dissociation of the exertion tolerance.

**PURPOSE:** The objective of the study is to investigate the effects of music and watching TV on times of volitional fatigue and Borg's rate of perceived exertion.

**METHODS:** Fifteen (n=15) college students (Mean 24 $\pm$ 2.3 years of age) participated in the study. Subjects signed an informed consent form and a parent/guardian signed for minor participants. Testing was performed in the Human Performance Laboratory at the University of Louisiana at Monroe. Participants returned to the lab on three separate occasions. In a random order each participant performed a controlled run on the treadmill use Bruce protocol. All the runs were to volitional fatigue. Heart rate (HR) and Borg's rate of perceived exertion (RPE) were measured at one minute intervals during runs. Time to volitional fatigue was measure at the end of the test. Subjects are allowed to choose their favorite music and shows while exercising. The levels of significance  $p$  being  $< 0.05$ .

**RESULTS:** Paired samples T - tests were conducted using SPSS 14.0 Significance was present at .05 level . The mean times of volitional fatigue for the control , music and watching television are 13min 21 sec  $\pm$  1 min 48sec, 13min 51sec  $\pm$  2min 7sec and 14min 01  $\pm$  1min 53 sec respectively. There is a significant difference ( $p=0.037$ ) in the times of volitional fatigue between the control and music. A significant difference ( $p=0.003$ ) is also noted in the times of volitional fatigue between controls and watching television .There isn't any significant increase in the times of volitional fatigue between the music and watching television.

**CONCLUSIONS:** Hearing music and watching television is significantly increasing the total time of exercise when compared to the control. However, this is a preliminary investigation and further investigation with a larger sample size may provide more information.

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**2759 Board #153 May 29 3:30 PM - 5:00 PM**  
**Difference In Wingate Power Output In Response To Music As Motivation**

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**INTRODUCTION:** Wingate testing while using music to enhance performance has produced mixed results in past studies. The effect of motivational music on anaerobic power is unclear.

**PURPOSE:** The purpose of this study was to test Wingate performance with the presence of music as a motivational tool, and without the presence of music. The study aimed to identify if music played a significant role in performance enhancement.

**METHODS:** Subjects were randomized into two groups. The two groups were composed of a "music first" trial group and a "music last" trial group, as the testing order was counterbalanced between groups. Subjects were tested with or without music, according to randomized groups. Music was deemed motivational by the Brunel Music Rating Inventory.

**RESULTS:** Results indicated a significant difference in anaerobic performance when using motivational music. Peak power, average power, overall anaerobic power, and the drop in power over time were all significantly different ( $p<.01$ ) than when music was not used. Performance was significantly better in all categories when motivational music was present ( $p<.01$ ). The order in which the music was played (during the first trial or the second trial) did not have a significant difference on performance.

**CONCLUSIONS:** It was concluded that motivational music has a positive impact on anaerobic performance during a Wingate test. This can translate into a possible increase in anaerobic sports performance. Future studies may look at unmotivational music and performance, or at the application of using music during anaerobic conditioning.

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**2760 Board #154 May 29 3:30 PM - 5:00 PM**  
**The Influence Of Music On A Supramaximal Exercise Bout**

Jasmin Hutchinson<sup>1</sup>, Todd Sherman<sup>1</sup>, Lyndsey Davis<sup>1</sup>, Dusty Cawthon<sup>1</sup>, Nathan Reeder<sup>1</sup>, Gershon Tenenbaum<sup>2</sup>. <sup>1</sup>Oxford College of Emory University, Oxford, GA. <sup>2</sup>Florida State University, Tallahassee, FL.

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**PURPOSE:** To evaluate the influence of music on anaerobic performance using a maximal effort Wingate anaerobic test.

**METHODS:** Physically active male and female participants (N = 25) completed a 30-second Wingate anaerobic test under two different conditions: music and no music. The volume of the music was standardized at 75dB. The musical selection was the same for each participant, and was selected based upon a survey of musical preferences of undergraduate students using the BMRI-2. During the task physiological and psychological data were collected. Monark anaerobic testing software was used to obtain measures of peak power, mean power, and % power drop, while a scale questionnaire was administered immediately after the trial to gauge the subject's level of motivation, exertion, and affect. Data analysis was conducted using a series of paired-sample t-tests in SPSS.

**RESULTS:** Peak power and mean power were significantly higher with music than without. In addition, participants reported increased motivation and more positive affect in the music condition as opposed to the non-music condition.

**CONCLUSIONS:** The results of this study suggest that music can have a positive influence over anaerobic performance. This supports previous research that has suggested music can be a valuable tool during physically strenuous activities, and extends these findings to include supramaximal exercise.

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## **F-32 Free Communication/Poster - Sports Biomechanics II**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### **2761 Board #155 May 29 2:00 PM - 3:30 PM**

#### **Evaluation Isokinetic Swimming Propellants Muscles: Comparative Study Between Styles. Pilot Study**

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(No relationships reported)

Swimming is characterized as a sport of pitch, where the internal rotators (IR) are one of the primary muscles involved in the movement. There is no evidence about the isokinetic parameters of the upper muscles as the thrusters (internal rotators and adductors) comparing the different styles, where these are the main means of displacement in the water.

**PURPOSE:** To compare the muscle function, using isokinetic evaluation in butterfly and breaststroke (symmetric styles) and freestyle and backstroke (asymmetric styles) based on the hypothesis that symmetric styles have a higher torque (kinetic synchronous movement) when compared to asymmetric styles.

**METHODS:** 21 subject male and female, elite swim level, age: 16 - 33 years old, height: 161 - 190 m, weight: 54 - 88 kg and mean week 18.000 - 80.000 m. 10 athletes are specialized in symmetric swim and 11 athletes in asymmetric. They were evaluated on isokinetic dynamometer (Biodex Medical Systems 3 Inc, USA). They performed 5 (60°/s) and 20 repetitions (300°/s). The peak torque (PT) and work fatigue (WF) were evaluated.

**RESULTS:** One way analysis of variance found no differences between the groups for the initial tests ( $p > 0.05$ ).

**CONCLUSION:** The peak torque and fatigue are not affected by the styles in elite swimmer with high level of training.

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### **2762 Board #156 May 29 2:00 PM - 3:30 PM**

#### **The Effect Of Back Exercises On Drawing Arms In Archers**

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According to some studies, elite archers develop a specific forearm and pull finger muscle activation strategy by active contraction of the forearm extensors with the fall of the clicker. On the other hand, the back muscles play the major role in drawing and releasing phases of the bow. Besides, properly working back muscles help to maintain forearm muscle activation strategy. This strategy may require a relatively long training period.

**PURPOSE:** to investigate the effect of back and shoulder-girdle strength training program on muscular activities during release phase and performance in beginner archers.

**METHODS:** Six male and two female beginner archers (age: 16,38±0,38 ; years of training 1,94±1,04; FITA scores 1083±71,2) were involved in the study. Each subject participated in double test session. Eight weeks of back and shoulder-girdle strength training program (Lateral Pull Down, Rowing, Dumbell Lateral Rise, Dumbell Front Rise, Dumbell Behind Rise, Dumbell Shrug, Upright Rowing, Back Extension, Sit up) were applied in %40-60 of max. between two test session. Forearm extensors and flexors, deltoid posterior, deltoid middle, trapezius middle and trapezius lower muscle's activities belonging both of drawing and bow arms were measured in each test session by using EMG. Besides, the scores on the target was also recorded. Subjects have made a total of twentyfour successive shots at the each experimental part of the study.

**RESULTS:** EMG recordings 2 s prior and 1 s after the fall of clicker has been rectified, integrated and normalized. Differences between two test sessions were analysed in Wilcoxon statistical tests. According to the results of the study, there were significant differences in forearm flexors and extensors, deltoid posterior, deltoid middle, trapez middle and lower in drawing arm, and forearm extensors, deltoid middle and lower in bow arm and the performance between two test session ( $p < 0,05$ ).

**CONCLUSIONS:** A positive development was observed with the effect of back shoulder-girdle strength training in beginner archers. So that the archery coaches may involve strength training program in their training cycle in addition to technical training to gain more performance and time.

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### **2763 Board #157 May 29 2:00 PM - 3:30 PM**

#### **Comparison Of 2d Kinematical Images Reconstruction In Breaststroke Swimming: Dual Media Versus Separated Recording Plans**

António Reis<sup>1</sup>, Victor M. Reis<sup>1</sup>, António J. Silva<sup>1</sup>, Bruno Figueira<sup>2</sup>, Hugo Louro<sup>3</sup>, Daniel A. Marinho<sup>4</sup>, Tiago M. Barbosa<sup>5</sup>. <sup>1</sup>*UTAD/CIDESD, Vila Real, Portugal.* <sup>2</sup>*UTAD, Vila Real, Portugal.* <sup>3</sup>*ESDRM/CIDESD, Rio Maior, Portugal.* <sup>4</sup>*UBI/CIDESD, Covilhã, Portugal.* <sup>5</sup>*IPB/CIDESD, Bragança, Portugal.*

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**PURPOSE:** The aim of the present study was to compare two approaches for a 2D kinematical image's reconstruction in Breaststroke swimming: dual media recording vs. separated recording plans.

**METHODS:** The sample comprised seven male breaststrokers (19.1 ± 4.3 years of age; 1.78 ± 0.62 m of height; 70.4 ± 8.0 kg of body mass; 69.10 ± 4.16 s of personal best in the 100 m



Breaststroke event). The subjects performed a 100 m maximal Breaststroke bout on a 50 m swimming pool. Two video cameras ( $f = 50$  Hz) were placed in sagittal plane at 25 m of the head wall to record swimmer's images underwater camera (GR-SXM25 SVHS, JVC, Yokohama, Japan) and above water (GR-SX1 SVHS, JVC, Yokohama, Japan). The images were subsequently reconstructed (Panasonic, AG 7355, Japan) using two different procedures: dual media (DM) and separated recording plans (SP). A full stroke cycle was then analyzed twice for each subject with Ariel Performance Analysis System (Ariel Dynamics Inc., California, USA). Digitalization of the subjects considered the modified anthropometric model of Zatsiorsky (Leva, 1996). Data were filtered using a 5 Hz cutting frequency (Winter, 1990). Reliability of digitalization was very high ( $R = 0.97$ ;  $IC_R = 0.87$ ;  $0.95$ ). The following kinematic variables were compared with Wilcoxon tests: stroke cycle period (SCP), stroke frequency (SF), stroke length (SL), mean swimming velocity ( $v$ ), stroking index (SI), intra-cycle variation of the horizontal velocity of the centre of mass ( $dv$ ) and vertical displacement of the center of mass (VD).

**RESULTS:** The kinematic variables did not differ when the two procedures of reconstruction were compared; with an exception for the VD ( $DM = 0.17 \pm 0.05$  cm,  $SP = 0.14 \pm 0.06$  cm,  $p = .018$ ). Indeed, VD assessment using SP digitalization procedure may be influenced by different factors such as the light refraction phenomena, non-steady flow of the water around the swimmer's body, higher difficulty to clearly determine the air-water interface plan and be unable to observe the head, trunk and limbs actions above the water.

**CONCLUSIONS:** The DM procedure seems to slightly underestimate the water depth when compared with SP. On the other hand, DM seems more suitable to digitalize anatomic points especially when the air-water interface is determinant for the analysis.

Supported by FCT grant: POCI/DES/58362/2004.

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**2764 Board #158 May 29 2:00 PM - 3:30 PM**  
**Expressions Of Strength And Average Rate Of Dynamic Force Development: Are These Measures Related?**

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Average rate of force development (RFD) may be calculated as  $DF / DT$ . The elapsed time for force is based upon operationally-defined starting and ending points. Specific time segments of RFD have been proposed as being unique for each individual with implications for both performance and training. These segments consist of the first and second halves of the total elapsed time for RFD. The first half is referred to as the "start gradient" (SG), and the second half, the "acceleration gradient" (AG). It has been reported that RFD and SG have little association with peak force (P<sub>KF</sub>). Although often associated with isometric force, RFD might also be considered for dynamic performance (DRFD). Dynamometers exist that measure only dynamic actions, so associations between the analogous segments of DRFD may be examined.

**PURPOSE:** To determine the association between various aspects of strength and DRFD for two "explosive" lifts to ascertain if they represent unique characteristics.

**METHODS:** Subjects were 48 men, 22.9 yrs ( $s = 4.17$ ) of age, weighing 83.3 kg ( $s = 14.55$ ), who had been engaged in systematic wt training for at least 3 months and could perform a 1RM parallel back squat with  $\geq$  body wt and a 1RM hang power clean with  $\geq 70\%$  body wt. Subsequent to three practice sessions, testing took place during two identical sessions in which 30% 1RM parallel jump squats and 90% 1RM hang power cleans were performed in duplicate. Data were obtained using a linear velocity transducer. Velocity was sampled at 100 Hz and smoothed using a five-point rolling average. The direct measure of velocity and known lifting loads were used to calculate force and power via inverse dynamics with no further smoothing. Variables analyzed for this report were average DRFD, SG, AG, P<sub>KF</sub>, P<sub>KP</sub>, 1RM, and relative 1RM (adjusted for body wt.). Associations were calculated via Pearson Product-moment correlations.

**RESULTS:** For the squat, DRFD was associated ( $p < .01$ ) with SG (.73), AG (1.00), P<sub>KF</sub> (.66), P<sub>KP</sub> (.82), 1RM (.44), and Rel1RM (.44). For the hang power clean, DRFD was associated ( $p < .01$ ) with SG (.98), AG (1.00), P<sub>KF</sub> (.88), P<sub>KP</sub> (.82), 1RM (.61), and Rel1RM (.59).

**CONCLUSION:** For squats and hang power cleans, DRFD appears to be directly related to AG, highly related to SG, P<sub>KF</sub>, P<sub>KP</sub>, and moderately related to 1RM and Rel1RM, indicating that they have a tendency to covary with each other.

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**2765 Board #159 May 29 2:00 PM - 3:30 PM**  
**An Optimal Isotet Rest Period For Strength Recovery During A Common Isokinetic Test**

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Isokinetic testing has been used in rehabilitation settings on a regular basis, yet there is a lack of consistency in rest period usage among protocols.

**PURPOSE:** The purpose of this study was to establish an optimal rest period that would allow reproducibility of strength during a common isokinetic strength-test.

**METHOD:** Twenty-seven healthy college-aged males ( $23 \pm 3.8$  yrs and body weight  $79.61 \pm 11.11$  kg) underwent isokinetic strength testing (Cybex NORM) of the knee flexors and extensors, to determine peak torque at 60, 180 and 300 deg/sec, respectively. Work:rest ratios of 1:3, 1:8 and 1:12 were counterbalanced between sets. Subjects were tested on five separate occasions; two familiarization sessions and three experimental sessions. A 3 X 3 repeated measures ANOVA was used to analyze the data with  $\alpha < .05$ .

**RESULTS:** There was no significant interaction of rest and velocity for either knee extension or knee flexion peak torque. Secondly, there was no significant difference in either knee extension or knee flexion peak torque when comparing work:rest ratios. However, there was a significant difference in peak torque between velocities: knee extension peak torque ( $F = 498.238$ ,  $p < .05$ ), knee flexion peak torque ( $F = 1048.166$ ,  $p < .05$ ).

**CONCLUSION:** These findings suggest that a 1:3 work:rest ratio is sufficient during a common isokinetic strength test. Furthermore, the lack of significant differences among work:rest ratios suggests the need for more research in this area to better understand the impact of rest duration on strength performance.

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**2766 Board #160 May 29 2:00 PM - 3:30 PM**  
**Effect Of Variable Repetitions On Peak Torque In Male And Female Athletes**

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(No relationships reported)

Isokinetic testing is often used to assess strength in various muscle groups. It was determined that a number of protocols have used several different repetition sets to assess peak torque. This study measured peak torque in both males and females when using five different velocities and four different repetition sets.

**PURPOSE:** To examine the effects of using variable repetitions on peak torque production in male and female athletes.

**METHODS:** Fifteen male (mean age=20.2 years, height = 199 cm, weight= 84.85 kg) and fifteen female (mean age= 20.5 years, height = 171.9 cm, weight = 77.15 kg) university athletes with no known knee injuries were tested on a Cybex NORM isokinetic machine performing maximal knee extensions with knee flexions held constant at 300 deg/sec. Each subject was tested five or six times, one or two familiarization and four experimental sessions, at velocities of 60, 120, 180, 240, and 300 deg/sec. The variable repetitions of four, six, eight or ten were randomly assigned. A 2 X 4 X 5 repeated measures ANOVA ( $\alpha < 0.05$ ) was used to analyze the data, with gender, repetitions, and velocities as independent variables and peak torque as the dependent variable.

**RESULTS:** There were no significant differences in peak torque in either male or female athletes when using a variable number of repetitions. Interestingly enough, when

assessing the means of the males and females, the females were much more consistent in peak torque production at each velocity than their male counterparts, regardless of number of repetitions. Additionally, the males in four of the five velocities produced the greatest peak torque when performing four repetitions. Females tended to produce greater peak torques when they executed eight or ten repetitions. As expected there were significant differences in peak torque based on velocity ( $F=742.95$ ,  $p<0.05$ ). Additionally, there were significant differences in peak torque by gender ( $130.774$ ,  $p<0.05$ ).

**CONCLUSIONS:** When assessing peak torque it appears that females need more repetitions while males need fewer repetitions. This would seem to be an important consideration in rehabilitation protocols and research investigations.

**2767 Board #161 May 29 2:00 PM - 3:30 PM**  
**Kinematic Differences In Youth Baseball Pitchers: An Investigation Into The Cocking And Acceleration Phases**

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The use of studies incorporating mature pitchers as the basis for defining proper throwing mechanics across all ages does not take into account the unique differences between pitchers of different ages.

**PURPOSE:** The purpose of this study was to examine kinematic differences between youth pitchers of different ages.

**METHODS:** Reflective markers were attached to 18 pitchers before a series of fastballs were thrown the age regulated distance. Each pitch was recorded by three synchronized video cameras (120 Hz). Marker locations were calculated using DLT and standard techniques were used to calculate pitching motion kinematics. Student t-test analyses were conducted at maximum shoulder external rotation (MER) and ball release (BR) to identify differences between groups.

Table 1. Results of t-tests analysis.

	MER		BR	
	Prepubescent Pitchers	Pubescent Pitchers	Prepubescent Pitchers	Pubescent Pitchers
Trunk rotational velocity (°/s)	701.9 ± 440.7	926.4 ± 364.2	850.2 ± 512.1	1043.2 ± 408.6 *
Horizontal adduction (°)	4.7 ± 7.4	13.7 ± 6.1	2.01 ± 5.28	3.9 ± 4.6
Elbow extension (°)	125.0 ± 36.6	138.6 ± 27.2	156.45 ± 16.41	164.2 ± 12.9

\*  $p < 0.01$

**RESULTS:** Results of t-test analyses are shown in Table 1. At MER, the rate of forward trunk rotation and the angles of horizontal shoulder adduction and elbow extension were significantly higher in older pitchers. At BR, the rate of forward trunk rotation was the only variable that remained significantly higher in the older group.

**CONCLUSION:** Increased core muscular strength accompanying pubescence may result in the torso being rotated at higher rates in older pitchers. This increase in torso rotational velocity may play a role in increasing the angles of horizontal adduction and elbow extension at MER by increasing centrifugal forces transferred down the throwing arm. At BR, although the rate of forward trunk rotation remained higher in older pitchers, strength increases in the musculature of the throwing arm may compensate for the higher torso rotation velocities, allowing the shoulder and elbow to reach a position that is similar to that observed in younger pitchers.

**2768 Board #162 May 29 2:00 PM - 3:30 PM**  
**Comparison Of On-horse And Postflight Techniques Used By Elite Gymnasts In Performing Two Handspring Category Vaults**

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The handspring and salto (somersault) forward tucked vault forms the basis for learning the advanced handspring and double salto forward tucked (Roche) vault. On-horse and postflight (second flight) mechanical variables have important "causal influence" on postflight performance, landing on the mat, and overall score of a vault.

**PURPOSE:** To identify the differences of on-horse and postflight techniques in performing the handspring and salto forward tucked vault and the Roche vault.

**METHODS:** The subjects were 51 gymnasts performing the handspring and salto forward tucked vault at the 1988 Olympic Games and 23 gymnasts performing the Roche vault at the 2000 Olympic Games. The vaults were filmed by a 16-mm camera operating at 100 Hz. Approximately 80 frames were digitized for each vault. A theoretical model was developed to identify the mechanical variables that determine the linear and angular motions of the vaults.

**RESULTS:** The results of t tests applied to the data indicated that the Roche vault, compared to the handspring and salto forward tucked vault, had significantly ( $P < .005$ ): (1) greater resultant and vertical velocities of body center of mass (CM) at horse touchdown (TD); (2) shorter time of arm support on horse; (3) greater resultant and vertical velocities at horse takeoff (TO); (4) greater maximum height attained by CM, greater horizontal distance traveled by CM, and longer duration of time in postflight; (5) greater somersaulting angular distance, smaller average somersaulting moment of inertia, and greater average somersaulting angular velocity of postflight; and (6) greater resultant and vertical velocities at mat TD.

**CONCLUSION:** Successful progression from the handspring and salto forward tucked vault to the Roche vault is likely when the focus is on achieving: (1) large vertical velocity at horse TD by reaching toward the far end of the horse with the hands and arms as quickly as possible upon the board TO; (2) large vertical velocity at horse TO by pushing off the horse quickly and forcefully downward and forward with the hands and shoulders (flexion of the humerus and elevation of the scapulae); and (3) great maximum height, large horizontal distance, and long time of postflight to enable additional salto forward required for the Roche and simultaneously prepare for controlled landing on the mat.

**2769 Board #163 May 29 2:00 PM - 3:30 PM**  
**Place Kicking Kinematics Following Static And Dynamic Stretching Warm-ups In Young Female Soccer Players**

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 (No relationships reported)

**PURPOSE:** This study compared the effects of a standardized static and dynamic stretching warm-up on performance of a maximal instep type soccer place kick.

**METHODS:** Sixteen female high school varsity soccer players (age:  $15.9 \pm 0.9$  yrs) completed two randomly assigned experimental sessions that consisted of either a 10-min standardized static (S) or dynamic (D) warm-up (Faigenbaum et al., 2005), each followed immediately by 3 consecutive trials of a maximal effort instep place kick with the preferred leg. Testing was performed using a ball of standard size and inflation (FIFA, 2008) under controlled indoor athletic field conditions. Kicking performance motion was obtained using a video camera (Panasonic PV-GS55), and then digitized and measured from the start of the kicking leg's forward swing to the toe contact on ball at 60Hz using video-based, 2-D motion analysis software (Peak Motus, Peak Performance, Inc.). The primary dependent variables were mean and maximal linear velocities on the toe of the kicking foot, as the index for kicking performance. In addition, mean angular velocities on the ankle, knee, and hip of the kicking leg were measured to allow for a more in-depth interpretation of the kinematic characteristics of the place kick.

**RESULTS:** Paired t-tests revealed no significant differences between the static and dynamic warm-up conditions on mean linear velocity (S:  $10.50 \pm 1.85$  m/s; D:  $10.63 \pm 1.75$  m/s) and maximal linear velocity (S:  $18.06 \pm 3.12$  m/s; D:  $18.23 \pm 2.77$  m/s) on the toe ( $p>0.05$ ). Similarly, no differences for the warm-up conditions were observed on any of the

angular velocity variables ( $p>0.05$ ).

**CONCLUSION:** The present data in young female soccer players demonstrate no differences in soccer place kicking performance with the instep of the preferred leg following completion of either a static or dynamic warm-up. Recent clinical recommendations to avoid pre-event static stretches and to use a dynamic pre-event warm-up to optimize exercise performances in tasks that require a high power output need further evidence-based refinements that should include sport-specific tasks.

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**2770 Board #164 May 29 2:00 PM - 3:30 PM**

**Kinematic And Kinetic Differences Among Three Landing Tasks: Drop-jump, Sidestep, And Pivot**

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(No relationships reported)

Several tasks have been utilized to identify potential risk factors for Anterior Cruciate Ligament (ACL) injuries. Each task may place different demands on the joints; therefore it is relevant to understand the kinematic and kinetic differences among these tasks.

**PURPOSE:** The purpose of this study was to determine kinematic and kinetic differences between a drop-jump (DJ), sidestep (SS), and pivot (PI) task.

**METHODS:** 19 female collegiate soccer athletes ( $19.58 \pm 0.84$  years;  $1.67 \pm 0.05$  m;  $63.66 \pm 10.11$  kg) from a Division I institution participated in this study. 3D Motion analysis data were captured with a VICON system and Bertec force plates sampling at 500Hz. Three trials were collected for the DJ task, while 10 unanticipated trials were collected for the SS and PI, with a custom visualization software creating the unanticipated factor. Separate repeated measures analyses of variance were conducted for each dependent variable. Alpha level set at  $p<0.05$ . Kinematic measured in degrees, and kinetic measured in multiples of body weight.

**RESULTS:** There was a significant difference in ankle flexion (AF) at initial contact (IC) between tasks ( $SS=13 \pm 14 > PI=2 \pm 13$ ,  $SI > DJ=-8 \pm 13$ ,  $PI > DJ$ ,  $pPI=16 \pm 8$ ,  $SS > DJ=17 \pm 6$ ,  $pSI=-3 \pm 8$ ,  $PI > DJ=-0.6 \pm 4$ ,  $pDJ=38 \pm 10$ ,  $p=.003$ ). There was also a significant difference in maximum knee flexion (MKF) ( $DJ=83 \pm 10 > SI=52 \pm 6$ ,  $DJ > PI=50 \pm 15$ ,  $pSI=57 \pm 16$ ,  $DJ > PI=53 \pm 9$ ,  $pSI=1.42 \pm 27$ ,  $DJ > PI=1.08 \pm 48$ , and  $SS > PI$ ,  $p<0.001$ ).

**CONCLUSIONS:** The three tasks appear to have distinct kinematic and kinetic characteristics. DJ task had higher VGRF than the other two tasks, as well as higher MKF and MHF that may help in attenuating the increased landing forces. When conducting biomechanical studies to understand ACL injuries the tasks chosen should be sport specific.

**Funding Source:** National Institutes of Health RO3: PA 04-002 NIAMS Small Grant Program for New Investigators: 1R03AR054031-01

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**2771 Board #165 May 29 2:00 PM - 3:30 PM**

**Effect Of Footwear On Lower Extremity Secondary Plane Movements During A Soccer Specific Jumping Task**

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R. Queen presenting  
(No relationships reported)

**PURPOSE:** The purpose of the study was to examine the effect of different types of footwear (running, turf, and bladed cleat) on lower extremity landing mechanics in the secondary planes of motion. Due to the increased rigidity of the bladed cleat, it was hypothesized that the bladed cleat condition would result in increased joint moments and increased peak joint angles compared to the running and turf shoe conditions.

**METHODS:** Fourteen male and fourteen female recreational soccer players were selected for the study. Subjects underwent a movement analysis while performing a controlled jump heading activity in the three different footwear conditions. The jump heading activity consisted of the subject jumping forward from a standing position half of their body height behind the 2 force plates, landing on the force plates covered with artificial turf with both feet and then jumping up to head a ball that was suspended at half the subject's maximum jump height above the front of force plates, and landing back on the force plates. The footwear testing order was randomized for each subject. Peak knee and hip joint moments and angles in the frontal and transverse plane were examined from initial contact with the force plates until the subject left the force plates to head the ball. Due to suggested differences in male and female landing mechanics, a two-way ANOVA (gender x footwear) was utilized to analyze the data with a critical p-value established at 0.05.

**RESULTS:** No interactions were observed for any variables. Independent of shoe condition, females exhibited a greater peak knee external rotation angle and a greater peak hip adduction angle compared to the male subjects, while males exhibited a greater peak ankle inversion moment than the females. Independent of gender, wearing the turf shoe resulted in a significantly greater ankle inversion moment compared to the running shoe.

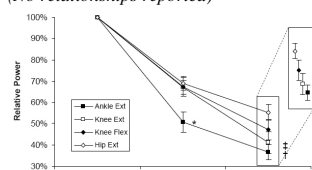
**CONCLUSIONS:** Contrary to the hypothesis, the rigid bladed shoe did not increase moments or angles when compared to the turf or running shoe conditions. Therefore, footwear does not appear to effect landing mechanics in preparation for a jump heading task. However, it may be appropriate to assess changes in landing mechanics during different landing conditions to thoroughly examine the role that footwear may play in altering injury risk during jump landings.

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**2772 Board #166 May 29 2:00 PM - 3:30 PM**

**Joint-specific Power Production And Fatigue During Maximal Cycling**

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Cycling power decreases substantially during a maximal 30 s cycling trial. It is not known whether powers produced at each joint decrease to a similar extent or if each joint exhibits an individual fatigue profile. Changes in movement patterns and/or relative joint powers with fatigue could arise from several different mechanisms or from a complex interplay of mechanisms.

**PURPOSE:** The purposes of this investigation were to determine the changes in movement and power at each joint during a fatiguing cycling trial.

**METHODS:** Thirteen trained cyclists performed a 30s maximal isokinetic cycling trial at 120 rpm. Pedal forces and limb kinematics were recorded. Joint powers were calculated using a sagittal plane inverse dynamics model, averaged for the initial, middle, and final 3s intervals of the trial, and normalized to initial values.

**RESULTS:** Relative ankle plantar flexion power was significantly less than all other joint actions at the middle interval ( $51 \pm 5\%$  of initial power;  $p=0.013$ ). Relative ankle plantar flexion power for the final interval ( $37 \pm 3\%$ ) was significantly less than the relative knee flexion and hip extension power ( $p=0.010$ ). Relative knee extension power ( $41 \pm 5\%$ ) was significantly less than relative hip extension power ( $55 \pm 4\%$ ) during the final three second interval ( $p=0.045$ ). Knee flexion power ( $47 \pm 5\%$ ) did not differ from relative hip extension power ( $p=0.06$ ).

**CONCLUSION:** These changes in power were accompanied by a decrease in time spent extending by each joint with fatigue (i.e., decreased duty cycle,  $p < 0.03$ ). Because the ankle fatigues more than the hip and knee joints, either peripheral muscle fatigue or changes in motor control strategies were identified as the potential mechanisms for joint-specific fatigue.

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**2773 Board #167 May 29 2:00 PM - 3:30 PM**  
**Muscle Onset Timing In Subjects Trained To Reduce Tibial Shock**

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Stress fractures are one of the most serious overuse injuries in runners. High tibial shock, or peak positive tibial acceleration (PPA), is correlated to high loading rates and tibial stress fracture incidence. Runners are able to reduce their PPA by altering their footstrike pattern. This change may be associated with earlier onset times of the ankle musculature.

**PURPOSE:** To compare the onset times of the ankle dorsiflexors and plantarflexors, before and after a gait retraining protocol.

**METHODS:** 9 subjects with high PPA have been studied to date. Following a baseline instrumented gait analysis, all subjects underwent a gait retraining protocol aimed at reducing their PPA. Along with kinematics, electromyographic (EMG) data were collected from the medial and lateral gastrocnemius, soleus, and tibialis anterior muscles. Data were sampled at 1200 Hz. Onset was determined when the linear envelope exceeded 2.5 standard deviations above the resting mean. Onsets were extracted from the period from 125 ms before footstrike through the end of stance. These times were compared between baseline and post-gait retraining.

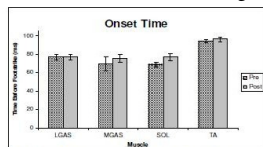


Figure 1. Mean EMG onset time expressed in milliseconds prior to footstrike, error bars are mean  $\pm$  SEM.

**RESULTS:** Subjects reduced their PPA by 39%, 6/10 increased, and 2/10 decreased their dorsiflexion at footstrike. Mean EMG onset times were similar before and after the retraining (Figure 1). However, the between-subject variability for these times was extremely high for all four muscles tested. The individual differences were largest in the soleus and tibialis anterior. For example, one subject activated the soleus as much as 22 ms later while another 27 ms prior to the pre-retraining onset time.

**CONCLUSION:** While all subjects reduced their tibial shock significantly, there were no consistent changes in ankle muscle onset times.

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**2774 Board #168 May 29 2:00 PM - 3:30 PM**  
**Comparing EMG Data On Upper And Lower Regions Of Rectus Abdominis During Exercise To Fatigue**

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A long standing debate in Exercise Science concerns the anatomy and physiology of the rectus abdominis muscle. The debate centers around whether the rectus abdominis (RA) may be parsed into upper (URA) and lower (LRA) functional units even though anatomically it is one unified muscle with tendinous inscriptions which compartmentalize the muscle into the famous "six pack" configuration.

**PURPOSE:** To determine if there were differences in the electromyographical (EMG) signatures of the upper and lower regions of the rectus abdominis during two conditions of the crunch exercise performed by each subject to volitional fatigue.

**METHODS:** Ten male volunteer collegian athletes (mean age = 20.8 yrs.) performed 2 sets of crunch exercises, randomly assigned, on 2 separate days, 48 hours apart. Data were collected using the BIOPAC<sup>TM</sup> bipolar EMG system, normalizing the data to the maximal EMG signatures of the URA and LRA during a resisted crunch maneuver. Two conditions of the crunch exercise were used. Condition 1 (C1) consisted a crunch cycle of 2 seconds; one second up and one second down. Condition 2 (C2) consisted of a crunch cycle of 4 seconds; two seconds up and 2 seconds down. EMG data were collected continuously throughout testing with the initial and final 8 seconds deleted prior to statistical analysis. Data were analyzed using a Student's t test for paired means, initial vs. fatigue EMG C1 and C2 for the URA and LRA, with a  $P \leq .05$  accepted for significance.

**RESULTS:** The mean EMG data during the initial phase of activities for the URA and LRA, respectively, were, C1:  $9.7 \pm 2.6$  mVsec. and  $8.4 \pm 2.5$  mVsec. C2:  $7.6 \pm 2.8$  mVsec. and  $6.5 \pm 2.7$  mVsec. The mean EMG data during the fatigue phase of activities for the URA and LRA were C1:  $10.6 \pm 4.4$  mVsec and  $11.8 \pm 4.2$  mVsec; C2:  $8.0 \pm 1.8$  mVsec. and  $8.6 \pm 2.2$  mVsec. The changes in EMG data between initial and fatigue components of the exercises were significant for the LRA under both conditions,  $P \leq .031$  (C1) and  $P \leq .007$  (C2) respectively, with no differences found in the URA.

**CONCLUSION:** The RA may be parsed into an URA and LRA for the physiologic purposes of core strength training.

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**2775 Board #169 May 29 2:00 PM - 3:30 PM**  
**The Relationship Of Arm Span To Maximum Voluntary Isometric Contraction And 1rm Bench Press Performance.**

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In previous studies, isometric lifting has produced varied results. These studies have examined both the acute and training effects of isometric contraction on the bench press. To date there have been no published studies that account for arm length on the acute affects of isometric contraction on the bench press exercise.

**PURPOSE:** The purpose of this study was to determine what the relationship between arm span and the acute effects of Maximum Voluntary Isometric Contraction on one repetition maximum performance in the bench press.

**METHODS:** The participants involved in this study were eight female college track and field athletes (Height  $1.72 \pm 0.9$ , BMI  $32.1 \pm 9.2$ ) who compete in the throwing event (Hammer, Shot Put, Discus, Javelin). The average 1RM bench press for the participants was  $59.5 \pm 19.8$  kilograms. A counterbalanced, within subjects design was chosen for this study. Participants were asked to report to the weight room on two separate occasions. Both days began with a standard warm-up of the bench press exercise consisting of 70% 1RM for a set of five repetitions and 80% 1RM for 3 repetitions. After the warm-up both trial days consisted of three separate, single maximal attempts to set a new 1RM in the bench press. The two treatments that were counterbalanced were Standard (STAND) and MVIC. The STAND treatment consisted only of the three maximal lifts in the bench press exercise. The MVIC treatment consisted of a 30 second maximal voluntary isometric contraction against a stationary bar at 90 degrees of elbow flexion immediately prior to each single maximal bench press lift to induce fatigue. A 72 hour washout period was incorporated between treatments.



**RESULTS:** A significant bivariate correlation ( $r=-0.855$ ,  $p=.007$ ) was found between arm span and change between previously determined 1RM and performance during MVIC. No significant relationship was found between arm span and performance change in the STAND condition ( $r=-.344$ ,  $p=0.404$ ).

**CONCLUSION:** The significant negative correlation suggests that those individuals with longer arm spans were not able to lift as much weight post-MVIC. Thus the fatigue associated with MVIC produced a greater affect in those who displaced the weight the farthest past 90 degrees of elbow flexion.

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**2776 Board #170 May 29 2:00 PM - 3:30 PM**

**Anterior Cruciate Ligament Injury Mechanism: Effects Of High Knee Abduction Loads On Passive Knee Restraints**

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(No relationships reported)

Mechanisms of non-contact ACL injuries include evidence supporting two loading patterns: injury via anterior tibial (AT) shear or via knee abduction (AB) collapse. While the ACL appears to be susceptible to AT loads, AB collapse is a commonly reported ACL injury mechanism. Intuitively, if an AB mechanism predominated, concomitant injury to the MCL would be expected, as it may provide primary restraint against AB stress. However, combined ACL/MCL injuries are rarer than isolated ACL injury.

**PURPOSE:** Analyze stresses ( $S$ ) and strains ( $E$ ) in ACL and superficial MCL (sMCL) during landing and injury simulations in a female athlete at high risk for ACL injury. The hypotheses were that combined AT/AB loads would have higher ACL  $S$  and  $E$  compared to AB loads and AT/AB loads would have higher ACL  $S$  and  $E$  relative to the sMCL.

**METHODS:** A validated finite element knee model developed from CT and MRI images of this at risk athlete was employed to analyze  $S$  and  $E$ . Kinematic and kinetic data from the same athlete were used as input for the model (ABAQUS 6.8 software). ACL and sMCL  $S$  and  $E$  were analyzed at the peak AB moment during landing from multiple drop vertical jumps (5 trials). The trial with the highest peak AB moment ( $HAB_m$ ) was used for control and injury simulations. The control was simulated with AB angle neutralized to static posture position. Injury simulations included AB injury via 4° increase in AB angle and AT/AB injury via combined 6mm AT translation and 4° AB angle increases.

**RESULTS:**  $HAB_m$  had higher ACL  $S$  and  $E$  than the control. AB injury had higher ACL  $S$  and  $E$  compared to  $HAB_m$  and control. However, AB injury had 40% higher  $S$  and  $E$  in sMCL compared to the ACL. In contrast, AT/AB injury had 7-fold higher ACL  $S$  and  $E$  compared to AB injury loads and AT/AB loads had 55% higher ACL  $S$  and  $E$  relative to the sMCL.

**CONCLUSIONS:** These findings indicate combined AT/AB loads may increase the likelihood for ACL injury compared to AB loads alone during high abduction moments. Interestingly, the sMCL appeared to be a secondary restraint to combined AT/AB loads relative to the ACL. These results help to explain the high prevalence of reported isolated non-contact ACL injuries in the absence of MCL injury, which likely result from combined anterior tibial shear and knee abduction collapse.

Supported by ACSM Foundation Plus One Active Research Grant Using Internet Technology.

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**2777 Board #171 May 29 2:00 PM - 3:30 PM**

**Knee Biomechanics In Air Assault Soldiers Performing Two-legged Drop Landings With And Without Visual Input**

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Landing tasks commonly result in non-contact knee ligament injuries and are widely performed in military training and operations. Previous civilian research has demonstrated mixed results on the effects of visual input availability on landing performance. Soldiers are frequently required to perform landings without sufficient visual input and although data are not available for fast-roping exercises performed by air assault soldiers, night time tactical maneuvers increase the risk of injury two fold.

**PURPOSE:** To determine the differences in knee landing kinematics and vertical ground reaction forces (VGRF) of air assault soldiers with and without visual input.

**METHODS:** A total of 110 male air assault soldiers ( $28.7 \pm 7.1$  yrs,  $177.2 \pm 7.2$  cm,  $83.6 \pm 12.8$  kg) participated. Subjects performed a two-legged drop landing task from a 50 cm platform onto two force plates. Six high-speed infrared cameras tracked the trajectories of the reflective markers attached to subjects' lower extremities. Subjects performed three trials each with visual input and blindfolded. Knee flexion angle, knee valgus angle, and VGRFs (normalized to body weight) were compared between conditions with dependent t-tests.

**RESULTS:** No significant differences in knee flexion and valgus angles were detected at initial foot contact. When blindfolded, maximum knee flexion was less (right:  $89 \pm 20^\circ$  vs.  $85 \pm 20^\circ$ ,  $p < 0.001$ ; left:  $89 \pm 19^\circ$  vs.  $86 \pm 20^\circ$ ,  $p < 0.001$ ), maximum VGRF of the left foot was greater ( $333.9 \pm 88.9\%$  BW vs.  $351.5 \pm 83.3\%$  BW,  $p = 0.001$ ), and time elapsed from initial foot contact to maximum VGRF of the left foot was longer ( $0.374 \pm 0.10$  vs.  $0.394 \pm 0.09$  s,  $p = 0.022$ ).

**CONCLUSIONS:** Diminished visual acuity caused the subjects to alter their landing strategy for the two-legged drop landing task. While the greater VGRF of the left foot may pose greater risk of injury, soldiers are able to dissipate the force by prolonging the time from initial foot contact to peak VGRF. Significant differences found only with the left leg raises the question whether landing strategies change based on the availability of visual input, perhaps increasing asymmetrical or preferable joint loads.

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**2778 Board #172 May 29 2:00 PM - 3:30 PM**

**Differences In Impact Force Attenuation And Knee Kinematics During Drop Jump And Drop Landing**

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(No relationships reported)

Few studies have compared impact attenuation during a pure landing task when impact attenuation is the main goal to a drop jump task where impact attenuation is immediately followed by energy generation.

**PURPOSE:** To examine differences of impact force attenuation between drop landing and the landing phase of a drop jump activity.

**METHODS:** Seven NCAA football athletes (TRAINED) and 7 recreationally active students (REC) with limited sports training and prior experience in jumping sports, performed 5 drop landing trials from each of 3 landing heights: 40 cm, 60 cm and 100% of each individual's maximum jump height (100%MJH) and 5 drop jump trials from each of the 3 drop heights. Simultaneous recording of 3D kinematics and ground reaction force (GRF) were conducted at 240 Hz and 1200 Hz, respectively. Selected peak GRF and kinematic variables were evaluated using a mixed design  $2 \times 2$  (group  $\times$  height) repeated measures analysis of variance (ANOVA,  $p < 0.05$ ) for the 40 and 60 cm conditions for the two activities separately. The group differences at the 100%MJH were evaluated with an independent-samples t-test.

**RESULTS:** The results showed that the TRAINED participants had significantly smaller peak GRF (1.7 and 2.2 BW for 40 and 60 cm) and longer time to the peak (0.057 and 0.053 s for 40 and 60 cm) compared to the REC participants (2.0 and 2.7 BW, 0.050 and 0.048 s for 40 and 60 cm) in the landing phase of drop jump. However, the TRAINED participants had greater peak GRFs (2.7 and 3.5 BW for 40 and 60 cm) and significantly shorter times to the peak (0.048 and 0.043 s for 40 and 60 cm) compared to the REC participants (2.0 and 2.7 BW, 0.060 and 0.053 s for 40 and 60 cm) in drop landing. The TRAINED athletes also showed similar knee ranges of motion (ROM) in the landing phase during drop jump but smaller and non-significant knee ROMs ( $p = 0.051$ ) in drop landing compared to the REC counterparts.

**CONCLUSIONS:** The TRAINED athletes exhibited greater impact attenuation during the landing phase of drop jump but less impact attenuation during drop landing. This difference is related to the differences in the knee ROMs during the two different landing activities. The TRAINED athletes are able to tolerate greater impact force in the regular landing and absorb greater impact force during the landing phase to facilitate energy generation during the takeoff phase in drop jump.

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**2779 Board #173 May 29 2:00 PM - 3:30 PM**  
**Ability Of Competitive Swimmers To Modify Start Depth Is Not Dependent Upon Age**

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(No relationships reported)

**PURPOSE:** There is a distinct paucity of research relating to safety concerns in competitive swimming starts. The purpose of this study was to expand upon the existing literature by examining the ability of competitive swimmers of different ages to modify on request the maximum head depth achieved during a competitive swimming start.

**METHODS:** Fourteen swimmers aged 10 years and under (age =  $7.9 \pm 1.3$  years, height =  $1.29 \pm 0.10$  m, mass =  $30.94 \pm 6.6$  kg), ten 11-12 year old swimmers (age =  $11.3 \pm 0.5$ , height =  $1.48 \pm 0.06$  m, mass =  $42.9 \pm 6.1$  kg), and eighteen 13-14 year old swimmers (age =  $13.5 \pm 0.5$ , height =  $1.62 \pm .06$  m, mass =  $54.0 \pm 6.3$  kg) were filmed underwater during execution of two competitive starts. All subjects were members of a USA Swimming sanctioned swim club. Swimmers completed one start and a subsequent freestyle sprint without instruction. Prior to the second start the swimmers were asked to make the start as shallow as possible while still completing the sprint. For each start, the maximum depth of the center of the head was determined using 2D DLT analysis.

**RESULTS:** A two-way mixed design ANOVA for maximum depth of the center of the head yielded no interaction between instruction and age group, but significant main effects for both instruction ( $F_{1,39} = 16.6$ ;  $p < 0.01$ ) and age group ( $F_{2,39} = 5.4$ ;  $p = 0.08$ ). As there was no significant interaction between instruction and age group, the 10&U, 11-12, and 13-14 groups were combined in an analysis of the ability to modify depth. When instructed to dive shallowly, the maximum head depth decreased significantly ( $p < 0.01$ ) from  $0.56 \pm 0.03$  m to  $0.45 \pm 0.02$  m. Similarly, the uninstructed and instructed groups were combined in an analysis of the age groups. The maximum head depth was significantly greater ( $p = .006$ ) for 13-14 year olds ( $.58 \pm .03$  m) than for 10&U swimmers ( $.42 \pm .04$ ), but neither group was different with respect to maximum head depth from 11-12 year olds.

**CONCLUSIONS:** Swimmers 14 years of age and younger possess the ability to modify competitive start depth on command. However, from a safety perspective, it is important to note that not all swimmers successfully modified their competitive start depth.

*Supported by a grant from USA Swimming*

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**2780 Board #174 May 29 2:00 PM - 3:30 PM**  
**Retention Of A One-session Injury Prevention Intervention After Training Abstinence**

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(No relationships reported)

**PURPOSE:** To examine the level of retention of technique feedback instruction for ACL injury prevention on the lower extremity kinematics and kinetics of a stop-jump task in strength-trained female athletes after a 9-week period of training abstinence.

**METHODS:** 10 recreational female athletes ( $n=10$ , age= $22.5 \pm 2.3$  yrs, ht= $1.67 \pm 0.07$  m, wt= $64.1 \pm 9.1$  kg) completed a strength training program focusing on the quadriceps, gluteus medius, gluteus maximus, and hamstrings. Lower extremity kinetic and kinematic data were collected during 5 stop-jump trials both before (PRE-FB) and after (PST-FB) participation in a feedback protocol. Data was also collected after a period of 9 weeks during which subjects refrained from strength or feedback training (RET). Statistical analyses were performed using dependent samples t-tests ( $\alpha < .05$ ).

**RESULTS:** The subjects demonstrated significantly improved kinetics and kinematics at PST-FB compared to PRE-FB, including decreased knee anterior shear force ( $.44 \pm .14$  BW vs  $.61 \pm .24$  BW,  $p=.011$ ), vertical ground reaction force ( $1.43 \pm .47$  BW vs  $2.10 \pm .85$  BW,  $p=.024$ ), knee valgus moment ( $.08 \pm .04$  BW\*BH vs  $.14 \pm .09$  BW\*BH,  $p=.033$ ), knee extension moment ( $.18 \pm .05$  BW\*BH vs  $.23 \pm .06$  BW\*BH,  $p=.020$ ), and hip adduction moment ( $.08 \pm .04$  BW vs  $.16 \pm .08$  BW,  $p=.011$ ), as well as increased hip flexion angles ( $37.1 \pm 7.8^\circ$  vs  $31.9 \pm 8.1^\circ$ ,  $p=.003$ ). Subjects demonstrated significantly decreased strength in all muscle groups after refraining from strength training for 9 weeks (RET) compared to PST-FB. No significant differences were observed in the subjects' kinetic or kinematic data at RET compared to PST-FB.

**CONCLUSIONS:** The results indicate that strength-trained subjects who underwent a one-time feedback intervention on stop-jump technique were able to improve their performance during a stop-jump task. Furthermore, these subjects were able to retain those improvements over a period of 9 weeks, even though the subjects' strength had significantly decreased. These results suggest that athletes who undergo pre-season injury prevention programs may be able to retain the effects during the course of a season.

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**2781 Board #175 May 29 2:00 PM - 3:30 PM**  
**Systematic Review Of Biomechanical Analysis Of Male 100 Meter Sprint**

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(No relationships reported)

In track and field, 100 meter (m) sprint is one of the most exciting events. Improved technology has facilitated sport skills and performance enhancement. However, the research in 100m sprint is not well documented.

**PURPOSE:** To analyze key elements in different phases of male 100m sprint and to compare skill characters among Chinese and American elite sprinters to help the 100m sprinters in China to improve their performances.

**METHODS:** Systematic views and secondary data analysis to compare biomechanical characters in elite 100m sprinters in China and America.

**RESULTS:** In sprint start, no difference was found on the forces exerted against the blocks and on reaction time among the sprinters. Through the analysis of leg movement, the sprinters should flex their knees properly ( $90^\circ$  for front leg &  $120^\circ$  for rear leg) in order to produce the maximum impulse so that they can leave the blocks with the greatest possible velocity in the sprint start. Acceleration phase was the most important phase in sprint since it made up the maximum velocity and accounted for 64% of performance. Maximum velocity (MV) was found highly related to the sprint performance ( $r = 0.78$ ). Chinese sprinters had less MV ( $11.11 - 11.30$  m/s) compared to American elite sprinters ( $11.76 - 12.05$  m/s). Maintaining MV was found to be crucial to keep high performance ( $r = 0.99$  for  $MV > 11.5$  m/s). At initial foot contact, the vertical velocity and landing angle were  $1.15$  m/s and  $85.7^\circ$  for American sprinters, and  $1.35$  m/s (17% higher) and  $81.5^\circ$  for Chinese sprinter. Compared to American sprinters with  $144.4^\circ$  of initial knee flexion and  $10.2^\circ$  range of motion during landing, Chinese sprinters had disadvantages in lifting leg ( $152.1^\circ$  of initial knee flexion and  $3.2^\circ$  of range of motion). Increasing the horizontal distance between supporting leg and the project of center of gravity (.67m for American and .53m for Chinese sprinters) was related to increased stride length and velocity.

**CONCLUSIONS:** Sprint training and performance improving should emphasize on increasing stride frequency and length, high center of gravity with less fluctuation, as well as smooth movement rhythm. It is crucial to increase duration and distance for acceleration phase in order to optimize the maximum velocity in sprint.

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**F-33 Free Communication/Poster - Sport Science III**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

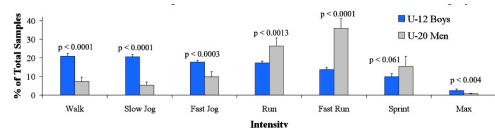
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**2782 Board #176 May 29 3:30 PM - 5:00 PM****Age And Experience Differences In Work Intensity During Soccer Matches**

Morris Levy<sup>1</sup>, Michael S. Orendurff<sup>2</sup>, Jason D. Walker<sup>3</sup>, David Hoffman<sup>4</sup>. <sup>1</sup>University of Minnesota, Duluth, MN. <sup>2</sup>Texas Scottish Rite Hospital for Children, Dallas, TX. <sup>3</sup>University of Southern California, Los Angeles, CA. <sup>4</sup>University of Dallas, Duluth, TX.  
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*(No relationships reported)*

**PURPOSE:** The purpose of this project was to compare the distribution of movement intensity for a men's under-20 (U-20) and a boy's under-12 (U-12) team.



**METHODS:** Step rate data were recorded on 5 players from each team during competitive matches using

StepWatch Activity Monitors. Step rates were categorized into 7 levels of intensity: Walk, Slow Jog, Fast Jog, Run, Fast Run, Sprint, and Max as a percentage of the total samples. Each level was compared between the two teams using ANOVAs. First Referees' step rates were also recorded.

**RESULTS:** For U-12 players the step rate data showed much more time spent in recovery at low levels of intensity (Walk, Slow Jog, Fast Jog), less time spent in Run, Fast Run, and Sprint intensities, but more time at Max intensity compared to the U-20 team. The First Referees' distributions mimicked the players they were officiating.

**CONCLUSIONS:** Data confirm that younger players are apt to run more often at maximum intensity, with more frequent low-level recovery periods. The U-20 players were able to compress their step rates to maintain a moderate to high level of activity more often but spent less time at either the slowest or fastest rates. U-20 players rarely hit top speed unless a critical play was forming that might result in a scoring opportunity in either goal. So, these more experienced players were also more likely to avoid frequent rest periods necessary after bouts of maximum speed. This is likely due to reduced fitness and ball control skills by U-12 players, and not an inability to read the development of a critical play. Coaches may want to encourage younger teams to focus more on ball control skills as it would allow these younger players to better modulate work intensity to manageable levels during soccer matches.

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**2783 Board #177 May 29 3:30 PM - 5:00 PM****Lean Tissue Index: An Excellent Predictor Of Bone Mineral Density Of Adolescent Female Cross-country Runners**

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*(No relationships reported)*

**PURPOSE:** Determine the best body-composition variable for predicting bone mineral density (BMD) in the sub-population, which included body weight (WGT), lean tissue (LT), body mass index (BMI), body fat (BF), lean tissue index (LTI = LT/Height<sup>2</sup>), and body fat index (BFI = BF/Height<sup>2</sup>). Subjects: 28 female runners (Mean Age + SD = 14.9 + 1.6 yrs).

**METHODS:** Measure BMD using DXA and estimate skeletal maturity (SM) using questionnaire data.

**RESULTS:** Partial correlations indicated LTI was the variable most highly associated ( $p = .712$ ) with BMD. Multiple linear regression indicated LTI was the predictor variable with the best fit. Predictions of the dependent criterion variables, BMDleg and BMD, were calculated using the independent predictor variables, LTI and SM. Significant regression equations were found. The subjects' BMDleg was found to be equal to  $(-2.486) + (2.912)SM + (5.540E-02)LTI$ ,  $[F(2,23) = 20.161, SEE = .0634]$  with an  $R^2 = .637$ ; and the subjects' BMD was found to be equal to  $(-1.645) + (2.209)SM + (4.068E-02)LTI$ ,  $[F(2,23) = 18.828, SEE = .0487]$  with an  $R^2 = .621$ .

**CONCLUSION:** LTI was the body composition variable most highly associated with BMD ( $p = .712$ ). LTI was also the best body-composition component to predict BMD ( $r = .788$ ).

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**2784 Board #178 May 29 3:30 PM - 5:00 PM****Influence Of Body Fat Percentage On Agility, Strength, And Endurance Performance**

Katie J. Bouley, Mary C. Pieklo, Tracey D. Matthews, Vincent J. Paolone, FACSM. *Springfield College, Springfield, MA.*  
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*(No relationships reported)*

Individuals carry different levels of body fat, and the degree of fatness can impact overall performance, including strength, agility, and endurance. A low relative body fat and a high ratio of lean muscle mass to body fat are two characteristics observed in most athletes. Some athletes may display body fat percentages that are too high or too low for optimal performance.

**PURPOSE:** The purpose of the investigation was to examine the relationship between body fat percentage and athletic performance in moderately active females.

**METHODS:** Fifteen moderately active females currently taking a form of estrogen based chemical contraceptive performed a series of performance tests to measure overall endurance, relative muscular strength, muscular endurance, and agility performance. Percent body fat was estimated using hydrostatic weighing techniques. Endurance was measured by performing a VO<sub>2</sub>peak test following the Modified McConnell Running Protocol. Relative muscular strength was measured using a handgrip dynamometer to determine maximum grip strength. Muscular endurance was measured using a handgrip dynamometer to determine the strength decrement index (SDI). Agility performance was measured using the SEMO Agility Test. The Pearson Product Moment Correlation Coefficient was used to determine the relationship between percent body fat and athletic performance.

**RESULTS:** Significant linear relationships were found between endurance performance and percent body fat ( $r = -0.88, p < 0.01$ ) and between muscular endurance and percent body fat ( $r = 0.64, p < 0.05$ ). No significant linear relationships were found between percent body fat and relative muscular strength ( $r = -0.43, p > 0.05$ ) and agility performance ( $r = 0.25, p > 0.05$ ).

**CONCLUSION:** Body fat percentage is highly related to cardiovascular endurance and muscular endurance performance in moderately active females.

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**2785 Board #179 May 29 3:30 PM - 5:00 PM****Body Mass Index Misclassifies Fatness Of College Athletes**

Gunnhildur Hinriksdóttir<sup>1</sup>, Sigurbjörn Á. Amgrímsson<sup>1</sup>, Barry M. Prior<sup>2</sup>, Kirk J. Cureton, FACSM<sup>3</sup>. <sup>1</sup>University of Iceland, Laugarvatn, Iceland.

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(No relationships reported)

The relation between body fatness (%Fat) and body mass index (BMI) has been studied in athletes using estimates of %Fat from densitometry, which are less valid than estimates from a 4-component model for athletes in certain sports.

**PURPOSE:** To evaluate the relation between %Fat and BMI and to estimate the validity of BMI standards for overweight/obesity (O/O) in athletes using a 4-component (4C) model to assess %Fat.

**METHODS:** Height and weight were measured in young (21.0±2.5 yrs) female athletes (FA, n=54, 165.6±7.5 cm, 59.3±7.8 kg, 21.6±2.1 kg·m<sup>-2</sup>), male athletes (MA, n=38, 181.4±8.5 cm, 78.0±15.0 kg, 23.5±3.0 kg·m<sup>-2</sup>), football players (FP, n=40, 186.4±6.5 cm, 107.5±16.4 kg, 30.8±3.6 kg·m<sup>-2</sup>), female sedentary controls (FC, n=45, 164.5±4.9 cm, 58.2±8.6 kg, 21.5±3.3 kg·m<sup>-2</sup>), and male sedentary controls (MC, n=36, 177.9±4.9 cm, 71.1±7.6 kg, 22.5±2.3 kg·m<sup>-2</sup>). Measures of body density by underwater weighing, total body water via deuterium dilution, and total body mineral from DXA were used to assess body composition using a 4C model.

**RESULTS:** FA did not differ from FC in height, weight or BMI (p=0.381-0.887) but FA were leaner (18.7±5.3% vs. 26.4±5.2%, p<0.001). Similarly, MA did not differ from MC in BMI (p=0.091) but were taller (p=0.036), heavier (p=0.015), and leaner (10.1±54.1% vs. 15.1±4.8%, p<0.001). In contrast, FP were taller, heavier, and had greater BMI (all p<0.001) than MC, but did not differ in %Fat (13.2±6.6%, p=0.146). BMI was curvilinearly related to %Fat among FA and that relation was moderated by race (%Fat = 128.905 - 10.874\*BMI + 0.267\*BMI<sup>2</sup> - 4.463\*Race (0=white, 1=black), R=0.53, SEE=4.6%, p=0.001). The relation was similar in the combined group of MA and FP (%Fat = 39.362 - 2.785\*BMI + 0.064\*BMI<sup>2</sup> - 2.417\*Race, R=0.69, SEE=4.2%, p<0.001). Low rates of overfatness were found in FA (3.7%), MA (10.5%), FC (11.1%), and MC (13.9%) but many (42.5%) FP were classified as overfat. Using BMI >25 kg·m<sup>-2</sup> for O/O, sensitivity was low (FA = 0.50), medium (MA = 0.75), and high (FP = 1.00), whereas the opposite was found for specificity (0.94, 0.74, 0.09). BMI cutpoints maximizing sensitivity and specificity were 23.4, 25.4, and 31.7 in FA, MA, and FP, respectively.

**CONCLUSION:** BMI and %Fat are not strongly related in athletes and BMI should not be used to classify overweight/obesity in this group, especially not among FA and FP.

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**2786 Board #180 May 29 3:30 PM - 5:00 PM**  
**Subcutaneous Fat Distribution Of Wheelchair Basketball Players**

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(No relationships reported)

Exercise and caloric restriction can lead to a reduction in total body fat mass. However, it is not clear whether local changes in the amount of the subcutaneous fat happen during activity and inactivity.

**PURPOSE:** Evaluate the subcutaneous fat distribution of wheelchair basketball players.

**METHODS:** Subcutaneous fat thickness (FTH) at 11 places was measured using B-mode ultrasound in wheelchair basketball players (WB, n=13), inactive wheelchair users (SW, n=12), and able-bodied persons (AB, n=11). Subcutaneous fat cross-sectional area (F-CSA) was presumed using a cross-sectional model and the cross-section was modeled by a double circle. The outside circle represents the whole outline of the modeled part and the inside circle represents the outline of the musculoskeletal system. The area between inside circle and outside circle represents F-CSA, which was calculated by subtracting the area of musculoskeletal cross-section (MS-CSA) from the area of whole organization cross-section (W-CSA). MS-CSA and W-CSA were calculated by using FTH (f) and circumference (l), measured at the modeled part [(W-CSA)=p(l/2p)(l/2p), (MS-CSA)=p(l/2p-f)(l/2p-f)].

**RESULTS:** As for FTH of the upper limb and the trunk, a significant difference was not found in either area among the three groups. Within the lower thigh, FTH of WB and SW were thicker than that of AB (p<0.05). However, WB and SW had smaller W-CSA and MS-CSA in the lower limb than AB (p<0.01). In addition, W-CSA and MS-CSA in the upper limb of WB were larger than that of the others (p<0.05). Finally, while F-CSA in most parts of the body of WB tended to be smaller compared with SW, there was no significant difference of F-CSA in any areas of the three groups.

**CONCLUSIONS:** The thicker subcutaneous fat measured in the paraplegic person's lower limbs does not mean that a localized increase of subcutaneous fat at the paralyzed part occurred. It is expected that atrophy of the muscle had occurred at the paralyzed part, and the place where muscle had existed was occupied by subcutaneous fat, which led to thicker subcutaneous fat. On the other hand, it is suggested that the activity of the upper limb during the wheelchair basketball has caused muscle hypertrophy at the activated part and a decrease of subcutaneous fat in the whole body.

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**2787 Board #181 May 29 3:30 PM - 5:00 PM**  
**Comparison Between Skinfolts And Dexa For Determination Of Body Composition In Weight Category Athletes**

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(No relationships reported)

Weight category sports are classified as those for which athletes must weigh in at a designated weight prior to competition. Due to the weight restrictive nature of such sports, body mass must take precedence over many other factors for these athletes. Accurate assessment of body composition for athletes competing in weight category sports is essential, to ensure that the most efficient use of body mass is made in order to optimise performance.

**PURPOSE:** The purpose of this study was to compare skinfold assessment and DEXA as methods of estimating body composition in a group of weight category athletes.

**METHODS:** 41 weight category athletes were recruited to take part in this study (29 horse racing jockeys and 12 boxers). The subjects (age: 24 ± 6yrs) anthropometric characteristics were, stature: 1.71 ± 0.08m, mass: 61.8 ± 11.38 kg and BMI: 21.01 ± 2.52. Body composition values were extrapolated from a dual energy x-ray absorptiometry (DEXA) total body scan. Subcutaneous fat was measured using the skinfold calliper technique from 7 sites: bicep, tricep, subscapular, supraspinale, abdominal, front thigh, and medial calf. Body density was estimated using a 7 site regression equation, and converted to percentage body fat using a standard equation.

**RESULTS:** Mean ± SD for DEXA and skinfold estimates were 11.05 ± 5.36 and 9.13 ± 2.81 respectively. Significant differences were shown between the two estimates of body composition (p = 0.000). A strong positive correlation was found between both types of assessment (r = 0.920, r<sup>2</sup> = 0.85). Mean percentage difference between both types of assessment was 2.37 ± 2.26 %, though this varied from 0.10 - 12.3 %. Variations in body composition assessments appeared to become more pronounced as DEXA total body scan estimates increased.

**CONCLUSIONS:** Though skinfold assessment is a useful and practical tool for estimation of body composition, results differed significantly from those achieved using DEXA, which has been described as a level two measure of body composition assessment. Weight category athletes are a unique population, with specialised requirements in relation to management of body composition. Population specific regression equations for estimation of body density may be required, in order to provide a more accurate assessment of body composition in this population.

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**2788 Board #182 May 29 3:30 PM - 5:00 PM**  
**A Skinfold Regression Equation For Predicting Body Fat Percentage In Elite Female Distance Runners**

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(No relationships reported)

**PURPOSE:** Elite female distance runners have a rational concern for sustaining relatively low body fat mass to maintain a low air-resistance profile and a high strength-to-weight ratio. However, the current criterion measure for body composition assessment, dual-energy x-ray absorptiometry (DEXA), is expensive and requires that athletes visit labs to monitor changes in soft tissue. So as to create a field technique with a relatively low standard error, we investigated the potential of creating a regression equation that would use either skinfolds (SF-BF%) or bioelectrical impedance (BIA-BF%) for predicting DEXA-derived body fat percent (DEXA-BF%).

**METHODS:** Long-distance female runners (N=77) were assessed in the Laboratory for Elite Athlete Performance at Georgia State University over a 5-year period using IRB-approved protocols. Body composition was predicted for all athletes using DEXA (Lunar DPXL) and 9 skinfolds (triceps, biceps, pectoral, midaxillary, subscapular, suprailiac, abdomen, thigh, and calf) using a Harpenden caliper. A sub-portion (N=23) of these athletes were also assessed using BIA (Tanita BF-350) set to 'athlete' mode.

**RESULTS:** Athletes ranged in age from 18 to 39 (mean=25.4 yr;  $\pm 5.07$ ), and had a mean weight of 56.6kg ( $\pm 4.58$ ) and a mean height of 168.47cm ( $\pm 6.16$ ). The DEXA-BF% was more highly correlated with SF-BF% ( $R=.864$ ;  $p<.001$ ) than with BIA-BF% ( $R=.417$ ;  $p<.05$ ). As a result, a regression analysis using age, 9 skinfolds, height, and weight was used to predict DEXA-BF%. The variables explaining a significant portion of the variance in DEXA-BF% included weight and the midaxillary, suprailiac, mid-thigh, and calf skinfolds. These variables were included in a linear regression analysis to predict DEXA-BF% that resulted in an equation with an  $R^2$  of .909, and a SEE of  $\pm 1.77\%$ .  $[DEXA_{BF\%} = WT_{kg} (.124) + MIDAXILLARY_{mm} (.826) + SUPRAILAC_{mm} (.475) + THIGH_{mm} (.237) + CALF_{mm} (.512) - 8.063]$

**CONCLUSIONS:** Skinfolds are predisposed to wide error when used by inexperienced anthropometrists, and also produce large intrameasurer error. However, when used by an experienced single measurer on the same individual, the high  $R^2$  and relatively low SEE of this equation may provide female endurance athletes with a satisfactory field assessment technique for monitoring changes in body fat percent.

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**2789 Board #183 May 29 3:30 PM - 5:00 PM**  
**The Effects Of Hypoxic Manipulation On  $VO_{2max}$  And Sea-level Performance: A Meta-analysis**

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(No relationships reported)

In the past decades there has been an increased interest in hypoxic manipulation (HM) (i.e. altitude training, live high + train low (LH+TL) etc.) for improvement in sea-level performance. The efficacy and mechanism of HM has been conflicting. A method of resolving the equivocal nature of HM data is through the use of meta-analysis.

**PURPOSE:** The purpose of this meta-analysis was to identify the effects of HM versus normoxic training on  $VO_{2max}$  and sea-level performance.

**METHODS:** An online database and the reference lists of peer-reviewed journal articles were used to find pertinent journal articles. A total of 74 journal articles were found, of which 32 met the inclusion criteria and 16 of the 32 were reviewed for this preliminary study. The journal articles included in the meta-analysis had to meet the following 1) used a control group in their design and 2) reported means and standard deviations with their results. The dependent variables were  $VO_{2max}$  and exercise performance. Exercise performance was defined as time trial performance, peak power during a GXT, or total work capacity. The independent variable was HM and included traditional altitude training, LH+TL, live low + train high and intermittent hypoxic exposure. There were a total of 43 extracted data points:  $VO_{2max}$  (n = 19 control and n = 24 HM) and performance (n = 20 control and n = 23 HM). Effect size (ES) was calculated using Cohen's d:  $ES = (\text{posttest mean} - \text{pretest mean}) / \text{pretest SD}$ . A t-test was used to determine the difference between the mean ES for the control and the HM.

**RESULTS:** The mean ES for control and HM were .28 and .33 for  $VO_{2max}$  and .29 and .50 for performance, respectively. There were no difference in ES for  $VO_{2max}$  but a statistically higher ES was observed for performance in HM group.

**CONCLUSION:** In summary our data indicates a statistically higher ES for performance in HM versus normoxic training but no differences were observed between ES's of  $VO_{2max}$ .

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**2790 Board #184 May 29 3:30 PM - 5:00 PM**  
**Influence Of Body Mass, Body Composition, And Performance State On Total Hemoglobin Mass**

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(No relationships reported)

**PURPOSE:** To define the separate impact of lean body mass and of endurance performance state on total haemoglobin mass and to evaluate its influence on  $VO_{2max}$ .

**METHODS:** In total, 114 male subjects categorized into 7 performance groups which were characterized by extremely different inter-group body dimensions and endurance performance participated at the study (I. German elite rowers (R, n=15,  $VO_{2max}$  65.7 $\pm$ 6.3 ml/kg/min), II. German elite runners (GR, n=13, 69.0 $\pm$ 3.0ml/kg/min), III. Kenyan elite runners (KR, n=10, 71.5 $\pm$ 5.0ml/kg/min), IV. Body Builders (BB, n=20, 48.2 $\pm$ 7.7ml/kg/min), V. leisure athletes (LA, n=14, 59.5 $\pm$ 6.0ml/kg/min), VI. fit but untrained subjects (UTr, n=10, 51.1 $\pm$ 6.0ml/kg/min), and VII 10.4  $\pm$ 2.4 yrs old fit boys (Y, n=32, 56.6 $\pm$ 6.2ml/kg/min)). tHb-mass was determined using the optimized CO-rebreathing method and  $VO_{2max}$  was measured on a discipline-specific ergometer and calculated to treadmill conditions. Lean body mass was determined using skin fold measurement and was calculated by age-adjusted formulas.

**RESULTS:** Absolute  $VO_{2max}$  ranged from 1010 to 6320 ml/min and tHb-mass from 242g to 1453g showing a very close relationship. Except BB all groups fit well in this relationship (regression analysis without BB:  $r = 0.973$ , BB included:  $r = 0.92$ ). tHb-mass was best related to lean body mass (LBM,  $r = 0.964$ ) and less to body surface area (BSA,  $r = 0.935$ ) and body mass ( $r = 0.919$ ). At identical body mass those groups characterized by high performance state (R, GR, KR) showed ~25% higher tHb-mass than those with low performance (LA, UTr, Y). Comparing both subgroups at identical lean body mass the difference in tHb-mass was reduced to 11.5%.

**CONCLUSION:** In athletes and fit sedentary subjects  $VO_{2max}$  is closely related to tHb-mass over the whole physiological range indicating that the change in 1g haemoglobin is associated with a change in  $VO_{2max}$  by 4.4 ml. tHb-mass mostly depends on lean body mass (16.8g haemoglobin per 1kg LBM), whereas endurance performance has only minor impact. BBs, however, differ from all other groups. Although their tHb-mass is very high due to high LBM, this beneficial precondition can not be converted into high aerobic performance. It is concluded that although high tHb-mass is a prerequisite metabolic adaptations are necessary for high  $VO_{2max}$ .

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**2791 Board #185 May 29 3:30 PM - 5:00 PM**  
**Laboratory Performance Evaluations, Time Trial Performance, And Training Intensity Distribution In Elite Masters Cyclists**

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(No relationships reported)

**PURPOSE:** This study looked at the relationship between laboratory performance evaluations (Lactate Threshold (LT) Power and  $VO_{2max}$ ), simulated time trial (TT) performance, and training intensity distribution in a group of elite masters cyclists.

**METHODS:** On two occasions separated by 7 weeks, 5 males [54.0 $\pm$ 10.0 yr, 73.0 $\pm$ 7.0 kg, 52.02 $\pm$ 3.61 ml·kg<sup>-1</sup>·min<sup>-1</sup>] volunteered to perform an incremental lactate profile and

VO2max test on a cycle ergometer. After a sufficient warm-up, workload started at 100W and increased by 25W every 4 minutes until exhaustion. Two days later the subjects performed a 38km simulated TT using their own bicycles on a computer controlled stationary trainer. The course was programmed to mimic the altitude and distance profile of a local TT course. No training modifications were made; subjects were asked to maintain their normal training and racing patterns for the duration and were asked to record all training using a commercially available power measuring device. All training data were downloaded via commercially available software for analysis.

**RESULTS:** Subjects' body mass was 2.6% lower ( $73.0 \pm 7.0$  kg vs.  $71.2 \pm 7.3$ ;  $p > 0.05$ ) following 7 weeks of training. Subjects completed the 38km TT 4.1% faster ( $1:07:47 \pm 4:20$  vs.  $1:05:00 \pm 3:51$ ;  $p = 0.05$ ) at 8% higher power ( $232 \pm 32$  W vs.  $251 \pm 36$  W;  $p > 0.05$ ). This performance improvement was despite no statistically significant difference in power at LT ( $240 \pm 31$  W vs.  $246 \pm 36$  W;  $p > 0.05$ ) or in absolute VO2max ( $3.84 \pm 0.44$  L/min vs.  $3.97 \pm 0.37$  L/min,  $p > 0.05$ ). Subjects spent  $33.9 \pm 3.0\%$  of their training time at less than 50% of their initial sustained TT power,  $26.4 \pm 8.6\%$  between 50 and 75% of TT power,  $16.9 \pm 1.9\%$  between 75 and 95%,  $3.4 \pm 0.7\%$  from 95-100%,  $6.4 \pm 2.1\%$  from 100-110%,  $9.4 \pm 3.0\%$  from 110-140% of TT power, and  $3.7 \pm 1.9\%$  above 140% of TT power. Subjects trained an average of  $7.6 \pm 3.1$  hours per week (range 12.2 to 3.7).

**CONCLUSIONS:** We conclude that performance improvements may occur without improvement in laboratory variables typically associated with increased performance, namely LT power and VO2max. We also conclude that the training distribution and/or total training time undertaken by our subjects was sufficient to improve TT performance and relative VO2max but insufficient to improve power at LT as defined by our protocol.

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**2792 Board #186 May 29 3:30 PM - 5:00 PM**  
**Comparison Of RPE To Blood Lactate Levels In Cyclists Based On Mileage Per Year**

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(No relationships reported)

**PURPOSE:** To examine the effect of number of miles cycled per year on use of the BORG-RPE (6-20) scale to predict blood lactate accumulation while cycling.

**METHODS:** Thirty male cyclists (Age 30-60, mean = 47 years) were grouped according to number of miles ridden per year (group 1 < 100, group 2 = 1000-2000, group 3  $\geq 5000$ ). Subjects completed an incremental stage cycling protocol, increasing resistance every three minutes. Rating of perceived exertion (RPE), revolutions per minute (RPM) and heart rate (HR) were recorded every minute. Blood lactate concentration was collected every 3-min and an additional sample was taken when the subject reported an RPE = 13. Lactate threshold (LT1) was defined as an RPE of 13 on the BORG-RPE scale and by a one millimole (mM) increase in blood lactate accumulation. Onset of blood lactate accumulation (LT2) was defined as a blood lactate concentration of 4.0 mM.

**RESULTS:** There was a significant difference in the RPE reported at LT1,  $p < .042$ . Groups 1 & 2 reported an RPE of 13 (mode) and group 3 reported a mode RPE of 16. However, there was no significant difference between the RPE reported at 4 mM (LT2) of lactic acid accumulation between the three groups. There was a significant difference in heart rate at 175 watts,  $p < .043$ . The mean HR for groups 1, 2, & 3 were 150, 144, & 126 bpm respectively. There was a significant difference in power output between groups 1, 2, & 3 for both LT1 (125W, 150W, 275W) & LT2 (150W, 200W, 325W),  $p < .000$ .

**CONCLUSION:** Training higher than 5000 miles per year is associated with an over estimation of LT1 using RPE. All three groups were able to predict LT2 using RPE. Lactate level coincides with RPE at LT1 and LT2, but it may not be the feedback signal which determines RPE. Subjects may attend to muscular effort rather than metabolic signaling to assess their perceived exertion.

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**2793 Board #187 May 29 3:30 PM - 5:00 PM**  
**Energy Expenditure And Comfort During Nordic Walking And Ordinary Walking**

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(No relationships reported)

It is a characteristic of Nordic Walking that energy expenditure is greater during this fitness activity than during ordinary walking. As much as 23% greater energy expenditure has been reported. The amount of extra energy expenditure during Nordic Walking most likely depends on how vigorously the Nordic Walking is performed. However for another important characteristic of fitness exercise, it is unknown how comfort compares for Nordic Walking and ordinary walking.

**PURPOSE:** To compare energy expenditure and comfort during Nordic Walking and ordinary walking.

**METHODS:** Twelve participants (mean  $\pm$  SEM: 171.5  $\pm$  1.5 cm, 67.0  $\pm$  2.7 kg, 50.6  $\pm$  2.4 years, maximal oxygen uptake of  $43.4 \pm 2.8$  ml  $\text{kg}^{-1} \text{min}^{-1}$ ) performed 6-min bouts of uphill ( $12^\circ$ ), downhill ( $12^\circ$ ), and horizontal Nordic Walking as well as ordinary walking on a motorized treadmill with their preferred pole length of  $67.6 \pm 0.6\%$  of body height. Energy expenditure was calculated from measured oxygen uptake while comfort was self-rated on a 1- to 10-point scale where 1 and 10 corresponded to "very, very uncomfortable" and "very, very comfortable", respectively.

**RESULTS:** Nordic Walking required as much as  $65 \pm 12\%$  greater energy expenditure ( $p < 0.05$ ) than ordinary walking with the greatest difference observed for the horizontal condition. During uphill and downhill conditions, energy expenditure for Nordic Walking was  $8 \pm 2\%$  and  $55 \pm 12\%$  higher, respectively ( $p < 0.05$ ). Nevertheless, comfort was similar for the two types of locomotion for each slope ( $p > 0.05$ ). Illustrating the peculiarity of Nordic Walking, comfort was  $7.3 \pm 0.6$  at the same time as participants exercised at more than 85% of their maximal oxygen uptake during uphill Nordic Walking.

**CONCLUSION:** Comfort responses were generally high and at the same time similar for Nordic Walking and ordinary walking for each slope condition despite greater energy expenditure during Nordic Walking. The substantially larger energy expenditure of Nordic Walking compared to previous studies reflects the particularly vigorous Nordic Walking technique used here. From a physical activity and public health perspective it is noteworthy that Nordic Walking (vs. other forms of physical activity, e.g. running) is comfortable and apparently gentle on the body for many people, even when performed at a considerable cardiovascular load.

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**2794 Board #188 May 29 3:30 PM - 5:00 PM**  
**The Onset And Magnitude Of Cardiovascular Drift Depend On Exercise Intensity In Recreational Runners.**

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(No relationships reported)

Cardiovascular drift (CVD) is a gradual increase in heart rate (HR) during prolonged steady-state exercise. Despite considerable research on the etiology of this complex phenomenon, little is known as to the effects of CVD on energy consumption.

**PURPOSE:** To examine the potential effects of CVD on aerobic and anaerobic metabolism. **METHOD:** Recreational runners ( $n=10$ , age  $40.3 \pm 8.3$  years, height  $176 \pm 7$  cm, weight  $71.29 \pm 10.76$  kg,  $\text{VO}_{2\text{max}}$   $57.29 \pm 5.96$  ml  $\cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ) volunteered for this study and signed informed consent forms. Each participant performed 5 running tests 2-4 days apart: a maximal oxygen consumption ( $\text{VO}_{2\text{max}}$ ) test (2-min stages to exhaustion), a Maximal Lactate Steady State test (MLSS), and 3 prolonged submaximal bouts (45 min duration each) at intensities corresponding to 95%, 100%, and 105% of the MLSS velocity (1% grade). HR and  $\text{VO}_2$  were recorded continuously throughout all tests; blood lactate was measured at the end of each stage during the first 2 tests, and every 10 minutes for the 3 prolonged bouts. All protocols were approved by the IRB.

**RESULTS:** Only 3 runners were able to complete the 105% MLSS bout. Onset of CVD was different for every participant, often with no HR plateau in the 105% MLSS bout. Small differences in exercise intensity ( $0.22 \text{ m} \cdot \text{sec}^{-1}$ ) yielded statistically significant ( $p < 0.05$ ) differences across the three intensities in the amplitude of CVD (increases of 7 BPM, 14 BPM, and 18 BPM for the 95%, 100%, and 105% respectively),  $\text{VO}_2$  ( $1.42 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ,  $1.8 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ , and  $1.39 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$  respectively), and blood lactate ( $0.25 \text{ mmol} \cdot \text{L}^{-1}$ ,  $0.88 \text{ mmol} \cdot \text{L}^{-1}$ , and  $1.08 \text{ mmol} \cdot \text{L}^{-1}$  respectively) between steady state and minute 40.

**CONCLUSION:** We successfully measured the small changes associated with the metabolic cost of exercise during CVD. Our data conclusively indicate that the onset of CVD is affected by the intensity of exercise and the amplitude of CVD is greater as exercise intensity increases.

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**2795 Board #189 May 29 3:30 PM - 5:00 PM**  
**A Test For Determining Critical Heart Rate Using The Critical Power Model**

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(No relationships reported)

The critical power (CP) test relates the amount of work accomplished at exhaustion ( $W_{lim}$ ) and the time to exhaustion ( $T_{lim}$ ) and, theoretically, estimates the maximum power output (P) that can be maintained for an extended period of time without fatigue. The CP test, however, overestimates the exercise intensity that can be sustained over time and a significant, progressive increase in the metabolic intensity is observed until exhaustion.

**PURPOSE:** The purpose of this study was to apply the CP model to heart rate (HR) data to propose a HR based analog of the CP test called the critical heart rate (CHR) test. The CHR was compared to the HR values at CP ( $CP_{HR}$ ), ventilatory threshold ( $VT_{HR}$ ), and respiratory compensation point ( $RCP_{HR}$ ).

**METHODS:** Ten adults (mean age  $\pm$  SD =  $23 \pm 1$  years) performed an incremental (30W increase every 2 minutes) test to exhaustion on an electronically braked ergometer for the determination of  $VO_{2peak}$ , VT, and RCP. The subjects also performed four randomly ordered workouts to exhaustion at different power outputs (ranging from 100 to 246W) for the determination of CP and CHR. For each power output, the total number of heart beats that occurred were calculated as the product of the average 5-second HR (bpm) and total time to exhaustion (min). The total number of heart beats and work (kgm) for each of the four power outputs were plotted as a function of the  $T_{lim}$  at each power output. The CHR and CP were defined as the slope coefficients of the regression lines between total number of beats or  $W_{lim}$  and  $T_{lim}$ , respectively. The HR values from the incremental test were plotted against power output or  $VO_2$  values and the regression equations derived were used to determine the HR that corresponded to CP, VT, and RCP.

**RESULTS:** A one-way repeated measure ANOVA indicated that CHR ( $165 \pm 11$  bpm,  $91.7 \pm 3.1\%$   $HR_{max}$ ) was not significantly different from  $RCP_{HR}$  ( $169 \pm 10$  bpm,  $91.9 \pm 5.5\%$   $HR_{max}$ ), but was significantly higher than  $CP_{HR}$  ( $149 \pm 13$  bpm,  $82.6 \pm 5.5\%$   $HR_{max}$ ) and  $VT_{HR}$  ( $153 \pm 15$  bpm,  $83.2 \pm 6.3\%$   $HR_{max}$ ).

**CONCLUSIONS:** The relationship between HR and  $T_{lim}$  from the CHR test can be described by the CP model. The CHR test may be a practical method for estimating RCP. Furthermore, the use of a constant HR instead of P may provide an exercise intensity that prevents the progressive increase in metabolic intensity observed until exhaustion during the CP test.

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**2796 Board #190 May 29 3:30 PM - 5:00 PM**  
**Age, Gender, And Run Time As Determinants Of Pacing In The Marathon**

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(No relationships reported)

**PURPOSE:** To determine the independent influences of age, gender, and run time on marathon pacing. Pacing was defined as the mean velocity (min/mile) of the first 20.2 miles (32.5 km) divided by that of the last six miles (9.7 km), expressed as a percentage.

**METHODS:** Subjects were 186 men and 133 women marathoners from the 2005, 2006, and 2007 races of a midwest US marathon. The course was a one-mile (1.6 km) loop with pace markers throughout, thus facilitating pacing strategy. Split times were measured electronically via shoe chip for each mile. The February event ensured that ambient temperature (never above 5 deg C), was not a factor in hyperthermia, a condition known to substantially slow marathon times and affect pacing.

**RESULTS:** Multiple regression analysis revealed that female, older or faster runners demonstrated more consistent pacing than male, younger or slower marathoners ( $p < 0.01$  for each predictor and overall explained variance was 18%). No two- or three-way interactions were statistically significant. These effects are quantified in the table below.

**CONCLUSIONS:** This is the first study, to our knowledge, that has examined and quantified the independent effects of age, gender, and run time on marathon pacing. Future studies should examine the influence of other factors and/or confounders such as effort or body composition.

Sample Effects of Predictors	
Predictor	Change in Pacing (%)
Gender: F vs. M	+4.06
Age: 55 vs. 25 yr	+7.30
Run Time: 3:00 vs. 4:30	+10.71

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**2797 Board #191 May 29 3:30 PM - 5:00 PM**  
**Hydration Monitoring Of Elite Mountain Bike Riders During Preparation For The 2008 Beijing Olympic Games**

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(No relationships reported)

The Olympic mountain bike cross country event takes approximately 2 hours to complete, it is one of the longest endurance events of the Olympic Games. The riders can be susceptible to dehydration which may not only influence performance but be detrimental to health.

**PURPOSE:** The aim of the study was to assess hydration status of elite mountain bike riders during a training camp and to compare two different methods of assessing hydration status. This data was used to inform individualised hydration strategies for riders preparing for the 2008 Beijing Olympic Games.

**METHODS:** Eleven international (8M, 3F, Mean Age:  $19 \pm 4$  y) mountain bikers were assessed. Measures of urine osmolality (UO) (Osmocheck, Vitech Scientific Ltd) and urine specific gravity (USG) using urine analysis dip sticks (Healchex, Q-Tech Medical LTD UK) were taken from three consecutive mornings and two consecutive evenings during a training camp as part of the preparation of the 2007 World Championships. Self reported fluid intake was also measured on day one and day two. Hypohydration was set at a UO of greater than 700 mOsmols/kgH<sub>2</sub>O and a USG of 0.020. Measures of UO and USG were compared using Pearsons correlation coefficient. Change in UO and USG over the camp was analysed using a one way ANOVA. Post hoc analysis was undertaken with Tukeys HSD.

**RESULTS:** There was a significant correlation between UO and USG ( $r = 0.71$ ,  $p < 0.05$ ). There was no significant difference between morning UO on all three days (Day 1 AM mean = 521,  $s = 156$  mOsmols/kgH<sub>2</sub>O, Day 2 AM mean 550,  $s = 107$  mOsmols/kgH<sub>2</sub>O, Day 3 AM mean 588,  $s = 115$  mOsmols/kgH<sub>2</sub>O). No significant difference was shown between morning USG throughout all three days (Day 1 AM  $1.012 \pm 0.005$ , Day 2 AM mean 1.012,  $s = 0.003$ , Day 3 AM mean 1.012,  $s = 0.003$ ). Measurement of UO and USG both showed two individuals to be hypohydrated on Day 1 AM, and one person to be hypohydrated on both Day 2 AM and Day 3 AM. There was no significant

difference between total drink volume consumed between day one (mean 4.2 L, s = 0.7 L) and day two (mean 4.6 L, s = 1.7 L).

**CONCLUSION:** Athletes maintained hydration status throughout the camp. The use of a urine analysis dip stick was a convenient way to monitor hydration status through USG and can be easily used in the field. These data influenced hydration strategies in preparation of the 2008 Beijing Olympic Games.

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**2798 Board #192 May 29 3:30 PM - 5:00 PM**

**Variation Between Repeated Time-To-Exhaustion Trials Reduced With Utilization Of An Objective Exclusion Criteria.**

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(No relationships reported)

**PURPOSE:** Time to exhaustion (TTE) protocols are widely used to assess endurance performance. However, the subjective endpoint of this method can contribute to increased variance between trials. Our purpose was to determine if an objective criteria for determining successful TTE completion reduced error variance between repeated trials.

**METHODS:** Ten recreational exercisers (age = 24±5 yrs;  $\dot{V}O_{2max}$  = 53.6±9.9 mL·kg<sup>-1</sup>·min<sup>-1</sup>) completed a TTE protocol consisting of a 75 minute cycle at 70%  $\dot{V}O_{2max}$  followed by a treadmill run to exhaustion at 80%  $\dot{V}O_{2max}$ . Subjects completed two TTE trials. In trial 1, all subjects were instructed to run until volitional exhaustion. In Trial 2, five subjects were similarly instructed to provide a maximal effort until exhaustion (ME). The other 5 subjects received instructions to cease running when they estimated they could complete only 10 additional minutes of exercise (SME). Peak isometric force (MVC) of the leg extensors was assessed pre-exercise and immediately post-exercise. An objective MVC criteria was used to exclude subjects who did not successfully complete the TTE trials. Subjects TTE data was excluded if their MVC declined <10% from pre-exercise levels, and their lowest MVC decline occurred in their shortest TTE trial.

**RESULTS:** Prior to application of the exclusion criteria, there was a relatively low correlation (r=0.31) and high variation (CV=34.2%) between repeated trials, partially due to the inconsistent efforts of the SME group. The exclusion criteria eliminated three subjects from the analysis, which improved the correlation (r=0.61) and CV (24.3%) between trials.

**DISCUSSION:** The MVC criteria correctly eliminated the two subjects with the greatest variance between TTE trials, and significantly reduced the total error variance between trials. Thus, using % MVC decline as an objective TTE completion criteria may reduce error variance by identifying subjects who are unable to provide consistent efforts between trials. Refinement of the existing criteria may result in further improvement in consistency between trials, as not all SME trials were identified by the present criteria.

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**2800 Board #194 May 29 3:30 PM - 5:00 PM**

**Effects Of Inspiratory Muscle Training On Arterial Oxygen-hemoglobin Saturation In Female Collegiate Endurance Runners**

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**PURPOSE:** The current exploratory study was conducted to determine if inspiratory muscle training [IMT] can enhance arterial oxygen-hemoglobin saturation during exercise. Such enhancement may alleviate exercise induced arterial hypoxia, if present, in runners.

**METHODS:** Seven female collegiate endurance runners performed 5 weeks of daily IMT, while five subjects served as controls for comparison. Training was 5 sets of 12 repetitions per set. To assess the effectiveness of the training program, two treadmill endurance tests were performed pre and post IMT training. Oxygen-hemoglobin saturation [SaO<sub>2</sub>] and minute ventilation [V<sub>E</sub>] were measured during the endurance tests. Resting maximal inspiratory pressure [MIP] was also measured pre and post IMT. A two-way analysis of variance with one repeated factor was used to determine whether inspiratory muscle training affected respiratory function as measured through MIP, V<sub>E</sub>, and SaO<sub>2</sub>.

**RESULTS:** MIP improved from 91.89 ± 42.54 to 113.20 ± 39.54 cm H<sub>2</sub>O (p<0.05) in the trained subjects, with no significant difference in controls, 71.36±18.0 and 65.44±21.81 cm H<sub>2</sub>O. The treatment group's SaO<sub>2</sub> pre test 91.51 ± 4.73% and post test 90.29 ± 6.29% were similar to control subjects, 92.7±3.02% and 93.21±2.75, respectively. V<sub>E</sub> pre test and post test for the treatment group were 74.06 ± 8.52 L/min and 77.73 ± 6.72 L/min, compared to 67.53±15.05 and 71.71. Three of the treatment subjects did demonstrate improved SaO<sub>2</sub>. Two of these subjects also improved V<sub>E</sub>. The control group remained unchanged from pre to post testing.

**CONCLUSION:** While there were individual responses to IMT there were no statistically significant improvements seen in SaO<sub>2</sub> and V<sub>E</sub> following 5 weeks of daily IMT in female collegiate endurance runners.

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**2801 Board #195 May 29 3:30 PM - 5:00 PM**

**Activity Does Not Explain The Greater Skeletal Muscle Mass In Masters Swimmers**

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(No relationships reported)

**INTRODUCTION:** Previous research has shown Master Swimmers to have greater muscle mass when compared to members of the general population (GP) regardless of age. However, it is an assumption that all Masters swimmers are necessarily more physically active than the GP. Masters swimmers were thus sought out in an effort to characterize the impact of a highly active lifestyle skeletal muscle mass.

**METHODS:** Three hundred and sixty-two masters swimmers completed questionnaires to assess recent self-reported physical activity status. Subjects were stratified by low and high activity levels with the resulting 35 respondents compared separately by sex and activity (low n = 9, n = 6, high n = 10, n = 10 for men and women, respectively). Muscle mass was tested through bioelectric impedance analysis using an eight-lead segmental analyzer. Data was analyzed using SPSS with one sample, independent sample t-tests and ANCOVAs.

**RESULTS:** Statistical analysis from independent samples t-tests of activity indicated differences between those performing the lowest (women, 265.0 ± 39.87 min/wk; men, 223.3 ± 33.91 min/wk) and highest (women, 1182.0 ± 176.75 min/wk; men, 1071.0 ± 152.34 min/wk) weekly activity. Additionally, one-sample t-test for the lowest reported activity for both sexes and the data that obtained for the general population yielded no differences between the groups (p > 0.05). However, ANCOVA showed muscle mass did not differ between any groups even when body surface area, age, or height is co-varied.

**CONCLUSIONS:** It can be concluded that simply being a registered member of United States Masters Swimming does not necessarily assure that an individual is highly active. Additionally, muscle mass in those who are highly active does not appear to be solely dependent upon recent activity level even when accounting for body surface area, age and height. This may indicate other factors, perhaps more long term in nature, influencing muscle mass with advancing age.

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**2802 Board #196 May 29 3:30 PM - 5:00 PM**

**Changes In Heart Rate Variability During A Competition Season In Elite Speed Skaters**

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International-class speed skaters continue travelling around the world to participate in international and national competitions during a competition season. Although such tight schedule might induce tiredness, they are required to maintain their physical and mental conditions in good states to achieve good performance throughout the season. It is not well known, however, whether their physical and mental conditions are actually being maintained throughout a competition season.

**PURPOSE:** To estimate and compare the physical and mental conditions at the beginning and at the end of a competition season in international-class speed skaters.

**METHODS:** Six international-class speed skaters (23.2±1.7 yrs) participated in the study. Data were collected every morning during the first (Japan Single Distances Championships: JSDC, Oct, 2007) and the last (World Single Distances Championships: WSDC, Mar, 2008) competition in their 2007/2008 season, both held in Nagano. Beat-to-beat heart rate (HR) were recorded for five minutes under the controlled breathing of 15 breaths per minute. Frequency domain heart rate variability (HRV) indices were obtained using spectral analysis by fast Fourier transform. The spectral power in the low-frequency (LF: 0.04-0.15Hz) and the high-frequency (HF: 0.15-0.40Hz) bands were calculated. In addition, normalized units (LFnu and HFnu) and the ratio of LF/HF index were obtained. HF and HFnu represent parasympathetic activity and the ratio of LF/HF represents an evaluation of the autonomic nervous system balance. The subjects were also asked to fill a questionnaire in which they estimated their subjective mood states on a visual analog scale.

**RESULTS:** HFnu were significantly lower in WSDC than those in JSDC (27.1±3.5 vs. 47.3±4.9,  $p<0.01$ ). Moreover, the LF/HF ratio and the mean HR were tended to be higher in WSDC than those in JSDC (3.66±0.84 vs. 1.66±0.53,  $p=0.08$  and 59.3±2.2 vs. 54.4±2.1 beats/min,  $p=0.06$ , respectively). As for the subjective mood states, there was a tendency of lower subjective feeling of vigor in WSDC than those in JSDC (33.5±7.9 vs. 43.8±8.7,  $p=0.06$ ).

**CONCLUSION:** These results suggest that the physical and mental conditions in the international-class speed skaters might be altered in the course of the competition season.

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**2803 Board #197 May 29 3:30 PM - 5:00 PM**  
**Effect Of Prior Warm-up On Oxygen Uptake Kinetics During An 800-m Performance Trial**

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**PURPOSE:** This study investigated the effect of two different warm-up regimes on pulmonary V[dot]O<sub>2</sub> kinetics during an 800-m running time trial.

**METHODS:** Eleven well-trained middle distance runners undertook a laboratory-based progressive exercise test to determine V[dot]O<sub>2</sub>max, and on two further occasions, an indoor 800-m performance trial. Performance trials were preceded by a 10-min self-paced jog and standardised mobility drills followed by either 6x50m 'strides' (control, CON) or 2x50m strides and a continuous high-intensity 200m run (WU). All warm-up runs were performed at race-pace. Blood lactate was measured before and after the warm-up and performance trial. Oxygen uptake was measured breath-by-breath during all performance trials and subsequently modelled using non-linear regression techniques. The perceived race 'readiness' of the subjects was assessed by questionnaire.

**RESULTS:** Prior to the performance trial, baseline blood [lactate] was (mean ± SD) 1.8 ± 0.3 mM greater after WU compared to CON control ( $P<0.001$ ). Participants reported significantly greater readiness in WU vs. CON, ( $P<0.05$ ). The mean response time for the V[dot]O<sub>2</sub> response was no different between groups (27.4 ± 6.4 vs 28.0 ± 7.1 s,  $P = 0.73$ ). Peak V[dot]O<sub>2</sub> attained (WU, 4214 ± 848 vs CON, 3913 ± 633 ml.min<sup>-1</sup>;  $P=0.156$ ) and total O<sub>2</sub> consumed (WU, 119.1 ± 18.2 vs CON, 108.7 ± 27.8 ml.min<sup>-1</sup>.kg<sup>-1</sup>,  $P=0.11$ ) showed tendencies towards a greater response for WU.

**CONCLUSIONS:** These data suggest that a longer duration warm-up promotes readiness for time trial performance. Whilst the mean response time was unaffected by warm-up method, the data suggest a greater contribution from oxidative processes during the performance trial following WU, as indicated by the ~ 8% greater peak V[dot]O<sub>2</sub> attained and total O<sub>2</sub> used.

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**2804 Board #198 May 29 3:30 PM - 5:00 PM**  
**Stability Of Running Economy In Men And Women Division I Collegiate Basketball Players**

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Previous running economy studies have focused on individual, rather than team sports, and have not examined the stability of this variable as athletes mature.

**PURPOSE:** The purpose of our study was to compare running economy of NCAA Division I basketball players between their first and second years of college. **METHOD:** Anthropometrics (height, weight, % fat) were obtained on 38 (13 women, 25 men) NCAA Division I basketball players. Following these measures, all participants completed a discontinuous maximal treadmill protocol that featured alternating 3 min run and 90 sec rest stages. Expired respiratory gases (SensorMedics 2900) and heart rate (EKG) were measured continuously throughout, and finger stick blood samples (for blood lactate) were obtained during rest stages. Oxygen consumption (VO<sub>2</sub>) at the third min of stages 1 (VO<sub>2</sub>-1; 6 mph, 0% grade) and 2 (VO<sub>2</sub>-2; 6 mph, 5% grade) was used as an index of running economy. Changes in VO<sub>2</sub>-1, VO<sub>2</sub>-2, VO<sub>2</sub>max, % fat, and lactatemax were calculated by subtracting year one from year two values. Differences in running economy between years were evaluated using ANOVA. Pearson correlations were run (using absolute values and change scores) between VO<sub>2</sub>-1 and VO<sub>2</sub>-2 (dependent variables) and VO<sub>2</sub>max, % fat, and lactatemax (independent variables).

**RESULTS:** Running economy did not differ between freshman and sophomore years in either women (freshman VO<sub>2</sub>-1=34.7±0.8, sophomore VO<sub>2</sub>-1=33.4±0.8; freshman VO<sub>2</sub>-2=40.8±2.3, sophomore VO<sub>2</sub>-2=40.9±3.4) or men (freshman VO<sub>2</sub>-1=35.8±3.1, sophomore VO<sub>2</sub>-1=34.7±3.3; freshman VO<sub>2</sub>-2=42.4±3.1, sophomore VO<sub>2</sub>-2=42.9±2.7). Running economy was most strongly associated with VO<sub>2</sub>max and change in VO<sub>2</sub>max. This relationship was found to be stronger in women ( $R^2=0.31-0.64$ ) than in men ( $R^2=0.16-0.50$ ). Although, on average, running economy is stable from freshman to sophomore year, individual changes ranged from -6.3 to 4.6 ml.kg<sup>-1</sup>.min<sup>-1</sup> in VO<sub>2</sub>-1 and -7.3 to 9.1 ml.kg<sup>-1</sup>.min<sup>-1</sup> in VO<sub>2</sub>-2, and were significantly related to changes in VO<sub>2</sub>max.

**CONCLUSIONS:** On average, running economy remains stable over the first year of a varsity basketball player's collegiate career. Despite this, wide variability in change existed on an individual basis. Additional research is needed to determine the factors that may help a player improve his or her running economy.

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**2805 Board #199 May 29 3:30 PM - 5:00 PM**  
**Effect During A Short Distance Duathlon Laboratory Simulation On Fat And Carbohydrate Oxidation Rate**

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(No relationships reported)

**PURPOSE:** To assess the effects of a sprint distance duathlon laboratory simulation on FAT<sub>ox</sub> and CHO<sub>ox</sub>.

**METHODS:** 8 national level duathletes performed two incremental laboratory tests until exhaustion on a cycle ergometer (Initial workload: 60 W, stages: 30 W·min<sup>-1</sup>) and on a treadmill (Initial workload: 5 km·h<sup>-1</sup>, stages: 1 km·h<sup>-1</sup>) respectively to determine exercise intensities. Further on, subjects performed a laboratory simulation competition of a sprint distance duathlon (S<sub>1</sub>: 20 min running, S<sub>2</sub>: 45 min cycling, and S<sub>3</sub>: 12 min running) at a fixed exercise intensity of 90 %HR<sub>max</sub>. All subjects drank an amount of 475 ± 35 mL of water during the test. VO<sub>2</sub>, VCO<sub>2</sub>, and heart rate (HR) were measured and averaged for each sector. CHO<sub>oxr</sub> and FAT<sub>oxr</sub> were estimated by estequiometric equations. Physiological variables throughout the test were analyzed using repeated measurements ANOVA.

**RESULTS:** Exercise intensity expressed as %FC<sub>max</sub> was maintained throughout the test (S<sub>1</sub>: 91.0 ± 2.8 %, S<sub>2</sub>: 89.8 ± 3.8 %, and S<sub>3</sub>: 89.7 ± 4.3 %). A significant reduction in VO<sub>2</sub> (47.1 ± 6.9 vs. 43.1 ± 5.6 mL·kg<sup>-1</sup>·min<sup>-1</sup>, p<0.01), and running speed (15.6 ± 0.6 vs. 14.9 ± 1.0 km·h<sup>-1</sup>, p<0.001) was observed between S<sub>1</sub> and S<sub>3</sub>. A progressive reduction in CHO<sub>oxr</sub> and a progressive increase in FAT<sub>oxr</sub> were observed during the whole laboratory simulation test.

		S1	S2	S3
FAT <sub>oxr</sub>	(g·min <sup>-1</sup> )	0.38 ± 0.32 <sup>a, b</sup>	0.56 ± 0.23 <sup>a, c</sup>	0.74 ± 0.33 <sup>b, c</sup>
%FAT <sub>oxr</sub>	(%)	41.8 ± 34.0 <sup>d, e</sup>	65.5 ± 17.3 <sup>d, f</sup>	83.6 ± 14.6 <sup>e, f</sup>
CHO <sub>oxr</sub>	(g·min <sup>-1</sup> )	3.23 ± 1.65 <sup>g, h</sup>	1.64 ± 0.80 <sup>g, i</sup>	1.48 ± 1.01 <sup>h, i</sup>
%CHO <sub>oxr</sub>	(%)	77.4 ± 13.6 <sup>j, k</sup>	41.5 ± 11.3 <sup>j, l</sup>	33.5 ± 15.8 <sup>k, l</sup>

a, b, c, d, e, f, g, h, i, j p<0.001

**CONCLUSION:** Despite exercise intensity expressed as %FC<sub>max</sub> was controlled, running speed and VO<sub>2</sub> diminished between S<sub>1</sub> and S<sub>3</sub> as a possible effect of cardiovascular drift. Short distance duathlon laboratory simulation elicited an important limitation on CHO<sub>oxr</sub> as a possible effect of CHO stores depletion, and an increase of FAT<sub>oxr</sub> as a possible compensatory mechanism to maintain the intensity of exercise.

**2806 Board #200 May 29 3:30 PM - 5:00 PM**  
**Heart Rate, Blood Lactate And Time-motion Analysis Of Female Basketball Players During Competition**

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(No relationships reported)

Previous studies show average heart rate (HR) from 169 to 183 beats·min<sup>-1</sup> (89% of HR<sub>max</sub>) and an average number of 26.7 jumps and 13.6 sprints per game in female basketball players. However, in May 2000, basketball rules changed. The new rules have led to an increase in the game intensity and a higher cardiac work in male players.

**PURPOSE:** to investigate the physiological demands and movement patterns of female basketball players competing under the new rules of the game.

**METHODS:** 9 female university basketball players (25.8±2.5 years old, 172.8±4.7 cm, 63.2±4.5 kg, 19.9±3.4% of body fat) were studied during 9 games in the premiership league. During each game, HR was measured at 15-s intervals using Polar S810 heart rate monitors (Polar, Kempele, Finland), blood samples were taken to analyse [La]<sup>-</sup> between quarters, during timeouts, or during player substitution (Analox LM5, Analox Instruments Ltd., London, UK). In addition, video recordings of matches (JVC-x400 Hong Kong, China) were used to determine the frequencies of the main movements performed by the players. Differences in physiological parameters between the quarters and halves of the game were analysed by a one-way ANOVA and a student T-test for paired samples, respectively. Statistical significance was set at p<0.05.

**RESULTS:** The mean HR was 165.0±9.0 beats·min<sup>-1</sup> (89.8% of HR<sub>max</sub>) and the mean [La]<sup>-</sup> was 5.2±2.7 mmol·L<sup>-1</sup> (55.9% of [La]<sup>-</sup>max). In addition, HR was significantly higher in the first half compared to the second half (166.3±9.4 vs. 163.3±9.0 beats·min<sup>-1</sup>, P<0.01), whereas no significant effect of time was observed on [La]<sup>-</sup> (P>0.05). Video analysis showed that players performed on average 67±17 jogs, 52±19 runs, 49±17 sprints, 117±14 low-intensity shuffles, 123±45 medium-intensity shuffles, 58±19 high-intensity shuffles and 35±11 jumps.

**CONCLUSION:** These results indicated first, that the changes in the rules of the game have increased the intensity of the game, and second that less movements are performed during a game by female compared to male players.

**2807 Board #201 May 29 3:30 PM - 5:00 PM**  
**Stability Of Power Output Before And After Training In Beginner Rowers**

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(No relationships reported)

Repeated exposure to a novel rowing time trial task, as well as training may enhance pacing strategy development and improve performance.

**PURPOSE:** Our purpose was to evaluate time and power output (PO) during repeated rowing time trials before and after training.

**METHODS:** Ten participants with no previous rowing experience (7 women, 3 men) completed two 2000-meter time trials (T1 and T2) on a Concept II rowing ergometer with instructions to finish as quickly as possible. Time trials were performed 2-4 days apart. 500m pace, PO (watts) and stroke rate (strokes/min) (SR) were recorded every 100m. All participants then completed four weeks of ergometer training, using both variable and constant pacing strategies. After training, participants completed two additional 2000-meter time trials (T3 and T4). Finally, a graded maximal exercise test to fatigue was completed on the ergometer to estimate aerobic fitness (VO<sub>2max</sub>). Time, PO, and SR across trials were analyzed using repeated measures ANOVA. Pearson correlations were used to compare changes after training (T2 to T3) in these three outcome variables with VO<sub>2max</sub>.

**RESULTS:** Average time to completion was (T1=616 ± 147, T2=590 ± 123, T3=563 ± 93, T4=559 ± 93 sec) average PO was (T1=125 ± 78, T2=137 ± 82, T3=146 ± 75, T4=149±75 watts) and average SR was (T1=34±4, T2=33±4, T3=35±3, T4=35±3 strokes/min). Although time and PO improved from T1 to T2, only changes in PO achieved statistical significance (P<0.05). Significant improvements were seen in time and PO from T1 to T3 and T4. We found a weak relationship between participants' VO<sub>2max</sub> and change in time (r = 0.33) and power (r = -0.25) but a significant association between VO<sub>2max</sub> and change in stroke rate (r=0.65; P<0.05).

**CONCLUSION:** Based on these findings, beginning rowers become faster and produce greater PO through both repeat performance and training. Fitter participants were more likely to increase stroke rate with training. Results suggest a rapid learning of technique with minimal exposure to the task. Decrease in time between T1 and T3 suggest a training effect occurred and more than one trial may be needed to accurately gauge performance in this novel task. Smaller differences in time and PO between T3 and T4 suggest progress may occur in smaller increments once basics of the task are learned.

**2808 Board #202 May 29 3:30 PM - 5:00 PM**  
**Validation Of A 1-day Maximal Lactate Steady-state Protocol For Running**

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(No relationships reported)

Laboratory assessment of maximal lactate steady state (MLSS) has traditionally involved a time-consuming series of submaximal tests over multiple days.

**PURPOSE:** To validate a modified (1-day) protocol for determining the MLSS running velocity (MLSSv).

**METHODS:** Six endurance-trained athletes (age  $26 \pm 5$  y; height  $1.72 \pm 0.03$  m; body mass  $65.0 \pm 5.4$  kg;  $\text{O}_2$  peak  $60.0 \pm 7.1$  ml·kg<sup>-1</sup>·min<sup>-1</sup>; mean  $\pm$  SD) participated in this study. Each participant completed an initial progressive incremental treadmill test to determine submaximal and maximal  $\text{VO}_2$ , and lactate threshold (LT) velocity. LT was determined as the velocity before a  $>1$  mM increase in lactate concentration. After a 7-day break participants performed the modified single day (MLSS-1-d) to estimate the MLSSv. The new MLSS-1-d involved an initial 15-min bout at the LT velocity followed by a series of 10-min bouts increasing by  $0.5$  km·h<sup>-1</sup> until steady state conditions were lost. After a further 7-day break participants then performed the traditional multi-day (MLSS-multi) protocol involving at least three 30-min tests on different days as the criterion measure of MLSSv. Data were log-transformed and validity of the new method established in both raw units and % error (with 90% confidence limits) using linear regression.

**RESULTS:** The mean ( $\pm$  SD) values for MLSSv were  $13.9 \pm 1.4$  km·h<sup>-1</sup> for MLSS-1-d and  $14.0 \pm 1.5$  km·h<sup>-1</sup> for MLSS-multi, and  $2.7 \pm 0.6$  mM and  $2.9 \pm 0.8$  mM for the LT, respectively. The standard error of estimate (90% confidence limits) for MLSSv using MLSS-1-d was  $0.18$  ( $0.12$ - $0.43$ ) km·h<sup>-1</sup> and  $1.2$  ( $0.7$ - $2.8$ )%. The corresponding estimates for LT were  $0.45$  ( $0.29$ - $1.07$ ) mM and  $19.4$  ( $12.2$ - $52.2$ )%. Correlations between the two methods were  $r=0.99$  ( $0.96$ - $1.00$ ) for the MLSSv and  $r=0.75$  ( $0.02$ - $0.97$ ) for the LT.

**CONCLUSION:** The MLSS-1-d is a viable practical alternative to the traditional multi-day protocol for estimating the MLSSv in distance runners. However, the substantial noise in the estimate of the LT precludes use of this measure until further refinements are made to the protocol.

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**2809 Board #203 May 29 3:30 PM - 5:00 PM**  
**Physiological Determinants Of Success In Adolescent Soccer Players**

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(No relationships reported)

**PURPOSE:** The aim of the study was to compare the physiological characteristics and performance measures between elite adolescent soccer players that are retained or rejected by professional soccer clubs.

**METHODS:** Fifteen, highly-trained adolescent soccer players (English Premier League) (Mean  $\pm$  SD,  $14.6 \pm 0.9$  years, peak:  $54.7 \pm 6.5$  mL·kg<sup>-1</sup>·min<sup>-1</sup>, Self-assessed Tanner stage range 2 - 4) were divided into two groups, successful (retained by the club for future development) and unsuccessful (rejected by the club). All subjects completed laboratory tests to measure  $\text{VO}_2$  peak, body composition and resting cardiac structure and function. Tests included a cycle ergometer test to exhaustion pedaling at 60 rpm with 3-minute stages of 35 W load increments; standard gas exchange variables were measured. Body fat percentage was assessed using a Bod Pod, and Cardiac dimensions at rest were measured by M-mode echocardiography. Stroke volume was estimated by Doppler interrogation, of aortic flow velocity. Following laboratory testing, all subjects' running sprint performance was assessed over 10 (Spr10) and 20 (Spr20) meters, electronic timing gates were used for accurate measurement.

**RESULTS:** The successful players were significantly older ( $14.9 \pm 0.9$  versus  $13.9 \pm 0.2$  yrs,  $p=0.03$ ), taller ( $170.2 \pm 6.6$  versus  $160.8 \pm 4.1$  cm,  $p=0.01$ ), heavier ( $60.2 \pm 8.5$  versus  $49.2 \pm 6.5$  kg,  $p=0.03$ ), and had a lower body fat percentage ( $8.5 \pm 4.1$  versus  $16.2 \pm 4.7$  %,  $p=0.02$ ). The successful players were significantly faster (Spr10:  $1.9 \pm 0.1$  versus  $2.0 \pm 0.1$  sec,  $p=0.03$ , Spr20:  $3.2 \pm 0.2$  versus  $3.5 \pm 0.1$  sec,  $p=0.02$ ), and had greater absolute  $\text{VO}_2$  peak values ( $3.4 \pm 0.5$  versus  $2.5 \pm 0.4$  L·min<sup>-1</sup>,  $p=0.01$ ). Left ventricular end diastolic dimension (LVED) was significantly larger in the successful players ( $51.8 \pm 3.1$  versus  $47.9 \pm 2.1$  mm BSA<sup>-0.5</sup>,  $p=0.03$ ). There were no significant differences between groups for relative  $\text{VO}_2$  peak, left ventricular end systolic dimension (LVES), cardiac output at rest, and stroke volume at rest.

**CONCLUSIONS:** The present data indicate that successful adolescent soccer players are physically more mature and consequently have greater performance capacity. This suggests that early maturing adolescents are at an advantage when competing in age group soccer.

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**2810 Board #204 May 29 3:30 PM - 5:00 PM**  
**A Comparison Of The Physiological Demands Of Two Commercially Available Cycle Ergometers In Trained Cyclists**

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(No relationships reported)

Cycling ergometers are routinely used in a laboratory setting to evaluate physiological function and monitor changes in training status. One limitation of many cycle ergometers, in relation to the performance testing, is their inability to replicate the cyclist own specific cycling position thereby bringing the validity of the ergometer used into question.

**PURPOSE:** The purpose of this study was to compare the aerobic and anaerobic energy demands of two commercially available cycle ergometers in trained cyclists. The first ergometer allowed full adjustment of cycling position and was electromagnetically braked (EB). The second ergometer allowed for saddle height adjustment only and was resistance braked (RB).

**METHODS:** Ten trained male cyclists were tested on 2 separate occasions within a 14 day period under the same conditions. Subjects performed a 30 second Wingate maximal sprint test followed 60 minutes later by a continuous maximal incremental step test on either the EB or RB cycle ergometer, in a random order. The Wingate test was performed at 9% of body mass and for 30 seconds with a 5 second speed up period. The incremental test started at 100W and increased in resistance by 50W every 3 minutes until volitional exhaustion. Heart rate,  $\text{VO}_2$ , power output and blood lactate were measured during the maximal test.

**RESULTS:** The results showed a significant difference ( $p<0.01$ ) for the Wingate test between the RB and EB both in terms of peak power output ( $W_{\text{max}}$ ) and mean power output ( $W_{\text{mean}}$ ) with subjects generating greater power outputs on the EB. During the maximal incremental test, significant differences ( $p<0.01$ ) were found between EB and RB for submaximal power output, heart rate, and  $\text{VO}_2$  at both lactate threshold 1 (1mmol rise above baseline, LT1) and onset of blood lactate accumulation (4mmol blood lactate reading, OBLA), as well as peak power output at  $\text{VO}_{2\text{max}}$  ( $\text{PMAX}$ ).

**CONCLUSIONS:** Overall it was shown that significant differences in physiological demands were present between the two ergometers under both anaerobic and aerobic conditions. This is may in part be explained by the different positions that the cyclists adopted on either ergometer. Further research is required to compare the findings of the current study with actual cycling performance.

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**2811 Board #205 May 29 3:30 PM - 5:00 PM**  
**Effect Of Altering Tempo Of The Pre-match Warm-up On Skills In Youth Soccer**

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(No relationships reported)

The physiological consequences of a pre-match warm-up before a soccer match has been hypothesized to increase muscle temperature and range of joint movement, with a view to lowering the risk of injury during exercise. It is believed, however, that the warm-up can affect the soccer player's technical performance during competition and, therefore, the result of a match may rely on how effective the warm-up routine is.

**PURPOSE:** The aim of the study was to compare a high (HT)-and low-tempo (LT) pre-match warm-up on soccer-specific skills in a group of youth soccer players.

**METHODS:** 19 male, youth soccer players volunteered to participate in the study (Age:  $16.9 \pm 0.9$  years, Stature:  $1.73 \pm 0.05$  m and Body Mass:  $64.7 \pm 10.7$  kg). The players taking part in this study were highly trained (Number of years playing competitive soccer:  $8.6 \pm 3.1$ ; Hours per week training:  $13.7 \pm 4.8$ ). All players participated in a HT

(Heart rate:  $160 \pm 6$  beats·min<sup>-1</sup>) and a LT (Heart rate:  $132 \pm 6$  beats·min<sup>-1</sup>) warm-up lasting ten minutes. The tempo was modified by altering the dimension of the warm-up area and altering the speed of ball movement between players. Following each warm-up, the subjects carried out five skills test (Ball Control, Dribbling with a Pass, Dribbling Speed, Passing, and Shooting).

**RESULTS:** Significant differences ( $p < 0.05$ ) were identified between LT and HT for Ball Control (HT:  $35 \pm 2$  vs. LT:  $28.0 \pm 3.0$ , number of touches in 90 s) and approached significance for Shooting Skills (HT:  $16.1 \pm 4.2$  vs. LT:  $13.9 \pm 3.9$  points,  $p = 0.08$ ). No significant difference between HT and LT were identified for: Dribbling with a Pass (HT:  $7.34 \pm 1.00$  vs. LT:  $7.49 \pm 0.88$ ), Dribbling Speed (HT:  $13.11 \pm 1.55$  vs. LT:  $13.73 \pm 1.27$  s) and Passing (HT:  $2.4 \pm 1.6$  vs. LT:  $2.6 \pm 1.6$  successful passes).

**CONCLUSION:** A high-tempo warm-up can enhance certain technical skills of youth soccer players. It is possible to speculate that this can be achieved through improved proprioception and preactivation mechanisms.

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**2812 Board #206 May 29 3:30 PM - 5:00 PM**  
**Time Of Day Does Not Affect Measures Of Performance While Cycling**

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(No relationships reported)

**PURPOSE:** Studies have investigated a number of physiological and biomechanical variables which can impact cycling training and performance. Time of day (TOD) is a factor believed by many to influence the quality of training and performance, yet this topic has received little attention as it relates to cycling. Understanding the impact of TOD may help scientists better understand factors which influence physiological processes and help coaches develop training programs which improve performance and reduce risk of injury or overtraining. This study investigated the influence of TOD on measures physiology, perceived exertion, or gross motor performance.

**METHODS:** Fourteen avid recreational cyclists ( $47.20 \pm 11.93$  yr,  $181.40 \pm 5.85$  cm,  $80.58 \pm 7.67$  kg) volunteered for this study. Each completed three submaximal exercise bouts during two separate sessions, one session starting at 6:00am and the other at 6:00pm. The trials were performed at workload (Watts) to bodyweight (kg) ratios of 1.5:1, 2.0:1, and 2.5:1. The order of the two sessions and three workloads were randomized. Potential confounding variables such as caffeine use were controlled. Dependent measures of heart rate (HR), perceived exertion (RPE and OMNI), and gross motor performance (SpinScan™ and average torque angle) were collected throughout each trial.

**RESULTS:** A two-way within-subjects analysis of covariance ( $2 \times 3$ ) was conducted to evaluate the effect of TOD on dependent variables. No significant differences ( $p < .05$ ) were found for TOD in all dependent measures of HR, perceived effort (RPE and OMNI), or gross motor performance while cycling (SpinScan™ and average torque angle). There also were no significant differences ( $p < 0.05$ ) found related to the covariate of usual training time (AM vs. PM).

**CONCLUSIONS:** Based on the results of this study, TOD did not significantly affect performance measures during steady state cycling. Thus, the findings did not support the common observation that some individuals are "not morning people" (or vice versa) as it relates to the quality of performance during physical activities such as cycling. Additional study is needed on factors which may influence perceptions relating to TOD and exercise.

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**F-34 Free Communication/Poster - Supplements II**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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**2813 Board #207 May 29 2:00 PM - 3:30 PM**  
**Effect Of Conjugated Linoleic Acid And Exercise On Body Composition In Mice**

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(No relationships reported)

The effects of Conjugated Linoleic Acid (CLA) on body composition were investigated.

**PURPOSE:** Evaluate the effects of CLA supplementation associate to the Physical Exercise on Mice Wistar Body Composition.

**METHODS:** 24 healthy males Wistar mice, age 87 days. After a period 7 day of adaptation where the mice consumed water and diet *ad libitum*. Temperature and humidity of air were controlled in the range of 22°C and 60% to 70%, respectively. The mice were randomized into 3 groups (control and experimental) and supplemented by 60 days. The supplemented groups received CLA in the concentrations of 1% about the daily consumption of diet. The control group received corn oil to 1% of the daily consumption of the diet. The feed was supplied *ad libitum* daily and always was weighed the offer of the day. The next day, the remainder was analyzed the total amount of food ingestion. The animals of the exercise group accomplished a program of physical activity in a tank with water, 30 minute of swimming in a frequency of 3 times/week, supporting equivalent overload to 5% of the body weight of each coupled animal to the thorax. The animals were divided into next groups:- (PLA) group without physical activity and without CLA (1% of corn oil); - (CLA) group without physical activity and with CLA (1% of CLA); - (CLAEX) group with physical activity and with CLA (1% of CLA). For the statistical analysis was accomplished ANOVA TWO WAY for repeated measures and test "t" of student to verify the differences of % Body Fat (%BF) ( $p > 0.05$ ).

**RESULTS:** The average of %BF after are showed in table. There was significant difference between PLA and CLA and CLAEX ( $p < 0.001$ ).

Effect of CLA and Physical Exercise on Body Fat (%) in Mice			
	PLA n = 8	CLA n = 8	CLAEX n = 8
Body Fat (%)	$51.52 \pm 0.03$	$42.26 \pm 0.007 *$	$34.14 \pm 0.01 *$

**CONCLUSIONS:** The results suggest that CLA supplementation and exercise show significant effect on Body Fat (%) in Mice.

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**2814 Board #208 May 29 2:00 PM - 3:30 PM**  
**Post-exercise Carbohydrate Supplementation With Hydroxycitric Acids Coingestion Increased Glycogen Resynthesis In Human Skeletal Muscle**

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( I. Cheng, USD4000, Salary; NO, Royalty; NO, Intellectual Property; NO, Consulting Fee; NO, Honoraria; USD45000, Contracted Research; NO, Ownership Interest.)



**PURPOSE:**The present study was designed to examine the effects of coingestion of HCA with post-exercise carbohydrate supplementation on human skeletal muscle glycogen resynthesis.

**METHODS:** Six healthy active male volunteers (age,  $22.00 \pm 0.27$  years) completed two experimental trials. Subjects performed a 60-min cycling exercise at 70-75% Vo<sub>2</sub> max separated 7 days. After exercise, subjects consumed either a high carbohydrate meal (control group) or coingestion of HCA with high carbohydrate meal (HCA group). Postprandial blood samples were obtained at 30 min intervals for 3 h during exercise recovery. Muscle samples were obtained on vastus lateralis immediately after the exercise and 3 h after post-exercise.

**RESULTS:** There were significant increase in muscle glycogen resynthesis in HCA group compared to control group ( $P < .05$ ). Following exercise, the HCA group produced a significant lower insulin secretion level ( $P < .05$ ) and no different blood glucose response, respiratory exchange ration, and carbohydrate oxidation compared to control group ( $P > .05$ ). During post-exercise recovery, the HCA groups showed significant higher in total fat oxidation compared to control group ( $P < .05$ ). Both diets resulted in a rapid reduction in NEFA and glycerol after post-exercise carbohydrate supplementation with the presence or absence of HCA coingestion and no significant difference between these two groups.

**CONCLUSIONS:** the present study suggested that coingestion of HCA with carbohydrate supplementation during post-exercise recovery could be an effective way to enhance muscle glycogen resynthesis.

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**2815 Board #209 May 29 2:00 PM - 3:30 PM**

**Effect Of Hca With Post-exercise Carbohydrate On Substrate Transporter Gene Expression In Human Study**

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( Y. Chu, USD300, Salary; STUDENT, Royalty; 0, Intellectual Property; 0, Consulting Fee; MASTER, Honoraria; 0, Contracted Research; 0, Ownership Interest.)

**PURPOSE:** The aim of the present study was designed to examine the influences of coingestion of hydroxycitrate (HCA) with post-exercise supplementation on substrate transporters in human skeletal muscle.

**METHODS:** Six healthy active male volunteers (age,  $22.00 \pm 0.27$  years) completed two experimental trials. Subjects performed a 60-min cycling exercise at 70-75% VO<sub>2</sub> max separated 7 days. After exercise, subjects consumed either a high carbohydrate meal (control group) or coingestion of HCA with high carbohydrate meal (HCA group).

**RESULTS:** Muscle samples were obtained on vastus lateralis immediately after the exercise and 3 h after post-exercise. There were increase of FAT/CD36 mRNA and FAT/CD36 protein expressions in the this study. No difference on GLUT4 mRNA levels and protein expressions between the presence or absence of coingestion of HCA after post-exercise carbohydrate supplementation. In the carbohydrate utilization viewpoint, coingestion of HCA does not affect the glucose transporting into muscular cells after post-exercise carbohydrate supplementation.

**CONCLUSIONS:**The suggestion of the present study was that coingestion of HCA with post-exercise carbohydrate supplementation up-regulation of FAT/CD36 mRNA and increased FAT/CD36 protein expressions and it means that fat utilization was increased in skeletal muscle during post-exercise recovery.

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**2816 Board #210 May 29 2:00 PM - 3:30 PM**

**Effect Of Rhodiola Crenulata And Cordyceps Sinensis-based Oral Supplementation On Exercise Stress Test In Altitude**

Lu-Ling Cheng<sup>1</sup>, Chiu-Chou Chen<sup>1</sup>, Hsien Chin Yu<sup>1</sup>, Li Yen Tsao<sup>2</sup>, Chia Hua Kuo<sup>1</sup>. <sup>1</sup>Taipei Physical Education College, Taipei, Taiwan. <sup>2</sup>National Taipei College of Business, Taipei, Taiwan. (Sponsor: John L. Ivy, FACSM)

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(No relationships reported)

**PURPOSE:** To determine the effect to Rhodiola Crenulata and Cordyceps Sinensis-Based Oral Supplementation on muscle oxygenation after exercise at sea-level and altitude.

**METHODS:** Eighteen male subjects were weight-matched and evenly divided into 2 groups: Oral *Rhodiola Crenulata* and *Cordyceps Sinensis* (RC) supplementation and Placebo groups. A standardized 3-min step test was performed at sea-level and altitude (2200 meters). Arterial oxygen saturation (SaO<sub>2</sub>) and muscle tissue oxygenation (StO<sub>2</sub>) were measured before and after exercise. Running performance was determined by graded Bruce's protocol.

**RESULTS:** RC supplementation did not alter maximal oxygen consumption and heart rate recovery on 3-min step test. Blood lactate recoveries following both step test and all-out running was not altered by RC treatment. However, SaO<sub>2</sub> was lower in the RC group than that in placebo group. Conversely, total hemoglobin concentration and percent oxygen saturation in muscle tissue were significantly greater in the RC group than those in the placebo group.

**CONCLUSIONS:** Despites RC supplementation has no significant acute effect on exercise performance, this supplementation resulted in a greater oxygen delivery to skeletal muscle.

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**2817 Board #211 May 29 2:00 PM - 3:30 PM**

**Factors Related To The Status Of b-carotene**

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(No relationships reported)

Significant reactive oxygen species (ROS) generation after prolong and heavy exercises have been well documented. It has been suggested that carotenoids from antioxidant supplements may be an effective tool for measuring body antioxidant capacity which would protect subjects from exercise-induced oxidative damages.

**PURPOSE:** to investigate the relationship among the b-carotene status, antioxidant supplementation and exercise training.

**METHODS:** Seventy-four healthy subjects including 36 marathon runners (MR) and 38 sedentary individuals (age:  $47.67 \pm 1.98$  years, body weight:  $62.83 \pm 1.37$  kg; mean $\pm$ SEM) participated in this study. Antioxidant b-carotene counts of all 74 subjects' palms were examined using a non-invasive Raman spectroscopy. This method had been proved to be a valid evaluation of the human carotenoids status. A questionnaire including items of the fruit quantity and antioxidant supplementation frequency in recent two weeks was filled to investigate the antioxidant intake of subjects.

**RESULTS:** (1) MR had significant higher b-carotene level than sedentary subjects ( $31361 \pm 1800.9$  VS  $23342.1 \pm 1418.4$ ,  $p < .05$ ; mean $\pm$ SEM). (2) Sedentary individuals with supplements had significant higher b-carotene level than without supplementation group ( $29166.7 \pm 3323.1$  VS  $20653.8 \pm 1092.6$ ,  $p < .05$ ; mean $\pm$ SEM). (3) b-carotene level of MR with supplements is similar to MR without supplementation group ( $32666.7 \pm 3306.1$  VS  $30428.6 \pm 2040.1$ ,  $p < .05$ ; mean $\pm$ SEM).

**CONCLUSION:** (1) MR had significant higher b-carotene status than sedentary subjects majorly due to regular exercise training effects. (2) Antioxidant supplements might be important for sedentary individuals to improve their antioxidant capacity.

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**2818 Board #212 May 29 2:00 PM - 3:30 PM**

**Prophylactic Supplementation Of A Nano-sized Silica Mineral Antioxidant Complex On Changes In Clinical Safety**

## Parameters And Body Water.

Scott E. Hassell, Chad M. Kerkisick, Michael D. Roberts, Vincent J. Dalbo, Jordan R. Moon. *University of Oklahoma, Norman, OK.*

(No relationships reported)

A nano-sized silica mineral antioxidant complex (MIC) is purported to alter cellular chemistry kinetics by delivering reduced hydrogen ions to the cell and reducing blood lactate levels. Further, the chemical structure of MIC supports osmotic traits that may impact levels of body water.

**PURPOSE:** This study examined the effects of 7 days of prophylactic MIC supplementation on changes in clinical safety parameters and body water.

**METHODS:** On three occasions, fifteen males (23.6  $\pm$  3.7 yrs, 180  $\pm$  8 cm, 85  $\pm$  11 kg, 16  $\pm$  5 %) were tested using identical procedures under a control (CON), rice flour placebo (PLA) and microhydrin (MIC) condition. PLA and MIC supplementation was done in a prophylactic fashion over a seven day period (4 x 250 mg capsules/day). After controlling for diet and exercise habits, participants arrived fasted and donated a blood sample before and after supplementation for determination of serum and whole blood clinical safety markers. Total body (TBW), extracellular (ECW) and intracellular (ICW) water measurements using bioelectrical impedance spectroscopy were taken before and after supplementation and before and after a peak  $\text{VO}_2$  test. Repeated measures (2 x 3) ANOVA were completed on all variables using a p-value of 0.05.

**RESULTS:** No significant changes ( $p > 0.05$ ) were found for any component of the lipid and metabolic panels, kidney/liver enzymes, markers of protein breakdown and complete blood counts. Supplementation resulted in no change in TBW ( $p = 0.43$ ), ECW ( $p = 0.65$ ) and ICW ( $p = 0.38$ ) after each condition. Similarly, no significant group x time interactions were found for ECW ( $p = 0.19$ ), although TBW ( $p = 0.09$ ) and ICW ( $p = 0.052$ ) tended to change. Significant time effects for TBW ( $p < 0.01$ ) and ICW ( $p < 0.001$ ) were found. Within-group analysis of post-exercise body water revealed significant increases in ICW in PLA (+0.51 L;  $p < 0.005$ ) and MIC (+0.43 L;  $p < 0.01$ ) along with a significant increase in TBW for MIC (+0.59 L;  $p < 0.01$ ).

**CONCLUSION:** Clinical safety markers did not change after seven days of prophylactic MIC supplementation and was well tolerated. MIC supplementation did not stimulate any changes in body water compartments, while immediate increases in TBW and ICW after maximal exercise were found. Post-exercise ICW levels increased in PLA and MIC while TBW only increased in MIC.

Supported by RBC Life Sciences

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### 2819 Board #213 May 29 2:00 PM - 3:30 PM

#### Effects Of Various Sodium Bicarbonate Loading Protocols On Blood Buffering And Perceived Readiness For Exercise

Adrian W. Midgley<sup>1</sup>, Jason C. Siegler<sup>1</sup>, Remco C.J. Polman<sup>2</sup>, Lars R. McNaughton, FACSM<sup>1</sup>. <sup>1</sup>University of Hull, Hull, United Kingdom. <sup>2</sup>University of Central Lancashire, Preston, United Kingdom.

(No relationships reported)

The performance-enhancing effects of sodium bicarbonate ( $\text{NaHCO}_3$ ) are associated largely with the degree of metabolic alkalosis, which is altered by the dosage and timing of ingestion.

**PURPOSE:** To investigate the effects of various  $\text{NaHCO}_3$  loading protocols on the time-dependent buffering profile and the perceived physical and mental readiness for intense exercise.

**METHODS:** Eight male volunteers (age,  $22.4 \pm 5.7$  yrs; height,  $179.8 \pm 9.6$  cm, body mass,  $76.3 \pm 14.1$  kg) completed: *Part A*) measures of alkalosis and perceived readiness for intense exercise throughout 120 min following ingestion of various single  $\text{NaHCO}_3$  dosages ( $0.3 \text{ g} \cdot \text{kg}^{-1}$ ,  $0.2 \text{ g} \cdot \text{kg}^{-1}$ ,  $0.1 \text{ g} \cdot \text{kg}^{-1}$  and placebo); and *Part B*) similar profiles following alternative  $\text{NaHCO}_3$  loading protocols [single morning dosage (SMD), single evening dosage (SED) and dosages ingested on three consecutive evenings (CED)].

**RESULTS:** *Part A*) Although the blood buffering was relatively constant in the 0.1 and 0.2 conditions, it was significantly higher at 60 min than at 100 min and 120 min in the  $0.3 \text{ g} \cdot \text{kg}^{-1}$  condition ( $p < 0.05$ ). Subjects exhibited greater perceived readiness for exercise at 120 min than at 30 min ( $p = 0.015$ ) and 60 min ( $p = 0.037$ ). *Part B*) Blood buffering for SMD was higher than for SED and CED ( $p < 0.05$ ), yet at 11:00 hrs mental readiness was significantly lower in the SMD condition.

**CONCLUSION:** The single 0.2 and  $0.3 \text{ g} \cdot \text{kg}^{-1}$   $\text{NaHCO}_3$  dosages appeared to be the most effective for increasing blood buffering capacity and best ingested 90 min before exercise, as sooner will reduce perceived readiness towards exercise.

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### 2820 Board #214 May 29 2:00 PM - 3:30 PM

#### Effects Of L-arginine Supplementation On Pre And Post Maximal Exercise Inflammatory Response

Brian Kennell, Matthew R. Feeback, Eric Corbett, Jon B. Naylor, Ronald Ottestetter. *The University of Akron, Akron, OH.* (Sponsor: Gary Kami Mori, FACSM)

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(No relationships reported)

**PURPOSE:** To determine if varying acute doses of l-arginine supplementation pre-exercise has an immediate effect on pre-exercise and post-exercise inflammatory response.

**METHODS:** Twenty five male subjects were given oral supplementation of the amino acid l-arginine 30 minutes prior to performing a maximal exercise test. Blood draws were taken pre-supplementation, post-supplementation/pre-exercise, and post exercise. Treatments included a 3 g dose (LD), a 6 g dose (HD) of l-arginine, and a placebo (PLA) for the control trial. A complete blood count was performed, using white blood cells (WBC) as a marker of inflammatory response. Linear regression was tested to determine if acute treatment accounted for a significant proportion of unique variance in WBC.

**RESULTS:** The results showed an overall significant difference between treatments ( $p = 0.031$ ). LD began at a higher WBC count but had a smaller increase in WBC count over time. HD and the PLA started near the same baseline level with a near identical slope and increase of time. The linear regression of the treatment shows time interaction to account for significant proportion of unique variance in WBC count. When taken as unique significance factors the LD treatment and time interaction was found to be significant ( $p = 0.048$ ). PLA and HD treatment were not found to be significant over time. Regardless of supplementation amount or usage, WBC count increased post-exercise. WBC count decreased following supplementation, but before exercise. A maximal dose response was also observed, as the best result was seen with the LD while the HD and PLA were similar.

**CONCLUSIONS:** For the subjects tested, an acute low dose supplementation of l-arginine decreased inflammatory response. A higher dose did not augment the decrease. Future studies might investigate chronic supplementation or the optimal acute supplementation.

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### 2821 Board #215 May 29 2:00 PM - 3:30 PM

#### L-carnitine Supplementation Improves Performance And Attenuates Oxidative Stress Responses In Renal Hemodialysis Patients

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(No relationships reported)

Hemodialyzed patients (HD) demonstrate elevated oxidative stress and reduced functional status. Although exercise induces health benefits, acute exertion upregulates oxidative stress responses in HD patients. Carnitine has been postulated to have antioxidant properties.

**PURPOSE:** To investigate the effects of L-carnitine (LCAR) supplementation on performance and oxidative stress responses of HD patients.

**METHODS:** Twelve male HD patients (53.1±2.5 yrs) received either LCAR (intravenous infusion following each dialysis session, 20 mg/kg) or placebo (P, saline of equal dose) in a counterbalanced, double-blinded design, for eight weeks. Participants performed an exercise test to exhaustion before and post-supplementation. During the test,  $\dot{V}O_2$ , respiratory exchange ratio (RER), heart rate, and time-to-exhaustion were monitored. Blood samples, collected before and post-exercise, were analyzed for lactate, thiobarbituric acid-reactive substances (TBARS), protein carbonyls (PC), reduced (GSH) and oxidized glutathione (GSGG), antioxidant capacity (TAC), catalase, and glutathione peroxidase (GPX) activity.

**RESULTS:** Blood carnitine increased only in LCAR post-supplementation proportionately at rest and post-exercise. LCAR increased endurance (22%), decreased lactate (37%), RER, and submaximal heart rate but did not affect  $\dot{V}O_{2peak}$ . LCAR ingestion reduced TBARS by 19% and 10%, PC by 40% and 27%, and increased GSH/GSSG by 2.7-fold and 4-fold, at rest and post-exercise respectively, while increased GPX activity post-exercise by 10%.

**CONCLUSIONS:** The results of the present investigation suggest that LCAR intravenous infusion for two months may be effective in attenuating oxidative stress responses, enhancing antioxidant status, and improving performance of patients undergoing chronic haemodialysis treatment.

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**2822 Board #216 May 29 2:00 PM - 3:30 PM**  
**Impact Of Silica Hydride Supplementation On Aerobic Exercise Parameters In College-Aged Males**

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(No relationships reported)

A mineral based supplement purported to contain silica hydride (SH) has been suggested to bind reduced hydrogen ions which may serve to buffer hydrogen ion concentrations during aerobic exercise.

**PURPOSE:** The purpose of this study was to examine the effects of seven days of SH supplementation on physical and cognitive markers of aerobic exercise performance.

**METHODS:** Male participants (N = 15, 23.1 ± 0.8 yrs, 180.0 ± 2.1 cm, 83.4 ± 2.8 kg, 16.4 ± 1.3%) were tested on three occasions using identical testing procedures under a control (CON), rice flour placebo (PLA) and SH. PLA and SH supplementation consisted of seven-day periods in which participants consumed 4 x 250 mg capsules/day. Following the 7-day supplementation period participants arrived at the laboratory in a fasted state and completed a  $\dot{V}O_2$  peak test on a cycle ergometer. Blood lactate levels and ratings of perceived exertion (RPE) were assessed immediately pre-exercise, at 1.5 minute intervals starting 5 minutes following the initiation of exercise, and 5 minutes post-exercise. Separate one-way ANOVAs were performed for the assessment of time to exhaustion (TTE), time to ventilatory threshold (VT), time to respiratory quotient (RQ) of 1.0,  $\dot{V}O_2$  peak, peak power (PP), power at VT, heart rate at PP, TTE after VT and TTE after reaching a RQ of 1.0. Separate 3 x 8 RM ANOVAs with Tukey post hoc comparisons were used to examine blood lactate and RPE responses during testing. For each statistic a p-value of < 0.05 was used to determine significance.

**RESULTS:** A significant time effect was found for RPE and blood lactate, as the exercise protocol became more difficult and resulted in a significant increase in blood lactate over time. No significant differences between conditions were found for any of the examined performance variables.

**CONCLUSIONS:** SH supplementation had no buffering effect on blood lactate concentrations and presented no performance enhancing benefits. As a result, future research should examine if increasing the dosage and/or supplementation period affects blood lactate and/or performance outcomes.

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**2823 Board #217 May 29 2:00 PM - 3:30 PM**  
**Effect Of Co-enzyme Q<sub>10</sub> Supplementation On Muscle Blood Flow And Metabolism In Type 2 Diabetics With Peripheral Artery Disease**

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(No relationships reported)

The dietary supplement co-enzyme Q<sub>10</sub> (CoQ<sub>10</sub>) is a potent antioxidant and a component of the electron transport chain which has been shown to improve muscle metabolism and blood flow.

**PURPOSE:** The purpose of this study was to determine the impact of CoQ<sub>10</sub> supplementation on muscle metabolism and blood flow in type II diabetes (T2D) patients with mild peripheral artery disease (PAD) compared to a non-diabetic control group.

**METHODS:** Seven T2D patients (69.9±5.1 years) and 7 matched controls (67.0±8.9) were tested 2 weeks post placebo (week 2) and 2 weeks post CoQ<sub>10</sub> supplementation (week 4). During each testing session the participants performed a 12 s dynamic plantar flexion exercise during which medial gastrocnemius muscle PCr and pH were measured using <sup>31</sup>P magnetic resonance spectroscopy. Muscle oxygen saturation and blood flow were simultaneously measured using near infrared spectroscopy. The placebo and CoQ<sub>10</sub> dosage was 200 mg/day. Two-way ANOVA and Newman-Keuls post-hoc tests were used to determine differences.

**RESULTS:** Comparing the T2D patients to the controls in the placebo trial, there were no differences in resting PCr (37.8±3.2 vs. 41.1±2.1 mM), end exercise PCr (17.2±6.5 vs. 20.6±5.8 mM), or resting pH (7.02±0.02 vs. 7.01±0.04). However, end exercise pH (6.98±0.07 vs. 7.00±0.04), PCr recovery rate after exercise (22.3±13.4 vs. 49.4±36.6 mM/kg/min), and blood flow index (5.3±2.9 vs. 9.7±2.9 %/s) were lower for the T2D patients (p<0.03). The time for muscle oxygen saturation recovery to 50% (70.9±52.1 vs. 31.8±8.4 s) was longer for the T2D patients (p<0.01). Comparing the placebo trial to the CoQ<sub>10</sub> trial, there were no differences (p=0.96 to 0.47) between any of the variables measured for either the T2D patients or the control group.

**CONCLUSIONS:** Our results show that there are significant muscle metabolic and hemodynamic differences between T2D patients and controls as expected. Two weeks of CoQ<sub>10</sub> supplementation at 200 mg/day however, did not significantly impact these metabolic or hemodynamic measures in either group. The lack of significance may be due to the relatively short supplementation period and low dosage. When blood flow is severely compromised, studies suggest that a higher CoQ<sub>10</sub> dose and/or a longer dosing period may be needed to elicit a significant impact on physiology.

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**2824 Board #218 May 29 2:00 PM - 3:30 PM**  
**b-alanine Supplementation Fails To Increase Peak Aerobic Power Or Ventilatory Threshold In Trained Males**

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(No relationships reported)

Previous research reports an increase in aerobic performance and ventilatory threshold (VT) following b-alanine supplementation. However, these studies have not included highly trained subject pools.

**PURPOSE:** To determine the effect of 30 days of b-alanine supplementation (CarnageTM) on VT and peak aerobic power ( $\dot{V}O_2$  peak) in highly fit aerobic athletes.

**METHODS:** Fourteen male runners and triathletes ( $28.8 \pm 9.8$  yrs) were assigned into a b-alanine or Placebo (PL) group. Groups were matched for numbers of runners and triathletes, as well as for VT as a percentage of VO<sub>2</sub> peak. b-alanine supplementation consisted of 3000 mg/day for 7 days, and 6000 mg/day for the remaining 23 days. Before and after the supplementation period, subjects performed a continuous, graded cycle ergometry test to determine VO<sub>2</sub> peak and VT. VT was determined by the intersection of regression lines drawn to fit the upper and lower portions of the Ventilation vs. VO<sub>2</sub> curve. Data was analyzed using a 2 x 2 ANOVA with repeated measures.

**RESULTS:** 30 days of b-alanine supplementation did not increase VO<sub>2</sub> peak ( $4.05 \pm 0.6$  vs.  $4.14 \pm 0.6$  L/min) as compared to the PL group ( $3.88 \pm 0.2$  vs.  $3.97 \pm 0.2$  L/min) ( $p > 0.05$ ). VT did not significantly improve in either the b-alanine ( $3.47 \pm 0.6$  vs.  $3.49 \pm 0.6$  L/min) or PL ( $3.36 \pm 0.2$  vs.  $3.46 \pm 0.1$  L/min) group ( $p > 0.05$ ).

**CONCLUSIONS:** 30 days of b-alanine supplementation had no effect on VO<sub>2</sub> peak or VT in highly trained aerobic athletes. The potential efficacy of b-alanine supplementation need to be further investigated in both trained and untrained populations.

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**2825 Board #219 May 29 2:00 PM - 3:30 PM**  
**Muscle Strength And Power Before And After Sublingual Administration Of L-lysine, Co-enzyme Q<sub>10</sub>, And Vitamins And Minerals**

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(No relationships reported)

When a substance comes in contact with the buccal mucosa on the underside of the tongue it diffuses through the dense capillarized membrane of the area. Most substances may be suitable to sublingual administration if they dissolve readily in saliva and many drugs are much more potent taken sublingually. Factors such as pH, molecular weight, and lipid solubility, determine the rate and strength of absorption. Nutrients, chemicals, and drugs may be administered this manner to provide faster absorption and response.

**PURPOSE:** To determine the effectiveness of a sublingual, ergogenic spray containing vitamins, minerals, an amino acid, and a co-enzyme on muscle performance in highly trained college football players.

**METHODS:** Twenty-three Division I, NCAA offensive and defensive football linemen voluntarily participated in the study after signing a consent form. On day one, all participants were completed a questionnaire, were measured, warmed up, stretched, and were tested on number of maximum bench press repetitions (102kg, [225 lb]), the vertical jump, and grip strength. One week later participants were randomly given the placebo ( $p=11$ ) or the treatment ( $p=12$ ) spray and retested. Administration was double blind and spray containers were marked A and B.

**RESULTS:** Subjects ( $20.11 \pm 1.45$  yrs;  $132.1 \pm 9.85$  kg;  $191.19 \pm 3.85$  cm). Results of repeated measures ANOVAs yielded a significant ( $p=.047$ ) improvement for the experimental group in the bench press. The experimental groups demonstrated greater but not significant improvement in both the vertical jump ( $p=.65$ ) and grip strength ( $p=.74$ ).

**CONCLUSIONS:** While a significant improvement was found for the maximum repetition bench press and positive trends in both the vertical jump and grip strength for the experimental group, it is possible that a standardized dose (4 sprays) is too limiting for individuals averaging over 132 kg (290 lbs) and should be administered based on body weight. The tests used in this study were field-tests and may not be sensitive enough to elicit subtle responses. Additional research should focus on computerized strength testing for greater data discrimination.

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**2826 Board #220 May 29 2:00 PM - 3:30 PM**  
**Oxethazaine As The Source Of Mephentermine And Phentermine In Athlete'S Urine**

Mei-Chieh Hsu<sup>1</sup>, Su-Fan Lin<sup>2</sup>, Cheng-Ping Kuan<sup>3</sup>, Wei-Lan Chu<sup>4</sup>, Kuei-Hui Chan<sup>1</sup>, Guo-Ping Chang-Chien<sup>2</sup>. <sup>1</sup>National Taiwan Sport University, Taoyuan, Taiwan. <sup>2</sup>Chengshiu University, Kaohsiung, Taiwan. <sup>3</sup>Agricultural Research Institute, Taichung, Taiwan. <sup>4</sup>Taipei Veterans General Hospital, Taipei, Taiwan.

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(No relationships reported)

Under the Anti-Doping program, athletes' urine samples were collected and analyzed in-competition and out-of-competition. Samples collected from athletes during the period October 2005 to October 2006 led to ten positive results, revealing the presence of mephentermine in the samples of ten different athletes. These test results were unprecedented. However, one athlete claimed that she only ingested a locally manufactured prescription oxethazaine tablet for relieving gastritis and stomachache.

**PURPOSE:** To understand if ingesting oxethazaine will produce mephentermine.

**METHODS:** Three volunteers (A, B, C) orally ingested 5, 10, 20 mg of oxethazaine, respectively. Urine samples were collected ad lib in polyethylene bottles and stored at -20 °C until analysis. The urine was analyzed for the phentermine and mephentermine by liquid chromatography-tandem mass spectrometry (LC-MS-MS) method.

**RESULTS:** Subjects A and B provided samples for the 1-6 hrs periods. Subject C provided samples for the 1-16 hrs periods. Phentermine was not detected (lower than LOD) in urine samples from subject A; it was probably due to the low amount of oxethazaine (5 mg) ingested. Both mephentermine and phentermine were detected in samples from subjects B and C. Moreover, we found out that 48 brands of gastric medicines containing oxethazaine were legally imported or locally manufactured in Taiwan.

**CONCLUSION:** Oxethazaine was the source of mephentermine and phentermine. This information is useful for the prevention athletes misusing oxethazaine. The data suggested that the sports associations should warn the athletes about the risks for taking oxethazaine.

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**2827 Board #221 May 29 2:00 PM - 3:30 PM**  
**The Urine Metabolic Enantiomeric Differences On Famprofazone Ingestor And Methamphetamine Abuser**

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(No relationships reported)

Famprofazone is an antipyretic and analgesic that also has some slight sympathomimetic properties. It is a component of the multi-ingredient medication used for pain relief. This drug has been demonstrated to be metabolized to methamphetamine (MA) and amphetamine (AM) following administration and has been shown to produce a positive urinary test result.

**PURPOSE:** To distinguish the differences of enantiomeric composition of MA and AM in urine following famprofazone administration or MA abuser.

**METHODS:** Six healthy volunteers, with a mean age ( $\pm$ standard deviation, SD) of  $25.2 \pm 1.9$  yrs, weight of  $79.0 \pm 14.1$  kg, height of  $174.5 \pm 7.7$  cm, participated in the experiment. One Gewolent tablet (25 mg of famprofazone) was administered orally to the subjects. After administration, urine samples were collected in the intervals of 0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8, 8-9, 9-12, 12-15, 15-22, 22-28, 28-34, 34-40, 40-48, and 48-60 hrs. The concentrations of MA and AM for all urine samples were analyzed by gas chromatography-mass spectrometry (GC-MS). In addition, 12 urine samples from MA abuser which had been confirmed to MA positive testing result were collected. All urine samples were derivatized by N-trifluoroacetyl-L-prolyl chloride (L-TPC) and analyzed the enantiomers of the MA metabolites by GC-MS.

**RESULTS:** Thirty four percent of the urine samples from famprofazone ingestor showed MA positive (the concentrations of AM and MA higher than 100 and 500 ng/mL). The d-enantiomers of AM and MA in the urine of famprofazone ingestor were  $43.8 \pm 3.0\%$  and  $28.5 \pm 2.5\%$ . However, the d-enantiomers of AM and MA in the urine of AM abusers were  $98.6 \pm 2.1\%$  and  $97.5 \pm 1.7\%$ .



**CONCLUSIONS:** The enantiomers of urinary amphetamines metabolites from MA abuser urine differ from famprofazone ingester. Extra analysis of enantiomers can help the laboratory to avoid the interpretation of typical laboratory results of MA positive drug tests.

*Supported by NSC Grant 94-2413-H-252-003.*

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**2828      Board #222      May 29      2:00 PM - 3:30 PM**  
**Ingestion Of Capsiate Induces Increased Energy Expenditure And Increased Fat Oxidation At Rest, But Not During Exercise In Young Men**

Andrea R. Josse, Scott S. Sherriffs, Andrew M. Holwerda, Richard Andrews, Aaron W. Staples, Stuart M. Phillips. *McMaster University, Hamilton, ON, Canada.*

*(No relationships reported)*

**PURPOSE:** To examine how ingestion of capsiate, an extract from the CH-19 sweet pepper, affects energy expenditure and blood metabolites at rest and during exercise. Unlike capsaicin, a related more pungent (spicy) compound, capsiate acts through gastric vanilloid receptors before being broken down to vanillyl alcohol and a fatty acid. The thermogenic properties of capsiate remain understudied and no data exist on its interaction with exercise.

**METHODS:** Twelve healthy young men (age=24.3±3 yr, BMI=25.5±1.7 kg/m<sup>2</sup>) were studied on two occasions in a double-blind design following ingestion of either placebo (PLA) or 10mg of capsiate (CAP) at rest (60min), after 90min of cycling at 55% peak VO<sub>2</sub> and 30min into recovery. We measured energy expenditure throughout the protocol and took blood samples to determine concentrations of: lactate, glucose, glycerol, free fatty acids (FFA), and catecholamines. Subjects ingested the capsules 30min prior to exercise.

**RESULTS:** We observed increases in resting VO<sub>2</sub>, and serum norepinephrine, and decreases in serum FFA and respiratory exchange ratio with CAP vs. PLA (all p<0.05). At exercise onset, while lactate accumulation was relatively low, we did observe a reduced blood lactate concentration 30min into exercise with CAP vs. PLA (p<0.05). There were no other significant differences between CAP and PLA during or post-exercise.

**CONCLUSION:** Ingestion of 10mg of capsiate increased adrenergic activity, energy consumption, and shifted substrate utilization toward lipid at rest. Capsiate had little effect during exercise or recovery. The thermogenic changes indicate a potential role for capsiate in aiding with fat loss while dieting.

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**2829      Board #223      May 29      2:00 PM - 3:30 PM**  
**Improvement Of Inflammatory And Immune Response Of Athletes At Intense Endurance Exercise By Cystine/theanine Supplementation**

Masaru Otani<sup>1</sup>, Shigeki Murakami<sup>2</sup>, Hiroshi Yoshigi<sup>2</sup>, Keisuke Sawaki<sup>2</sup>, Shuzo Kamei<sup>3</sup>, Shigekazu Kurihara<sup>4</sup>, Charles A. Titchenal<sup>5</sup>. <sup>1</sup>*The University of Tokyo, Tokyo, Japan.* <sup>2</sup>*Juntendo University, Tokyo, Japan.* <sup>3</sup>*Takaoka University of Law, Takaoka, Japan.* <sup>4</sup>*Ajinomoto Co., Inc., Tokyo, Japan.*

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*(No relationships reported)*

Prolonged periods of intense endurance exercise training are often accompanied by an increased inflammatory response and immunosuppression. This effect has been reported to increase susceptibility to respiratory system viral infections. A recent trial in mice and elderly humans indicated that oral administration of the amino acids, cystine and theanine (CT), reinforces humoral immune response after antigen stimulation. However, the actions and effects of CT on athletes have not been reported previously.

**PURPOSE:** To determine the effects of CT supplementation on the inflammatory response and immune state in long-distance runners at a training camp.

**METHODS:** Sixteen distance runners were allocated to consume CT supplements (700 mg cystine + 280 mg theanine daily) or placebo (8 in each group) for 7 days prior to a training camp and during the 9-day camp. Daily run training averaged 19.9 km/day prior to the camp and 28.6 km/day during the camp. On the initial day and final day of the training camp, blood samples were collected before and after 15 km morning interval running workouts (1000 m 15 times) and analyzed for neutrophil and lymphocyte counts and myoglobin.

**RESULTS:** The relative change in exercise-induced blood neutrophil count (% of pre-exercise values) was significantly lower in the CT group than in the placebo group (163.3 ± 43.2 % vs. 200.4 ± 19.6 %, p = 0.044) on the initial day of training camp, but not on the last day of camp. The decline in lymphocyte count (% of pre-exercise values) was significantly less in the CT group compared with the placebo group (60.2 ± 19.2 % vs. 36.2 ± 12.0 %, p = 0.010) on the initial day of camp, but not on the last day. Post-exercise myoglobin levels were significantly lower in the CT group (p = 0.038) on the initial day of camp and there was a trend toward lower % of pre-exercise values in the CT group (p<0.09) on both measurement days.

**CONCLUSIONS:** Combined cystine and theanine supplementation significantly inhibited the increase in neutrophil count and the reduction in lymphocyte count induced by intense endurance exercise. These results suggest that combined cystine and theanine supplementation may suppress the exercise-induced inflammatory response and possibly help to reduce immunosuppression and inflammatory-derived muscle damage.

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**2830      Board #224      May 29      2:00 PM - 3:30 PM**  
**Benefits Of Quercetin On Intestinal Polyp Multiplicity In Apc<sup>Min/+</sup> Mice**

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*(No relationships reported)*

Quercetin is one of a broad group of natural polyphenolic flavonoid substances, present in a wide variety of food plants, which are being investigated for their widespread health benefits. Quercetin has a diverse range of biological properties among which include anti-inflammatory and anti-carcinogenic properties. The anti-carcinogenic effects of quercetin have been well established in cell culture models; however its effects on tumorigenesis in vivo are largely unknown.

**PURPOSE:** To determine the potential benefits of quercetin on intestinal polyp multiplicity, including polyp number, size, and distribution in Apc<sup>Min/+</sup> mice. The Apc<sup>Min/+</sup> mouse model is the most widely used genetically engineered mouse model for cancer studies that involve the gastro-intestinal tract. It has been shown to have a mutated Apc gene, similar to that in patients with familial adenomatous polyposis, and in many sporadic cancers.

**METHODS:** Male and female Apc<sup>Min/+</sup> mice were randomly assigned to placebo or quercetin treatment (n=10/group). Mice were given a placebo (standard diet) or a 0.2% quercetin (QU995) diet from 4 to 20 weeks of age. Tissues were collected at 20 weeks of age and intestines were analyzed for polyp number, size and distribution in the small and large intestines.

**RESULTS:** Quercetin decreased total intestinal polyps by 60% (p<0.05), the effects were seen in sections 2 (65%), 3 (70%), and 4 (80%) of the small intestine (P2mm) (50%) and medium (1mm) (75%) polyps (p<0.05), without increasing the number of small (<1mm) polyps.

**CONCLUSION:** These data suggest that the dietary supplement quercetin may be an important nutritional strategy to prevent the incidence or delay progression of colon cancer.

*Supported by a grant from Quercegen Pharma, LLC.*

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**2831      Board #225      May 29      2:00 PM - 3:30 PM**  
**Effects Of Ammonium Chloride Ingestion On Phosphocreatine Recovery Following Heavy-intensity Plantar Flexion**

## Exercise

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(No relationships reported)

Intracellular acidosis has been shown to increase the time constant and/or rate constant of the phosphocreatine (PCr) kinetic response during recovery from exercise, supporting the notion that mitochondrial respiration is reduced under low pH conditions. The slowed PCr recovery in the presence of intracellular acidosis has also been attributed to an increased ATP consumption by cellular ion pumps, and/or to a pH-induced shift in the creatine kinase (CK) equilibrium. However, during this recovery period, [PCr] often rises transiently above resting values before returning to pre-exercise values. This phenomenon has been named the PCr recovery overshoot, and the mechanisms responsible for it remain unknown.

**PURPOSE:** To examine the effects of ammonium chloride (NH<sub>4</sub>Cl) ingestion on PCr recovery and the magnitude of PCr overshoot following heavy-intensity plantar flexion (PF) exercise.

**METHODS:** Eight untrained male subjects performed isotonic PF exercise in a control (CON) and NH<sub>4</sub>Cl ingestion (ACID) trial (0.3g/kg oral dose of NH<sub>4</sub>Cl, over 3 hrs prior to exercise). PF exercise (contraction rate, 0.5 Hz) was performed for 9 min each during moderate- (MOD: 75% of intracellular pH threshold, TpHi) and heavy-intensity exercise (HVY: 125% TpHi), and was followed immediately by 15 min resting recovery. <sup>31</sup>P magnetic resonance spectroscopy was used to non-invasively monitor changes in intracellular pH (pHi), [PCr], and [ATP].

**RESULTS:** End HVY exercise pHi was lower (P<0.05) in ACID (6.61 (0.07); mean (SD)) than CON (6.69 (0.06)). During recovery the PCr time constant (tPCr) was greater (P<0.05) in ACID (45 s (16)) than CON (33 s (10)). The magnitude of [PCr] recovery overshoot, as a percentage of the pre-exercise resting value, was greater (P<0.05) in ACID than CON during the following recovery periods: 3-6 min (ACID, 110% (3); CON, 107% (3)); 6-9 min (ACID, 110% (3); CON, 106% (4)); 9-12 min (ACID, 108% (3); CON, 105% (3)); and 12-15 min (ACID, 108% (3); CON, 105% (4)).

**CONCLUSION:** A greater intracellular acidosis at the end of HVY was seen in ACID vs. CON. This was associated with a longer time constant describing PCr recovery kinetics and a greater magnitude of [PCr] overshoot above baseline values.

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## F-35 Free Communication/Poster - Training with Blood Flow Restriction

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### 2832 Board #226 May 29 3:30 PM - 5:00 PM

#### Skeletal Muscle Size And Strength Are Increased Following Walk Training With Restricted Leg Muscle Blood Flow: Effect Of Training Frequency

Takashi Abe<sup>1</sup>, Charles F. Kearns<sup>1</sup>, Satoshi Fujita<sup>1</sup>, Mikako Sakamaki<sup>1</sup>, Yoshiaki Sato<sup>1</sup>, William F. Brechue, FACSM<sup>2</sup>. <sup>1</sup>University of Tokyo, Kashiwa, Japan. <sup>2</sup>United States Military Academy, West Point, NY.

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Three weeks of twice-daily walk training with restricted leg muscle arterial inflow and venous outflow (KAATSU-walk) produced substantial muscle hypertrophy (4-7% increase in muscle volume) and increased strength (increase in 1-repetition maximum (1-RM) and maximal isometric torque (MVC) 8-10%) in the thigh muscles (J Appl Physiol 100:1460-1466, 2006) and a hypertrophic potential (% change in muscle mass/# training sessions; 0.19) approximating that of high intensity resistance training. However, the impact of lower frequency KAATSU-walk training on muscle size and strength is unknown. **PURPOSE:** To investigate once-daily KAATSU-walk training on thigh muscle size and strength.

**METHODS:** Twelve young men performed walk training: KAATSU-walk training (n=6) and control (no KAATSU; n=6). Training was conducted once daily, 6 days/wk, for 3 wk. Treadmill walking (50 m/min) was performed for five sets of 2-min bouts interspersed with 1-min rest periods. The KAATSU-walk group wore pressure cuff belts (5 cm wide) on both legs during training with incremental external compression; 160-230 mmHg. Thigh muscle cross-sectional area and volume (MRI), MVC and 1-RM were measured before and 3 days following final training.

**RESULTS:** In the KAATSU-walk group, quadriceps and hamstrings muscle volume increased (both p<0.05) 1.7% (pre, 1738 cm<sup>3</sup>; post, 1768 cm<sup>3</sup>) and 2.4% (622 cm<sup>3</sup> vs. 638 cm<sup>3</sup>), respectively, following training with a hypertrophic potential of 0.09. 1-RM leg press (pre, 85 kg; post, 93 kg) and leg curl (57 kg vs. 63 kg) increased 9% and 10% (both p<0.01), respectively, following KAATSU-walk training. Also, MVC knee extension strength (4.4%; p<0.01), but not knee flexion strength (1.7%) increased following KAATSU-walk training. There were no changes in muscle volume or strength in the Control-walk group. These results confirm previous work showing that the combination of slow walk training and leg muscle blood flow restriction induces muscle hypertrophy and strength gain. However, the magnitude of change in muscle mass and strength following once-daily KAATSU-walk training is approximately one-half that reported for twice-daily KAATSU-walk training over a three week period.

**CONCLUSIONS:** There is a frequency dose-dependency to the impact of KAATSU-walk training on hypertrophic potential and muscular strength.

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### 2833 Board #227 May 29 3:30 PM - 5:00 PM

#### Dose Gender Affect Skeletal Muscle Response To Resistance Exercise With Blood Flow Restriction?

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**BACKGROUND:** By-products (H<sup>+</sup>, Pi, H<sub>2</sub>PO<sub>4</sub><sup>-</sup>) of skeletal muscle activation are not only contributed to fatigue but also to muscular adaptation (muscle hypertrophy and strength gain). Resistance training with blood flow restriction (BFR) effectively increases muscle bulk and strength despite using small workload and is presumed to provide accelerated fatigue with high levels of intramuscular by-products due to hypoxia. Recent studies have shown that women have greater resistance to fatigue than men during submaximal contractions with the same relative force. It is suggested that higher absolute force in men vs. women may produce greater mechanical compression of the vascular bed and reduce the availability of oxygen. There is no clear information as to whether gender affects the muscular responses to resistance exercise even applying BFR.

**PURPOSE:** The purpose of this study was to examine the sex differences in intramuscular by-products during low-intensity resistance exercise with BFR and during conventional high-intensity resistance exercise.

**METHOD:** Twenty-six healthy subjects (22±4 yr, age-matched 13 men and 13 women) performed unilateral plantar-flexion for 2-min (30 repetitions/min) with various conditions. Protocols were randomly performed with low-intensity (L: 20% 1RM), L with BFR (LB) and high-intensity (H: 65% 1RM). Intramuscular pH,

phosphocreatine (PCr),  $\text{H}_2\text{PO}_4^-$  during exercise were measured every 30 sec by  $^{31}\text{P}$ -magnetic resonance spectroscopy.

**RESULT:** Resting systolic blood pressure (men:  $124.2 \pm 11.7$  vs. women:  $106.5 \pm 6.3^*$  mmHg), applying pressure for BFR (men:  $161.5 \pm 15.2$  vs. women:  $138 \pm 8.1^*$  mmHg) and 1RM (men:  $50.7 \pm 6.6$  vs. women:  $31.8 \pm 8.3^*$  kg) were significantly smaller in women than in men ( $^*p < 0.001$ ). PCr depletion (men:  $19.9 \pm 4.7$  vs. women:  $22.1 \pm 4.8$  mM), intramuscular pH decrease (men:  $6.90 \pm 0.08$  vs. women:  $6.92 \pm 0.05$ ) and  $\text{H}_2\text{PO}_4^-$  increase (men:  $9.6 \pm 2.7$  vs. women:  $8.2 \pm 1.8$  mM) at the end of LB did not show statistical difference between both genders. Those during H were very similar to LB.

**CONCLUSION:** Although women showed relatively smaller muscular stress during low-intensity resistance exercise with blood flow restriction and also during high-intensity resistance exercise compared with men, there is no statistical difference between genders.

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2834 Board #228 May 29 3:30 PM - 5:00 PM

**Remarkable Effects Of Continuous Blood Flow Restriction During Multiple Sets Of Low Intensity Resistance Exercise**

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**PURPOSE:** Skeletal muscle bulk and strength are now becoming important therapeutic targets in cardiovascular rehabilitation. However, usual resistance training needs to load muscles intensively and is hard for cardiac and elder subjects. Resistance training with blood flow restriction (BFR) is a new method to effectively increase muscle bulk and strength despite using lower workload, whereas we reported that usual low-intensity resistance exercise with BFR protocol could not result in energetically sufficient stimulus. The purpose of this study was to examine the optimal low-intensity resistance exercise with 2 difference BFR protocols composed of multiple sets in terms of muscle energy metabolism.

**METHODS:** Twelve healthy subjects ( $22 \pm 1$  yr, mean  $\pm$  SE) performed 3 sets of 1-min unilateral plantar-flexion (30 repetitions) with 1-min rest intervals. Protocols were randomly performed with low-intensity exercise by using 20% 1RM (L) and high-intensity exercise by using 65% 1RM (H) without BFR, L with intermittent (only during exercise) BFR (L-IBFR) and L with continuous BFR (L-CBFR). Phosphocreatine (PCr) and intramuscular pH were measured using  $^{31}\text{P}$ -Magnetic resonance spectroscopy.

**RESULTS:** The changes of PCr and intramuscular pH during all-sets among low-intensity conditions were significantly increased by applying BFR (L vs. L-IBFR and L-CBFR,  $p < 0.05$ ). In the PCr depletion (L-CBFR:  $15.5 \pm 1.5$ , L-IBFR:  $25.0 \pm 1.3$ , H:  $15.9 \pm 1.3$  mM) and intramuscular pH decrease (L-CBFR:  $6.84 \pm 0.02$ , L-IBFR:  $6.96 \pm 0.02$ , H:  $6.87 \pm 0.02$ ) at the end of final set, L-CBFR was significantly greater than those in L-IBFR ( $p < 0.05$ ) and similar to those in L-IBFR. Moreover, integrated PCr depletion during exercise session with rest intervals was equal level to that in H (L-CBFR:  $3952 \pm 315$  vs. H:  $4126 \pm 335$  sec $\times$ mM, ns).

**CONCLUSIONS:** Effects of low-intensity resistance exercise with BFR might be sufficiently enhanced by continuous BFR with multiple sets.

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2835 Board #229 May 29 3:30 PM - 5:00 PM

**Change In Temperature Of Active Muscle During Low-intensity Resistance Exercise With Blood Flow Restriction.**

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Heat-stress has been shown to prevent muscle atrophy and facilitate exercise-induced muscle hypertrophy due partly to the expression of proteins such as HSP 72. Low-intensity resistance exercise with blood flow restriction (BFR) has been shown to increase muscle size and strength comparable to that of high-intensity exercise. Furthermore, acute bout of exercise with BFR triggers a fatigue induced heat sensation, and it may elevate muscle temperature as compared to non-restricted exercise.

**PURPOSE:** To investigate the effect of low-intensity resistance exercise combined with BFR on skin temperature ( $T_{sk}$ ) over exercising muscle.

**METHODS:** 8 healthy males (age:  $25.4 \pm 5.2$  yrs) performed 4 sets (30, 15, 15, and 15 reps with 30-s rest between sets) of low-intensity (20% 1RM) unilateral arm curl exercise with (BFR-20) and without (CON-20) blood flow restriction, and 3 sets (10 reps with 90-s rest between sets) of moderate-intensity (60% 1RM) exercise without BFR (CON-60).  $T_{sk}$ , reflective of muscle temperature beneath the skin, was measured from skin above biceps brachii (BB) muscle of both arms during exercise and 10 minutes post-exercise. Surface EMG of the BB was recorded, and mean integrated EMG (iEMG) was analyzed. Blood lactate was assessed before and 1 minute post-exercise.

**RESULTS:** iEMG and blood lactate for BFR-20 (iEMG:  $280 \pm 82\%$ , Lactate:  $180 \pm 14\%$ ) was significantly increased ( $p < 0.01$ ) as compared with CON-20 (iEMG:  $180 \pm 14\%$ , Lactate:  $143 \pm 29\%$ ). During exercise,  $T_{sk}$  was increased similarly (CON-20: from  $33.0 \pm 0.6$  to  $34.1 \pm 0.8^\circ\text{C}$ , BFR-20: from  $32.9 \pm 0.8$  to  $33.8 \pm 0.8^\circ\text{C}$ ). However, peak  $T_{sk}$  appeared after exercise in both groups, and the peak  $T_{sk}$  for BFR-20 was higher ( $p < 0.01$ ) than that of CON-20 (CON-20:  $34.6 \pm 0.7$ , BFR-20:  $34.9 \pm 0.8^\circ\text{C}$ ). Hence, the increase in  $T_{sk}$  for BFR-20 was significantly higher ( $p < 0.01$ ) as compared with CON-20 (CON-20:  $1.6 \pm 0.4$ , BFR-20:  $2.0 \pm 0.5^\circ\text{C}$ ). The increase in  $T_{sk}$  for CON-60 trial was  $1.9 \pm 0.5^\circ\text{C}$ , which was similar to the change observed in BFR-20.

**CONCLUSION:** The results suggest that low-intensity resistance exercise with BFR may increase active muscle temperature more than that of non-restricted control exercise. However, further study is necessary to clarify whether the increase in muscle temperature by low-intensity resistance exercise with BFR contributes to muscular hypertrophy.

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2836 Board #230 May 29 3:30 PM - 5:00 PM

**Effects Of Walk Training With Restricted Blood Flow On Cardiovascular And Muscle Functions In Elderly**

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Slow walk training combined with restricted leg muscular blood flow (KAATSU-walk) produces substantial muscle hypertrophy and strength gains in young men. However, the impact of KAATSU-walk in middle-aged and older population on cardiovascular and muscle functions is unknown.

**PURPOSE:** To investigate the effects of KAATSU-walk on muscle size and function, as well as aerobic capacity, in elderly subjects.

**METHODS:** Sixteen elderly men and women, aged 60-78 years were randomized into either a KAATSU-walk (2 men, 9 women;  $n=11$ ) or a non-exercising control group (1 man, 4 women;  $n=5$ , CTRL). The KAATSU-walk group performed 20 min treadmill walking (67 m/min), five days/wk for 6 wk. Subjects in the KAATSU-walk group wore pressure belts on proximal part of both legs during training with restrictive pressure at 140-200 mmHg. The following were assessed prior to and following the training program; (1) maximum isometric knee extension and isokinetic knee extension and flexion strength, (2) muscle mass (MM), (3) functional fitness and (4) maximum oxygen uptake ( $\text{VO}_{2\text{peak}}$ ). MM was estimated from ultrasound-measured muscle thickness using the prediction equations. Functional fitness was assessed by Timed Up and Go Test (time to walk both ways from the chair to 2.4m marker) and Chair stand Test (repeated chair stand in 30 seconds).  $\text{VO}_{2\text{peak}}$  was extrapolated from the relationship between heart rate response and oxygen uptake measured during exercise.

**RESULTS:** In the KAATSU-walk group, maximum isometric and isokinetic strength (for example, 11.8% for isometric knee extension strength) and ultrasound-estimated skeletal muscle mass (6.0% and 10.7% for total and thigh, respectively) increased ( $P < 0.05$ ), but not in the CTRL group. Functional fitness also improved significantly only in

the KAATSU-walk group ( $P < 0.05$ ); however, there was no change in estimated  $\dot{V}O_{2peak}$  (absolute [pre:  $1.76 \pm 0.56$  l/min, post:  $1.70 \pm 0.55$  l/min]; relative [pre:  $31.8 \pm 6.3$  ml/kg/min, post:  $31.2 \pm 6.2$  ml/kg/min]) in either group ( $P > 0.1$ ).

**CONCLUSION:** Slow walk training combined with restricted leg muscular blood flow increased muscle strength and size improved functional fitness in elderly. However, aerobic capacity remained unchanged following the 6-week training period in either group.

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## **F-36 Free Communication/Poster - Weight Control**

MAY 29, 2009 1:00 PM - 6:00 PM

ROOM: Hall 4F

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### **2837 Board #231 May 29 3:30 PM - 5:00 PM**

#### **Effects Of Exercise And Low Caloric Diet With Varying Density On Body Weight And Satiety**

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**PURPOSE:** This study examined the combined effects of low caloric diet with either high or low energy density and aerobic exercise on body composition, blood lipids profiles, and satiety in overweighted young women.

**METHODS:** Twenty three women were recruited and randomly assigned to either high energy density diet plus exercise group (HDE;  $n=12$ ,  $22 \pm 1$  yrs,  $65 \pm 7$  kg,  $163 \pm 5$  cm,  $25.8 \pm 1.9$  kg/m<sup>2</sup>,  $34 \pm 4$  %fat) or low energy density diet plus exercise group (LDE;  $n=11$ ,  $22 \pm 2$  yrs,  $67 \pm 7$  kg,  $161 \pm 7$  cm,  $24.2 \pm 3.0$  kg/m<sup>2</sup>,  $35 \pm 4$  %fat) to participate a 4-week weight management program. All subjects were educated to maintain a low caloric diet ([Unsupported Character - &#8786;]1,500 kcal/d) throughout the study and record their daily dietary intake. During the study, their lunch, which was isocaloric ( $483 \pm 26$  for HDE,  $487 \pm 27$  kcal for LDE) but different weight of food ( $365 \pm 68$  for HDE,  $814 \pm 202$  g for LDE) was provided for each group. The food composition and volume of one group was not informed to other group. The hunger level was evaluated by a scale (1: extremely starving, 9: extremely full) at 17:30 hour of each day. Two hours after each lunch, they exercised on a stationary bike at approximately 60% of their maximal heart rate for 45 min. Prior to and at the completion of study, their physical characteristics were measured and resting blood samples were drawn for analyses of blood lipid profiles.

**RESULTS:** Average daily energy intake was  $1,551 \pm 259$  for HDE and  $1,404 \pm 150$  kcal for LDE ( $P > 0.05$ ). Body weight ( $-1.9$  kg) and %fat ( $-1.4$ %) were significantly reduced in LDE ( $P < 0.05$ ), but not in HDE ( $-0.9$  kg,  $-1.0$ %, respectively). Waist circumference was reduced from  $79 \pm 9$  to  $74 \pm 9$  cm in LDE ( $P < 0.05$ ), but not in HDE (from  $80 \pm 7$  to  $77 \pm 6$  cm). No changes were noticed before and after study between groups in total cholesterol, triglycerides, and glucose. The hunger level was significantly higher in HDE ( $2.46 \pm 0.28$ ) than in LDE ( $3.10 \pm 0.26$ ) ( $P < 0.05$ ).

**CONCLUSIONS:** Low caloric diet in LDE appeared to be more effective in controlling body weight compared to HDE. It appeared that weight control program with low caloric diet in combination with exercise should include the density of diet.

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### **2838 Board #232 May 29 3:30 PM - 5:00 PM**

#### **Acute Weight Loss Patterns By Professional Horse Racing Jockeys In Preparation For Racing**

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Horse racing is a weight category sport, for which jockeys must weigh in at a designated weight prior to, and immediately after each race. Current weight standards in Irish horse racing, range from 52.7 - 64 kg and 62 - 76 kg for Flat and National Hunt racing respectively. Weight allocations are based solely on the ability of the horse, requiring jockeys to constantly cycle their body mass at a specified weight allowance in order to compete. Strict and potentially dangerous weight loss practices have been previously reported to be used by jockeys in order to comply with the stipulated weight standards. The magnitude of acute weight loss typically attained by jockeys in preparation for competition would appear however, to be largely unknown.

**PURPOSE:** The purpose of this study was to examine typical weight loss patterns in professional horse racing jockeys.

**METHODS:** A structured self-report questionnaire was distributed to 24 jockeys (10 Flat, 14 National Hunt) who volunteered to participate in the study. This questionnaire provided a subjective evaluation of typical body mass on racing and non racing days. Mean percentage body mass loss was extrapolated from the results. Participants also provided information as to the typical amount of time given to achieve the stipulated weight.

**RESULTS:** Mean reported typical riding weight was shown to be  $3.8 \pm 2.2$  % below the subjects self reported non riding weight (range: 0 - 7.9%). The largest reported mean weight loss for a race was  $3 \pm 1.4$  kg (range: 1.4 - 7.3kg), equating to a mean percentage body mass loss of  $5 \pm 2$  % (range: 2.3 - 10.5%). Subjects were typically given 24 - 48 hours notification of the required weight they had to attain for a particular race.

**CONCLUSIONS:** Results from this study would appear to indicate that current weight standards are set below a level which is easily attainable for this group of subjects. Furthermore extreme acute weight loss practices appeared to be evident in a number of cases. Further research is required to specifically examine the impact of typical weight loss practices used by jockeys on their physiological and cognitive function as well as health and well-being.

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### **2839 Board #233 May 29 3:30 PM - 5:00 PM**

#### **Epicardial and Abdominal Fat Responses To Weight Loss In Obese Men**

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In cross-sectional studies, echocardiographic epicardial fat measurement seems to be a reliable and diagnostic marker of visceral fat. However, a comparative study of the changes in epicardial fat as well as those in the visceral or truncal depot in response to weight loss has yet to be investigated.

**PURPOSE:** To compare the changes of epicardial, abdominal, and regional fat compartments following a low calorie diet intervention in obese men.

**METHODS:** We evaluated 27 moderately obese men (age:  $45.8 \pm 1.7$  years; body mass index:  $30.5 \pm 0.7$  kg/m<sup>2</sup>, mean  $\pm$  SE) and conducted a 12-week clinical weight-loss intervention with a daily low calorie diet presented through weekly lectures. Immediately before and after the intervention, the epicardial fat thickness was measured by transthoracic echocardiography, and abdominal fat tissues were determined by computed tomography scans. Whole and regional fat compartments were measured by dual X-ray absorptiometry.



**RESULTS:** Subjects experienced a 27% decrease of the initial estimated daily calorie intake, on average, and had 11% and 17% loss of body weight and body fat, respectively, accompanied by a 15% decrease in epicardial fat thickness (from  $8.2 \pm 0.3$  to  $7.0 \pm 0.3$  mm,  $P < 0.001$ ) and a 30% decrease in abdominal fat compartments after the program. The percentage change in visceral adipose tissue in response to weight loss was twice as high as the change in epicardial fat tissue ( $P < 0.001$ ). Stepwise multiple regression analysis revealed that the change in abdominal fat compartments and initial visceral fat tissue were independent determinants of the change in epicardial fat thickness ( $P < 0.05$ ).

**CONCLUSION:** It appears that during low calorie diet-induced weight loss that the proportionally highest reduction is abdominal fat compartments in men with obesity. Whereas, when compared to other fat compartments, reduction in epicardial fat tissue in response to weight loss seems to be low.

**2840 Board #234 May 29 3:30 PM - 5:00 PM**  
**The Effect Of Weight Loss And Physical Activity On Bone Mineral Density In Overweight Women**

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It is known that weight loss can cause reductions in Bone Mineral Density (BMD); however, few studies have reported on the effect of weight loss combined with physical activity across long-term prospective studies.

**PURPOSE:** To examine the effect of weight loss, fat loss and physical activity on changes in BMD in overweight women across a 24 month weight loss intervention.

**METHODS:** Data from 90 overweight women (BMI =  $32.6 \pm 4.3$  kg/m<sup>2</sup>; age =  $38.6 \pm 5.5$  years) participated in a 24 month behavioral weight loss intervention. Participants were instructed to reduce energy intake to 1200-1500 kcal/d, and physical activity was prescribed at 1000-2000 kcal/wk at a moderate-to-vigorous intensity. Assessments of weight, physical activity, body composition, and BMD measured at the hip were completed at 0, 6, and 24 months. BMD of the femoral neck, greater trochanter, intertrochanter, and Ward's was assessed using DXA.

**RESULTS:** Weight change from baseline at 6 and 24 months was  $-8.8 \pm 4.5$  kg and  $-6.9 \pm 7.4$  kg, ( $p < 0.05$ ). The change in physical activity from baseline at 6 and 24 months was  $1265 \pm 1256$  kcal/wk and  $1236 \pm 1345$  kcal/wk. BMD decreased significantly at 6 and 24 months for total BMD ( $-0.0024 \pm 0.0184$ ,  $-0.0096 \pm 0.0283$  gms/cm<sup>2</sup>), femoral neck ( $-0.0101 \pm 0.0242$ ,  $-0.0129 \pm 0.0391$  gms/cm<sup>2</sup>), greater trochanter ( $-0.0018 \pm 0.0215$ ,  $-0.0090 \pm 0.0308$  gms/cm<sup>2</sup>), and Ward's ( $-0.0011 \pm 0.0420$ ,  $-0.0161 \pm 0.0481$  gms/cm<sup>2</sup>), ( $p < 0.05$ ). Weight change at 6 months was correlated with 6 month measures of BMD (total BMD,  $r = .28$ ; femoral neck,  $r = .34$ ; greater trochanter,  $r = .26$ ). Change in weight at 24 months was correlated with 24 month measures of BMD (total BMD,  $r = .53$ ; femoral neck,  $r = .58$ ; greater trochanter,  $r = .47$ ; intertrochanter,  $r = .33$ ), ( $p < .01$ ). Change in physical activity was not significantly correlated with change in BMD at 6 or 24 months.

**CONCLUSIONS:** Bone Mineral Density significantly decreased with weight loss resulting from decreased energy intake and increased physical activity. However, the clinical significance of this decrease in overweight or obese women is unclear. Physical activity did not appear to influence changes in BMD. However, walking was the primary form of activity. Whether a different dose or mode of activity or might result in different findings warrants further investigation.

Supported by the National Institutes of Health (HL64991)

**2841 Board #235 May 29 3:30 PM - 5:00 PM**  
**Residential Weight Loss Programmes For Children: Consistent Favourable Responses Irrespective Of Baseline Fitness And Fatness**

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**PURPOSE:** Assess variation of responses to a residential weight loss programme involving physical activities and dietary restriction.

**METHODS:** Repeated measures design pre and post the 8 week intervention. The daily schedule included six 1-hour, skill based, fun, physical activities, moderate dietary restriction and lifestyle education. BMI defined as overweight was required for inclusion. Tertiles were derived from baseline fatness and fitness. Analysis of covariance was used to evaluate the intervention across tertiles. 203 overweight and obese children (mean age 14.02 years) attended the camp for between 6 to 53 days. Children were assessed for height, weight, body composition, other anthropometrics and aerobic fitness pre and post intervention. Blood pressure and various biochemical markers of cardiovascular disease risk were also recorded for varying proportions of campers.

**RESULTS:** Campers, who stayed for a mean of 30 days, reduced their weight and standardised BMI scores by 6.35kg and 0.3 units respectively. Increases in VO<sub>2</sub> at 85% HR max of 0.2L.min<sup>-1</sup> and 3.89ml.kg<sup>-1</sup>.min<sup>-1</sup> were also observed. Significant ( $P < 0.003$  -  $P < 0.000$ ) improvements were consistently seen across all tertiles of campers, based on a comparison of pre and post values. Variability of change data are shown in table 1.

VARIABLE	ALL CAMPERS	FATNESS TERTILES	FITNESS TERTILES
(post-pre)	Mean	Range of means	Range of means
% Body fat	-3.3	-3.18 to -3.52	-2.67 to -3.87
Waist Circumference (cm)	-6.2	-5.41 to -6.70	-5.64 to -6.85
BP Systolic (mmHg)	-6.63	-5.98 to -7.6	-4.79 to -7.61
BP Diastolic (mmHg)	-7.41	-6.67 to -8.51	-6.36 to -9.31
TC (mmol.L-1)	-0.76	-0.06 to -0.89	-0.67 to -0.94
TG (mmol.L-1)	-0.22	-0.07 to -0.31	-0.18 to -0.68
LDL (mmol.L-1)	-0.70	-0.44 to -0.92	-0.58 to -0.79
TC/HDL	-0.68	-0.19 to -1.16	-0.45 to -0.76
Leptin (ng.ml-1)	-60.90	-53.64 to -75.19	-41.34 to -75.39

Longer duration of stay was associated with greater improvements in outcomes, but the effect of the camp remained consistently significant when controlling for duration of stay for body fat, waist circumference and blood pressure.

**CONCLUSIONS:** The 8 week residential intervention was consistently effective for overweight and obese children across several key variables, when controlling for baseline

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**2842 Board #236 May 29 3:30 PM - 5:00 PM**  
**Characteristics Of Responders And Non-responders To A 12-week Fat Loss Intervention**

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(No relationships reported)

Metabolic and autonomic factors may influence the ability of overweight women to lose fat undergoing an exercise-based fat loss intervention.

**PURPOSE:** Characteristics of responders and non-responders to a 12-week lifestyle intervention consisting of high intensity interval exercise (HIIE), fish oil supplementation, and Mediterranean diet in sedentary overweight women were examined.

**METHODS:** Subjects were assigned to an intervention consisting of fish oil consumption, HIIE, and Mediterranean diet. Thirty-four females (BMI  $27.0 \pm 0.5$  kg/m<sup>2</sup>; age  $23.5 \pm 0.7$  yrs) underwent pre- and posttraining testing including a VO<sub>2peak</sub> test, resting metabolic rate assessment for respiratory exchange ratio (RER), heart rate (HR), systolic blood pressure (SBP), and a dual energy x-ray absorptiometry (DEXA) scan to measure body composition. The women undertook 36 supervised exercise sessions that involved 8 s of sprinting on a cycle ergometer followed by 12 s of relative rest, repeated for a total of 20 min. Dietary intake was regularly monitored through food diaries. Fish oil consumption consisted of 1.8 g of eicosapentaenoic and docosahexaenoic acid daily. The women were grouped into responders (RES; n=21) or non-responders (NRES; n=13) based on body weight loss. RES lost ( $\geq 0.05\%$ ) of their initial body weight while NRES did not. All values are expressed as mean  $\pm$  standard error.

**RESULTS:** There were significant differences ( $p < 0.05$ ), at baseline for HR ( $70.1 \pm 1.9$ ;  $64.2 \pm 1.4$  bpm), SBP ( $116 \pm 2$ ;  $109 \pm 3$  mmHg), and RER ( $0.87 \pm 0.01$ ;  $0.93 \pm 0.02$ ). In the RES women there was a significant decrease in fat mass ( $-2.7 \pm 0.4$ ;  $0.6 \pm 0.4$  kg) and overall body weight ( $-2.8 \pm 0.4$ ;  $1.2 \pm 0.3$  kg) compared to the NRES women. Both RES and NRES increased VO<sub>2peak</sub> ( $0.28 \pm 0.03$ ;  $0.29 \pm 0.03$  L/min) with no significant difference between groups. Diets were similar in composition and total kilojoules.

**CONCLUSION:** Thirty-six, 20-min bouts of HIIE, plus fish oil, and a Mediterranean diet led to significant fat loss in most but not all women. NRES possessed a higher RER and lower HR and SBP. The higher respiratory exchange ratio suggests impaired fat oxidation, whereas the lower heart rate and blood pressure suggest reduced sympathetic tone.

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**2843 Board #237 May 29 3:30 PM - 5:00 PM**  
**Effectiveness Of A Culturally Tailored Commercial Weight Loss Program Among UK South Asian Women.**

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(No relationships reported)

South Asian women have higher rates of central obesity, type 2 diabetes and heart disease than the general population. Based on limited published data, South Asian women are less physically active and eat diets higher in fat and energy compared to non-South Asian counterparts. There is little evidence on the effectiveness of weight-loss interventions targeted at and developed for this group.

**PURPOSE:** To determine the effect of a culturally-tailored commercial weight loss program on weight loss and adoption of healthy eating and physical activity behaviors in South Asian women.

**METHODS:** 41 overweight/obese South Asian women (BMI  $29.0 \pm 5.2$  kg/m<sup>2</sup>, weight  $71.9 \pm 14.9$  kg, Age  $38.5 \pm 10.0$  years, mean  $\pm$  SD) were recruited from two community-based locations. Culturally-tailored supplemental materials were developed prior to initiation of the intervention with input and approval from the target community; these materials were given in addition to standard program materials during intervention implementation. A non-South Asian program leader coached participants on culturally appropriate strategies to change diet and physical activity behaviors over the 11-week program. Weekly food diaries were kept and daily steps were recorded using a pedometer. Weight was measured weekly. Height, waist circumference and %body fat were measured at baseline and the end of the program. Focus groups and individual interviews were conducted post intervention to collect qualitative data on satisfaction with the program, views on culturally-enhanced materials and barriers and enablers of making diet and activity changes.

**RESULTS:** Reduction in weight and BMI of the 31 women who attended two or more meetings were statistically significant (weight  $-2.3 \pm 2.1$  kg,  $p < 0.001$ , BMI  $-0.9 \pm 0.9$  kg/m<sup>2</sup>,  $p < 0.001$ ). %body fat ( $-1.6 \pm 1.2\%$ ,  $p < 0.001$ ) and waist circumference ( $-1.3 \pm 2.1$  cm,  $p = 0.003$ ) also decreased significantly. Food diary and qualitative data indicated that women maintained their traditional dietary choices while reducing serving sizes which contributed to weight loss.

**CONCLUSIONS:** A culturally-tailored commercial weight loss program resulted in significant weight loss and other obesity indicators among South Asian women.

*Supported by Weight Watchers UK Ltd and University of Bristol Vice Chancellor's Scholarship.*

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**2844 Board #238 May 29 3:30 PM - 5:00 PM**  
**Determining The Efficacy Of The Bodybugg Armband When Implemented Into The Lifestyle Of Sedentary Individuals**

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**PURPOSE:** Fourteen sedentary individuals (4 males, 10 females, Age  $7.7 \pm 11.2$ ) were selected for a 12-week weight loss pilot study to determine the monitoring effectiveness of the bodybugg armband system. **METHOD:** Subjects worked out with a personal trainer at least three times a week performing both aerobic and resistance training, attended weekly educational sessions, wore the bodybugg monitor 24 hrs/day (except when showering or swimming), participated in team challenges, and download bodybugg data every 2-3 days. The subjects' exercise intensity and goals gradually increased weekly based on an individual's progress and initial testing.

**RESULTS:** Data showed a 9% weight loss and 8.6% BMI decrease with the greatest absolute fat losses occurring in the most active individuals (Low activity = -2.4%; High Activity = -8.2%). Over the entire 12-weeks, all contestants took 14,889,060 steps and expended 3,897,450. The strongest stepwise regression correlations were observed between weight loss and % kcal expenditure change from baseline (CFB): ( $r = 0.69$ ,  $p < 0.005$ ), % VO<sub>2</sub> max CFB ( $r = 0.65$ ,  $p < 0.01$ ), and % steps/day CFB ( $r = 0.65$ ,  $p < 0.01$ ). Declines in body weight or % body fat were not correlated with improvements in total and segmental body strength (i.e., bicep curl or chest press). Finally, using the median of daily kcal expenditure, subjects were divided into low versus high daily energy expenditure groups (LDEE versus HDEE), fitness improvements were not different between the groups (VO<sub>2</sub> max,  $p = 0.16$  and total 1-RM strength,  $p = 0.71$ ). Yet, weight loss was 2.3 times greater in the group that had the greatest pre-to-post gain in total daily energy expenditure ( $p = 0.004$ ). Thus, the bodybugg system was able to distinguish if a lack of or increase in daily lifestyle physical activity level, independent of fitness changes, played a significant role in a person's weight loss success in the program.

**CONCLUSION:** In conclusion, the bodybugg monitoring system can play a very important role in determining both fitness and non-fitness related physical activity levels during a free-living monitored weight loss program. However, follow up research is needed to determine if the bodybugg system can facilitate continued weight loss success after a person completes a supervised program.

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**2845 Board #239 May 29 3:30 PM - 5:00 PM**

## Influences Of Weight Gain And Macronutrient Source On Monocyte TLR4 And Cytokine Expression In Mice

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(No relationships reported)

Excessive weight gain increases systemic inflammation, which is implicated in the development of most secondary diseases associated with obesity. Toll-like receptor 4 (TLR4) has been purported to mediate weight gain induced increases in systemic inflammation; to our knowledge, its role has not been fully evaluated. Excess calorie consumption is the most common cause of excessive weight gain, but the influence of macronutrient content on weight gain and TLR4 is unknown.

**PURPOSE:** The purpose of this study was to determine the effect of dietary macronutrient content on weight gain and markers of systemic inflammation in blood monocytes following 12-weeks of feeding.

**METHODS:** Male CD-1 mice were randomly assigned to high fat (HF, n = 12, 60% fat) or high carbohydrate (HC, n = 13, 60% CHO) groups. Mice were allowed ad libitum access to food and water. Venous blood was collected at 0, 4, 8 and 12 weeks from a peripheral saphenous vein. Three-color flow cytometry was used to measure monocyte TLR4 expression and intracellular LPS-stimulated monocyte IL-6 and TNF- $\alpha$  production. Data were analyzed with a repeated measure ANOVA, significance was set at  $P \leq 0.05$ .

**RESULTS:** Body weight at week 12 was 20% greater in HF than HC ( $P < 0.05$ ). Similar effects were found for percentage of weight gained. TLR4 MFI at week 12 was 30% greater in HC than HF ( $P < 0.05$ ). Percent increase in body weight at week 12 was positively correlated with the concentration of monocytes producing IL-6 ( $r = 0.34$ ,  $P < 0.05$ ) and TNF- $\alpha$  ( $r = 0.38$ ,  $P < 0.05$ ) but negatively correlated with IL-6 MFI ( $r = -0.38$ ,  $P < 0.05$ ) and TNF- $\alpha$  MFI ( $r = -0.41$ ,  $P < 0.05$ ).

**CONCLUSIONS:** Our findings are contrary to our hypothesis that weight gain due to high-fat feeding would lead to greater inflammatory responses. TLR4 expression appears to follow the same pattern during weight gain regardless of macronutrient content until week 8 (when HF gained ~50% of body weight and HC gained ~30%); at this point monocytes concentration appears to decrease and MFI increases relative to HF values. More research is needed to determine how changes in the blood relate to changes in peripheral adipose tissue compartments.

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### 2846 Board #240 May 29 3:30 PM - 5:00 PM Prevention Of Weight Gain In College Freshmen Through Environmental Change

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A university dining hall would be an ideal community in which to study the effects of an environmental change on the prevention of weight gain, since it will allow for tracking of the impact of an environmental manipulation over an extended period of time in the same participants, because freshmen are required to consume their meals in the dining hall. If the environment of the dining halls is altered to decrease the amount of food available, weight gain during the college years may be prevented.

**PURPOSE:** To determine the effectiveness of altering the environment to prevent weight gain in college students.

**METHODS:** College freshmen and transfer students were recruited. Two dining halls served as the research sites: one was the intervention dining hall, the other served as the control. In the intervention dining hall, portion sizes and serving utensils in self-service areas were decreased. Body weight and body mass index (BMI) were the primary outcome variables.

**RESULTS:** There was a clinically significant reduction in BMI of about 0.8% in the experimental group (initial n=57), while the control group had a 2% increase in BMI (initial n=61) (baseline to post-intervention). Similar patterns occurred with body weight: the intervention group lost about 0.8 kg, while the control group had a weight gain of about 0.9 kg (baseline to post-intervention).

**CONCLUSIONS:** Though not statistically significant, these results are clinically significant, because it has been reported that for every 1% above desirable BMI, the risk for coronary heart disease (CHD) increases by 3.3% for women and 3.5% for men. Moreover, for every kilogram of weight loss, there are significant reductions in risk factors for CHD and diabetes mellitus. For every kilogram weight gain after high school, the CHD risks increase by 5.7% for women and 3.1% for men.

*This project was funded by NIDDK 1-RO3-DK063991-01 and the University of Pennsylvania School of Nursing Center for Health Outcomes and Policy Research*

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### 2847 Board #241 May 29 3:30 PM - 5:00 PM Pomegranate Seed Oil Supplementation During High-Fat Feeding May Reduce Weight Gain And Type 2 Diabetes Risk In Mice

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(No relationships reported)

The health benefits of pomegranate consumption have recently received considerable scientific focus, with most studies examining fruit and/or juice consumption. Pomegranate seed oil (POMo) is a rich source of 9-cis, 11-trans conjugated linolenic acid (CLA), which may offset the side effects associated with weight gain.

**PURPOSE:** The purpose of this study was to evaluate the effects of POMo consumption during 14-weeks of high-fat feeding (60% calories from fat) in mice.

**METHODS:** Male, wild-type CD-1 mice were divided into one of three groups (N=20 per group): High-Fat (HF), HF + Seed Oil (HF+POMo), or lean control (LN). In HF and HF+POMo, mice were provided ad libitum access to a high-fat chow (60% of joules (calories) from fat). HF+POMo was supplemented with 61.79 mg of POMo/day. LN consumed a restricted low-fat (10% of joules (calories) from fat) chow to maintain body weight within 5% of initial weight. Plasma was analyzed for biomarkers associated with cholesterol profile (total cholesterol, HDL, and triglycerides), glucose sensitivity (glucose and insulin), adipose tissue accumulation (leptin and adiponectin), and systemic low-grade inflammation (CRP and haptoglobin). Data were analyzed for significance using a one-way ANOVA, with significance set at  $P < 0.05$ .

**RESULTS:** Weight gain (HF and HF+POMo) was associated with an increase in biomarkers of cholesterol profile, insulin insensitivity, adipose tissue accumulation, and systemic low-grade inflammation ( $P < 0.05$ ). POMo supplementation only altered selected aspects of weight gain. HF+POMo mice gained 20% less weight than HF, despite similar level of caloric intake ( $P = 0.002$ ). HF+POMo mice had a 100% lower plasma leptin concentration ( $P < 0.001$ ) and 80% greater adiponectin concentration ( $P = 0.019$ ), than HF mice. Plasma insulin concentration was 26% lower in HF+POMo, compared to HF ( $P = 0.003$ ).

**CONCLUSIONS:** POMo intake was associated with an improvement in insulin sensitivity, suggesting that risk of developing type II diabetes may have been reduced; however, cardiovascular disease risk did not appear change. More research is needed to determine the mechanism by which POMo exerts its action.

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### 2848 Board #242 May 29 3:30 PM - 5:00 PM Relationship Between Sedentary Behaviors And Markers Of Insulin Sensitivity In Young Women

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(No relationships reported)

Sedentary lifestyles may be associated with the rising prevalence of obesity and chronic disease in the US.

**PURPOSE:** The purpose of this study was to examine the relationship between accelerometer-determined sedentary behaviors and markers of insulin sensitivity.

**METHODS:** Young (25-40 y) normal weight (BMI  $22.2 \pm 1.9$  kg/m<sup>2</sup>; n=26), overweight (BMI  $27.2 \pm 1.4$  kg/m<sup>2</sup>; n=22), and obese (BMI  $34.4 \pm 2.7$  kg/m<sup>2</sup>; n=27) women were recruited for the study. Height, weight, and waist circumference were determined for each participant. Fasting blood samples were measured for serum insulin and plasma glucose concentrations. Insulin sensitivity was calculated according to the Quantitative Insulin Sensitivity Check Index (QUICKI) method. Participants wore an accelerometer (Kenz Lifecorder) and reported time to sleep and time awake for 7-days. Time (minutes/day) spent in four activity levels (inactive, light, moderate, vigorous) was determined. Sleep time (minutes/day) was subtracted from the inactive category. Sedentary behaviors (inactive - sleep minutes/day) was determined for each participant. One-way analysis of variance examined differences in markers of insulin resistance across the weight groups. Partial correlations (controlling for age) examined the relationship between sedentary behaviors (minutes/day) and markers of insulin sensitivity.

**RESULTS:** Waist circumference and serum insulin increased significantly across BMI categories (waist circumference [cm]: normal weight  $77 \pm 8$ , overweight  $92 \pm 6$ , obese  $105 \pm 9$  [p<0.01]; insulin [ $\mu$ U/mL]: normal weight  $6 \pm 3$ , overweight  $8 \pm 4$ , obese  $13 \pm 7$  [p<0.01]). QUICKI decreased significantly across BMI categories (normal weight  $0.389 \pm 0.041$ , overweight  $0.360 \pm 0.036$ , obese  $0.334 \pm 0.021$  [p<0.01]). No differences were seen between BMI categories for plasma glucose. The normal weight, overweight, and obese women participated in  $618 \pm 82$ ,  $631 \pm 137$ , and  $659 \pm 95$  minutes/day of sedentary behaviors, respectively [p=0.36]. Using partial correlations (controlling for age), time (minutes/day) spent in sedentary behaviors was positively associated with insulin (r=0.31; p<0.01) and negatively associated with QUICKI (r=-0.29; p=0.01).

**CONCLUSIONS:** In this study, more time spent in sedentary behaviors was associated with unfavorable markers of insulin sensitivity.

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**2849 Board #243 May 29 3:30 PM - 5:00 PM**  
**Body Composition and Hormonal Adaptations Associated With Forskolin Consumption In Overweight And Obese Women**

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(No relationships reported)

**PURPOSE:** This study examined the effect of forskolin on body composition, testosterone, sex hormone binding globulin (SHBG), and blood pressure in overweight and obese (BMI  $\geq 26$  kg/m<sup>2</sup>) women.

**METHODS:** Twenty-two subjects (forskolin, n=10; placebo, n=12) were studied in a randomized, double-blind, placebo-controlled study for 12 weeks.

**RESULTS:** Forskolin was not shown to elicit favorable changes in body composition as determined by the Bod Pod compared with the placebo group (p>.05) in women. There was no significant change for fat-free mass in the forskolin group ( $-0.06 \pm 3.66$  kg) compared with the placebo group ( $1.86 \pm 4.10$  kg). There was no significant change for fat mass in the forskolin group ( $0.39 \pm 2.72$  kg) compared with the placebo group ( $1.55 \pm 5.51$  kg). Serum free testosterone levels showed no significant change in the forskolin group ( $3.38 \pm 4.29$  pg/ml) compared with the placebo group ( $-2.05 \pm 3.88$  pg/ml). There was no significant change for serum total testosterone concentration in the forskolin group ( $3.38 \pm 4.29$  ng/ml) compared with the placebo group ( $-2.05 \pm 3.88$  ng/ml). There was no significant change for SHBG in the forskolin group ( $0.01 \pm 0.78$  nmol/L) compared with the placebo group ( $-1.15 \pm 2.39$  nmol/L).

**CONCLUSIONS:** Oral ingestion of forskolin (250 mg of 10% forskolin extract twice a day) for a 12-week period was not shown to alter body composition. The results indicate that forskolin is not a therapeutic agent for the management and treatment of obesity in women. A previous study conducted in our lab (*Obesity Research*, 13(8): 1335-1343, 2005) on overweight and obese men showed that forskolin did elicit favorable changes in body composition by significantly decreasing body fat percentage and fat mass and significantly increasing serum free testosterone compared with the placebo group (p $\leq$ 0.05). We conclude that the differences in women and men are likely attributed to the dissimilarity of basal testosterone levels.

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**2850 Board #244 May 29 3:30 PM - 5:00 PM**  
**Obesity In Elderly Women Is Associated With Insulin Resistance Of Glucose And Protein Metabolism**

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(No relationships reported)

We have previously shown that normal aging is associated with insulin resistance of glucose metabolism that also extends to that of protein. Obesity creates particular metabolic changes that contribute in further decreasing insulin sensitivity of glucose metabolism. How obesity affects insulin sensitivity of protein metabolism in the elderly remains unknown.

**PURPOSE:** To compare insulin sensitivity of whole-body glucose and protein metabolism between obese (O) and non-obese (NO) elderly women.

**METHODS:** [<sup>13</sup>C] leucine kinetics were measured in 10 healthy NO and 8 healthy O elderly women in the postabsorptive state and during a hyperinsulinemic ( $40 \mu\text{U} \cdot \text{m}^{-2} \cdot \text{min}^{-1}$ ), euglycemic ( $5.5 \text{ mmol} \cdot \text{L}^{-1}$ ), isoaminoacidemic (amino acids maintained at individual baseline) clamp for 210 min. Body composition was measured using bioelectrical impedance analysis with validated equations. Volunteers followed a 7-day, isoenergetic formula-based diet before the clamp comprising  $1.8 \text{ g protein} \cdot \text{kg fat-free mass (FFM)}^{-1} \cdot \text{day}^{-1}$ .

**RESULTS:** Age did not differ (O:  $72 \pm 4$  vs. NO:  $70 \pm 6$  yrs), and body mass ( $77 \pm 9$  vs.  $57 \pm 7$  kg), body mass index ( $31 \pm 3$  vs.  $23 \pm 2$  kg  $\cdot \text{m}^{-2}$ ), FFM ( $40 \pm 3$  vs.  $36 \pm 3$  kg) and fat mass (FM) ( $37 \pm 6$  vs.  $22 \pm 5$  kg) were significantly higher in O than NO (all P < 0.02). In the postabsorptive state, leucine rate of appearance (Ra, protein breakdown) was 12% higher (P < 0.01) and disappearance (Rd, synthesis) 10% higher (P < 0.01) in O than NO, but leucine oxidation and net balance did not differ between groups. With hyperinsulinemia, insulin sensitivity (glucose infusion rate  $\cdot \text{FFM}^{-1}$ /mean plateau insulin) was 56% less (P = 0.02) in O than NO, with no difference in the rate of amino acid infusion between groups. The percent change in leucine flux, Ra and Rd was not different between groups, but that of leucine oxidation was 26% higher (P = 0.02) in O than NO. FM (kg) correlated (r = 0.70, P < 0.01) with the % change in leucine oxidation.

**CONCLUSION:** In addition to demonstrating a reduced insulin sensitivity of glucose metabolism, our results suggest that obese elderly women also have a blunted protein anabolic response to hyperinsulinemia due to increased losses through oxidation.

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**2851 Board #245 May 29 3:30 PM - 5:00 PM**  
**Effects Of Exercise On Appetite And Whole Saliva in Humans**

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(No relationships reported)

We previously confirmed that the sight and smell of food enhance appetite and salivary flow, and decrease salivary viscosity.

**PURPOSE AND METHODS:** To examine the effect of exercise on appetite and the characteristics of saliva, six subjects performed high-intensity exercise for 12 min [2.0 and 1.6 W/kg (weight) for males and females, respectively] and low-intensity exercise for 24 min [1.0 and 0.8 W/kg (weight) for males and females, respectively] after a 3-min baseline. Then subjects rested for 36 min as a recovery phase. Whole saliva was collected for 3 min at the baseline and every 12 min during exercise and recovery phase.



Subjects rated prospective food consumption on a 100-mm visual analog scale (Question: How much food do you think you could eat? Answer: 0 = nothing at all, 100 = a large amount). Subjects placed a nylon ball (15 mm in diameter) in their oral cavity to promote salivary flow. We then measured the flow and viscosity of saliva.

**RESULTS:** The rate of prospective food consumption increased 30 min after the end of low-intensity exercise ( $p < 0.05$ ), but did not change during and after high-intensity exercise. Compared to the resting baseline, salivary flow significantly decreased during high-intensity exercise, but not during and after low-intensity exercise. The viscosity of saliva did not significantly change in response to exercise. There was no significant correlation between the changes in appetite and saliva variables.

**CONCLUSION:** These results suggest that the effects of exercise on appetite and salivary flow depend on the intensity of the exercise, and that the change in appetite associated with exercise does not relate to the characteristics of saliva.

*Supported by a grant from the Asahi Brewries Foundation awarded to NH.*

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**2852 Board #246 May 29 3:30 PM - 5:00 PM**  
**The Influence Of High Intensity Running And Cycling On Plasma Acylated Ghrelin Concentrations In Males**

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*(No relationships reported)*

Running suppresses plasma acylated ghrelin and this may be related to a well-documented transient suppression of hunger during running. The effects of cycling on acylated ghrelin may differ to those of running since body mass is supported during cycling.

**PURPOSE:** To examine the effects of cycling and running on plasma acylated ghrelin and hunger.

**METHODS:** Following University ethical approval 10 healthy males (mean  $\pm$  SEM: age  $21.6 \pm 0.5$  yrs, BMI  $23.4 \pm 0.9$  kg·m<sup>-2</sup>, VO<sub>2</sub> max  $55.7 \pm 2.6$  and  $47.4 \pm 2.4$  mL·kg<sup>-1</sup>·min<sup>-1</sup> for running and cycling respectively) completed 3, 4 h trials; control, running and cycling in a random order after a 10 h fast. During the exercise trials, subjects ran or cycled for 1 h at 70% of mode-specific VO<sub>2</sub> max for the first hour, and then rested for the remainder of the trial with a test meal consumed at 3 h. During the control trial subjects rested throughout. Hunger ratings were measured every 0.5 h using a visual analogue scale. Venous blood samples were collected at 0, 0.5, 1, 1.5, 2, 3, 3.5 and 4 h for determination of acylated ghrelin via an enzyme immunoassay (SPI BIO, France).

**RESULTS:** There was a wide variation in acylated ghrelin concentrations among subjects (mean  $\pm$  SEM: fasting value  $264 \pm 88$ , range 61-1227 pg·mL<sup>-1</sup>). There was a main effect of time (two-way ANOVA  $P < 0.05$ ) indicating suppression of acylated ghrelin and hunger after feeding but no main effect of trial and no interaction effect. Upon removal of an outlier whose mean fasting acylated ghrelin values were 795 pg·mL<sup>-1</sup> higher than the mean of the remaining 9 subjects (mean  $\pm$  SEM:  $184 \pm 42$  pg·mL<sup>-1</sup>), a trend was evident (main effect of trial  $P = 0.07$ ,  $N = 9$ ) for suppressed acylated ghrelin concentrations at 0.5 h in the running and cycling trials compared with the control trial ( $123 \pm 111$  v  $182$  pg·mL<sup>-1</sup> respectively) and at 1 h in the running and cycling trials compared with the control trial ( $105 \pm 114$  v  $178$  pg·mL<sup>-1</sup> respectively).

**CONCLUSION:** Plasma acylated ghrelin concentrations were not reduced during either running or cycling exercise although a trend was evident on removal of an outlier. These initial findings warrant further investigation with an increased subject number.

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**2853 Board #247 May 29 3:30 PM - 5:00 PM**  
**The Effect Of w-3 On Weight-loss And Inflammation In The Combat-sport Of Wrestling**

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Wrestlers frequently undergo periodic weight-loss in order to compete in the higher end of their weight-class and minimize the chances of conceding size to an opponent. Unsurprisingly, such "weight-making" practices can impair performance. Starvation and overtraining elevate levels of inflammatory mediators and decrease levels of anabolic compared to catabolic hormones, causing muscle-wasting. Recent advances have been made in treating inflammatory illnesses, such as exercise-induced asthma, with fish-oils.

**PURPOSE:** We aimed to examine the inflammatory response to weight-making and to ascertain the potential for fish-oil supplementation as a ergogenic aid in this context.

**METHODS:** A 2-way mixed-measures design was executed over a four week period prior to competition, during which, wrestlers lost weight. Circulating levels of cytokines, anabolic and catabolic hormones were compared between wrestlers assigned to either fish-oil supplementation or placebo at -28days, -7days and +3days relative to competition.

**RESULTS:** No significant differences in the ratio of growth hormone to cortisol (GH/C) existed, with individual wrestlers showing a contrasting array of responses to weight-making. Our data did suggest, however, that fish-oils may exert a female-specific regulatory effect on decreases in GH/C. Although none of the cytokine-profiles showed a significant difference from supplementation, a consistent trend was revealed towards lower levels in the fish-oil group. Fish-oil profiles for Interleukins 2/4/5/6/8/10/12p70/1b/ as well as TNF- $\beta$ , and TNF- $\alpha$  show lower concentrations than the controls at either -7days, +3days or at both time-points. The pro-inflammatory cytokines IL4, IL-8 and TNF- $\alpha$ , frequently associated with inflammatory disease, showed the most pronounced response to supplementation.

**CONCLUSIONS:** Our desire to work in elite sport limited our sample size and underpowered the study. Yet, consistent trends in the attenuation of cytokine levels, as well as an observed amelioration in the catabolic environment in females, would support the need for further research.

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**G-12 Free Communication/Poster - Age, Sex and Race Influences on Muscle and Bone**

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

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**2854 Board #1 May 30 9:30 AM - 11:00 AM**  
**Gender Comparison Of Vastus Lateralis Basal Myogenic, Proteolytic, Myostatin And Myokine Mrna Levels**

Emily Louis, Nick Luden, Erik Hayes, Ulrika Raue, Bozena Jemiolo, Scott Trappe, FACSM. Ball State University, Muncie, IN.

*(No relationships reported)*

It is well established that males generally have greater muscle mass compared to females. Additionally, it has been shown that in response to prolonged bed rest, females appear to experience unloading-induced atrophy more quickly and to a greater extent than males. These findings suggest that males and females may have differences in basal molecular regulation of muscle mass.

**PURPOSE:** The aim of this study was to compare basal levels of myogenic, proteolytic, myostatin, and myokine mRNA between the male and female vastus lateralis (VL) muscle.

**METHODS:** Biopsies from the VL of seven males ( $26 \pm 3$  yr,  $75 \pm 8$  kg) and seven females ( $25 \pm 3$  yr,  $59 \pm 5$  kg) were obtained 10-12 hours following a standardized meal. All

subjects were recreationally active, healthy, and had refrained from all non-essential physical activity during the 48 hours prior to the biopsies. Using RT-PCR, the mRNA levels of select myogenic (MyoD, myogenin, MRF4), proteolytic (MuRF-1, atrogin-1), myostatin, and myokine (IL-6, -8, and -15) genes were analyzed and normalized to GAPDH.

**RESULTS:** *Myogenic:* MRF4 gene expression was 1.8-fold higher in males ( $p<0.05$ ) than females. *Proteolytic:* Males had higher atrogin-1 (2.4-fold) and MuRF-1 (1.6-fold) gene expression compared to females ( $p<0.05$ ). *Myostatin:* Basal levels of myostatin mRNA was 12.5-fold higher in males compared to females ( $p<0.05$ ). *Interleukins:* Males had higher basal IL-6 (2.0-fold) and IL-15 (5.9-fold) mRNA ( $p<0.05$ ).

**CONCLUSION:** *In general, the male VL had higher basal levels of myogenic, proteolytic, myostatin and myokine mRNA as compared to females. These findings substantiate gender-specific differences in the molecular regulation of muscle mass at rest. However, direct factors responsible for, and as a result of these differences have yet to be elucidated. Supported by NASA grant NNJ06HF59G*

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**2855 Board #2 May 30 9:30 AM - 11:00 AM**  
**Isokinetic Strength And Anaerobic Performance In African-American And Caucasian Males**

Stacy D. Hunter, David R. Bassett, FACSM, Eugene Fitzhugh, Dinesh John. *University of Tennessee, Knoxville, TN.*  
(No relationships reported)

African-Americans outperform their Caucasian counterparts in anaerobic activities like sprinting and jumping. However, the mechanism explaining their superior performance in these activities remains unclear. The force-velocity characteristics of the muscles, as determined by isokinetic testing, are related to muscle fiber type, and may partially explain racial differences in anaerobic performance.

**PURPOSE:** To compare vertical jump (VJ) height and power (VJP), sprint time, and isokinetic strength in African-American and Caucasian college-aged males, and to examine correlations between these variables.

**METHODS:** The participants were 23 African-American and 27 Caucasian recreationally active, college-aged males. Anthropometric measures (height, weight, percent body fat, and thigh circumference) were taken and physical activity (PA) was assessed by questionnaire. Subjects were tested for VJ, 100-m run time, and isokinetic peak torque (PT). Isokinetic knee extension and flexion were performed on a Biodex System 3 at angular velocities of 60, 120, 210, 300, and 400 degrees  $\cdot$  s<sup>-1</sup>. Peak torques and relative torques (RT), using torque generated at 60 degrees  $\cdot$  s<sup>-1</sup> as the reference, were analyzed.

**RESULTS:** There were no significant differences between African-Americans and Caucasians in anthropometric variables, PA, PT, or RT. African-Americans exhibited greater VJ height ( $p<0.01$ ) and VJP ( $p<0.05$ ). African-Americans were also faster in the 100-m dash when controlling for body fat percentage and wind velocity ( $p<0.05$ ). Vertical jump height significantly correlated with 100-m sprint time ( $r = -0.769$ ,  $p<0.001$ ). Vertical jump power significantly correlated with isokinetic knee extension PT at all angular velocities and with knee flexion PT at 120, 300 and 400 degrees  $\cdot$  s<sup>-1</sup>.

**CONCLUSION:** African-Americans demonstrated superior performance in the VJ and 100-m dash, but not in isokinetic strength. However, African-Americans showed a trend towards greater PT and RT at high angular velocities which may give them a slight performance advantage in tasks requiring fast speeds of muscle contraction.

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**2856 Board #3 May 30 9:30 AM - 11:00 AM**  
**Growth Hormone Molecular Weight Variant Responses To Resistance Exercise Differ In Men Vs. Women**

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(No relationships reported)

Growth hormone (GH) exists as a family of molecular weight (MW) variants with different biological activities and whose response patterns to exercise are poorly understood. Whereas the pulsatile release of GH is known to be sexually dimorphic, no data are available that directly compare GH MW variant exercise responses in men and women. Such information may be important in understanding sex-related differences in exercise and metabolic adaptations.

**PURPOSE:** To compare GH MW variant responses to acute resistance exercise in men and women.

**METHODS:** 10 men and 10 women performed an acute exercise test (AET; 6 sets of 10 RM squats), and had blood drawn pre, mid, and post (0, +15, and +30 min post) of the AET. Serum samples were fractionated using high pressure liquid chromatography into 3 MW pools (A: >60 kDa; B: 30-60 kDa; C: <30 kDa) which correspond to GH oligomers, GH dimers and GH monomers, respectively. GH concentrations were determined using a commercially-available immunoassay. Data were analyzed with repeated measures ANOVA.

**RESULTS:** Across all time points and sex, Fraction C (GH monomer) was the highest MW variant collected (C:  $14.3 \pm 1.8 > A: 9.6 \pm 1.7 > B: 5.2 \pm 0.7$  ng;  $p<0.05$ ). Interactions with fraction, time, and sex ( $p<0.01$ ) indicated that women experienced GH increases in all 3 MW variants examined from pre to mid exercise (A: pre:  $7.7 \pm 7.1$  vs mid:  $14.9 \pm 12.4$ ; B: pre:  $4.1 \pm 3.1$  vs. mid:  $6.8 \pm 5.3$ ; C: pre:  $8.9 \pm 7.2$  vs. mid:  $19.7 \pm 15.8$ ), while men did not increase until post-exercise (A: pre:  $2.1 \pm 2.5$  vs. +15 post:  $11.0 \pm 8.5$ ; B: pre:  $0.9 \pm 1.1$  vs. post:  $5.7 \pm 3.7$ ; C: pre:  $2.7 \pm 2.3$  vs. post:  $17.1 \pm 8.9$ ). In recovery, men maintained elevations of the B (pre:  $0.9 \pm 1.1$  vs. +30 post:  $5.5 \pm 3.9$ ) and C fractions (pre:  $2.7 \pm 2.3$  vs. +30 post:  $14.9 \pm 10.7$ ) for at least 30 min ( $p<0.05$ ), while all fractions in women returned to baseline within 15 min ( $p>0.05$ ).

**CONCLUSIONS:** Women experienced earlier increases in all GH variants during exercise whereas men demonstrated more sustained increases in GH monomers and dimers in the post-exercise milieu. Temporal GH molecular variant responses to exercise differ in men and women.

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**2857 Board #4 May 30 9:30 AM - 11:00 AM**  
**Age-related Changes In Number Of Nucleus Around Neuromuscular Junction In Rat Diaphragms**

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(No relationships reported)

**PURPOSE:** Previous studies demonstrated a decrease in neuromuscular activity with aging and the extent of decrease could influence neuromuscular junction morphology and function. In this study, we compared number of nucleus around neuromuscular junction (NMJ nucleus) and 3-dimensional (3D) morphological properties of motor endplate in diaphragm muscle between young and old rats.

**METHODS:** Young (2-5 months old,  $n=7$ ) and old (over 2 years old,  $n=7$ ) male Wistar rats were used. Mid-costal diaphragm muscle segments were removed and endplates were labeled with a-bungarotoxin conjugated tetramethylrhodamine. A number of single muscle fiber with labeled endplate was isolated from the segments under fluorescent microscope, and myonuclei including NMJ nucleus were stained with DAPI (4', 6-diamino-2-phenylindole) to examine the space distribution of these nuclei.

**RESULTS:** In 54 single fibers from young diaphragm, the mean values (+ standard deviation) of endplate surface area and volume were  $1428 \pm 613$   $\mu$ m<sup>2</sup> and  $2019 \pm 972$   $\mu$ m<sup>3</sup>, respectively. In 58 single fibers from old diaphragm, the mean value of endplate surface area and volume were  $2531 \pm 1190$   $\mu$ m<sup>2</sup> and  $2440 \pm 1684$   $\mu$ m<sup>3</sup>, respectively. Large variations were found in endplate surface area and volume in old diaphragm, as compared to these values in young diaphragm. Decreased endplate density (endplate area / outer surrounding area) in the old diaphragm indicated fragmentation of the endplate (from  $71.5\% \pm 7.3\%$  to  $55.2 \pm 7.3\%$ ). The number of NMJ nucleus was significantly higher in

old ( $16.1 \pm 6.6$ ) than young ( $9.7 \pm 5.2$ ) diaphragm muscles. There were almost same significant relationships between the number of nuclei and endplate volume in both young ( $r=0.52$ ) and old ( $r=0.53$ ) diaphragms. Therefore, the endplate volume / number of NMJ nucleus were identical in both age groups.

**CONCLUSIONS:** The identical rate of endplate volume to number of NMJ nuclei of diaphragm muscle between two age groups suggest that the nuclear domain in NMJ area is also constant, as shown in myonuclei domain of muscle fiber with aging in previous study.

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**2858 Board #5 May 30 9:30 AM - 11:00 AM**

**Dexa-determined Body Composition Differences Between Young And Old Rats Are Not Sensitive Enough To Predict Age-related Strength And Sensorimotor Function Decrements**

Sang-rok Lee, Edward C. Archer, Jacob M. Wilson, Ken P. Leonard, Carlos Ugrinowitsch, Young-min Park, Paul C. Henning, Shirin Hooshmand, Neema Bakhshalian, Jeong-su Kim. *Florida State University, Tallahassee, FL*  
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(No relationships reported)

DEXA-determined Body Composition Differences between Young and Old Rats Are Not Sensitive Enough to Predict Age-related Strength and Sensorimotor Function Decrements

Sarcopenia defined as the age-related decline in muscle mass and resultant decrements in strength, and motor function that follow, is increasingly being studied with the use of animal models. Recently, dual-energy x-ray absorptiometry (DEXA) has been used to determine body composition in animals. Nevertheless, its ability to detect differences in age-related indices of lean body mass and to use these indices to predict changes in functionality and strength has not yet been investigated.

**PURPOSE:** To investigate the ability of DEXA to determine differences in age-related changes in body composition, and to investigate whether these measures were sensitive enough to predict changes in strength and motor function with age in young (10 months) and old (21 months) rats.

**METHODS:** Young ( $n=16$ ) and old ( $n=14$ ) Fisher 344 male rats were tested using DEXA to assess total body mass (TBM), lean body mass (LBM), and bone mineral content (BMC). A murine-specific digital force gauge was used to assess forelimb grip strength, while an inclined plane was used to evaluate sensorimotor function.

**RESULTS:** Young animals had significantly greater ( $p<0.05$ ) TBM ( $426 \pm 19$  vs.  $402 \pm 22$  g), LBM ( $271 \pm 22$  vs.  $239 \pm 29$  g), and BMC ( $14 \pm 7$  vs.  $12 \pm 4$  g). Similarly, grip strength ( $1394 \pm 180$  vs.  $1547 \pm 125$ ) and motor function, as determined by angle of inclined plane ( $44 \pm 5$  vs.  $38 \pm 5^\circ$ ), were higher ( $p<0.05$ ) in young as compared to old animals. Multiple regression analyses did not reveal any significant relationships between body composition measures and indices of strength or motor function ( $p>0.05$ ).

**CONCLUSIONS:** DEXA was able to detect differences in TBM, LBM, and BMC between young and old animals. However, these variables do not appear to be sensitive enough measures to explain the variance in strength and sensorimotor function. Future research should incorporate longitudinal models using more sensitive measurements to predict age-related differences in strength and motor function.

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**2859 Board #6 May 30 9:30 AM - 11:00 AM**

**Hindlimb Muscle Quality And Ambulation In Old Rats**

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(No relationships reported)

**PURPOSE:** To assess age-related declines in muscle contractile function and locomotion in an animal model.

**METHODS:** *In situ* force frequency data and *in vitro* sarcoplasmic reticulum (SR)  $Ca^{2+}$  release and reuptake rates were collected from the plantarflexor muscles of 5 young (6-8 months) and 5 old (24-26 months) F344/BN rats. Videographic and ground reaction force measurements were used to assess gait biomechanics in a subset of these animals ( $n = 3/\text{group}$ ).

**RESULTS:** The plantarflexors of old rats produced significantly less force ( $\sim 20\%$ ) than those of the young rats ( $P=0.046$ ), but age-related atrophy was minimal. Only the medial gastrocnemius showed a trend ( $P=0.10$ ) for age-related loss of mass. When muscle force was expressed relative to muscle mass (muscle quality) the effect of age disappeared, but a significant age X frequency interaction ( $P=0.036$ ) persisted, such that the muscle quality was reduced in old muscles only in response to higher frequencies ( $> 50$  Hz). When contractile forces were expressed relative to body mass however, marked reductions ( $>50\%$ ) were observed for all frequencies (all  $P < 0.01$ ). SR release was impaired in old vs. young muscles ( $\sim 20\%$ ,  $P = 0.036$ ), but SR reuptake was surprisingly enhanced ( $\sim 25\%$ ,  $P = 0.42$ ). Locomotor analyses revealed that old rats moved significantly more slowly than young rats ( $0.41 \pm 0.12$  vs.  $0.80 \pm 0.18$  m/s). Qualitatively, old rats exhibited greater gait asymmetry and spinal flexion than young rats during all stride phases. Additionally, while the gaits of young rats tended to exhibit either spring-like or pendular center-of-mass mechanics, those of old rats were extremely variable, falling within the domain of "intermediate mechanics."

**CONCLUSIONS:** Older animals exhibit a frequency-specific reduction in muscle quality, even in instances where muscle atrophy is minimal. This impairment may be related to SR calcium release, but not reuptake. These losses in muscular performance are magnified when expressed relative to body mass, and may contribute to marked locomotor dysfunction with aging.

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**2860 Board #7 May 30 9:30 AM - 11:00 AM**

**Exercise And Sarcopenia: Preliminary Data Of The Senior Fitness And Prevention Study**

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(No relationships reported)

**PURPOSE:** To determine the effect of a multipurpose exercise program on sarcopenia and functional ability of females 65 years and older living in the community.

**METHODS:** 246 women (69 $\pm$ 4 years) living independently in the area of Erlangen-Nürnberg (Germany) were randomly assigned into an exercise (EG:  $n=123$ ) or a control group (CG:  $n=123$ ). Subjects of the EG performed a multipurpose exercise program (2x60 min/w.) with special emphasis on exercise intensity, while subjects of the (wellness-)control group performed a program that primarily focused on well being.

**RESULTS:** After 18 months significant exercise effects were observed for Lean Body Mass (changes: EG:  $518 \pm 1357$  g vs. CG:  $8 \pm 1527$  g,  $p=.008$ , Effect size (ES): .35) and Appendicular Skeletal Muscle Mass (EG:  $20 \pm 760$  g vs. CG:  $-278 \pm 901$  g,  $p=.007$ , ES: .36). Significant group-differences were further detected for isometric maximum strength and power changes (leg-press strength:  $95 \pm 121$  N vs.  $-34 \pm 121$  N,  $p<.001$ , ES: .50; leg-press power:  $12.0 \pm 109$  W vs.  $-47 \pm 114$  W,  $p=.008$ , ES: .53). Changes of balance as assessed by static posturography did not significantly differ between the groups ( $p=.109$ , ES: .24). Significant exercise effects were also observed for changes of the Timed Up and Go-test ( $-.37 \pm .88$  vs.  $.09 \pm .93$  s,  $p<.001$ , ES: .51), complex reaction time ( $-7.5 \pm 10.5$  vs.  $-3.0 \pm 13.0$  s,  $p=.01$ , ES: .38) and time under load during treadmill test to voluntary maximum ( $1:07 \pm 2:46$  vs.  $0:15 \pm 2:06$  min,  $p=.04$ , ES: .35).

**CONCLUSIONS:** Low volume multipurpose exercise programs that focus on a high intensity philosophy relevantly affect sarcopenia and functional ability in the elderly.

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2861 Board #8 May 30 9:30 AM - 11:00 AM

**Relative Expansion Of Extracellular Water May Mask Actual Relationship Between Muscle Volume And Strength During Aging**

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(No relationships reported)

**PURPOSE:** Skeletal muscle tissue holds a large volume of water partitioned into extracellular water (ECW) and intracellular water (ICW) fractions. We hypothesized that age-related decreases in specific force (muscle strength per muscle size) are partly caused by the relative expansion of ECW.

**METHODS:** A total of 119 healthy men aged 20-88 years old participated in this study. Knee isometric extension strength, vertical jump, and chair standing were measured as indices of muscle strength and power in the lower extremities. The regional lean mass (LM), total body water (TBW), ICW, and ECW in the lower leg were estimated by anthropometry (skinfold and circumference measurements) and segmental multifrequency bioelectrical impedance spectroscopy (S-BIS). Furthermore, in 22 elderly, knee extension strength was measured, and muscle thicknesses of quadriceps were assessed by ultrasonography. The index of the ratio of ICW to ECW in the thigh was measured by segmental multi-frequency impedance analysis.

**RESULTS:** Although ICW and the LM index decreased significantly with aging ( $P < 0.001$ ), no significant changes in ECW were observed ( $P = 0.134$ ). Thus the ECW/TBW ratio was significantly ( $P < 0.001$ ) increased with age (young adult,  $27.0 \pm 2.9\%$ ; elderly,  $34.3 \pm 4.9\%$ ; advanced elderly,  $37.2 \pm 7.0\%$ ). Adjusting for this by including the ICW/TBW ratio in our models significantly improved the correlation between the LM index and strength-related measurements and correlated with strength-related variables independently of the LM index ( $P < 0.001$ ). The index of the ratio of ICW to ECW in the thigh was also correlated with knee strength independently from muscle thickness of quadriceps.

**CONCLUSIONS:** The ECW/TBW ratio increases in the lower leg with aging. The results of this study suggest that the expansion of ECW relative to ICW masked actual muscle cell atrophy during aging. Moreover, S-BIS may be useful to assess the physical function of the lower extremities.

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2862 Board #9 May 30 9:30 AM - 11:00 AM

**Relationship Of Body Composition And Physical Activity To Muscle Performance In Women Across The Lifespan**

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(No relationships reported)

The relationship between body composition and physical function is an emerging area of research within the aging literature. In particular, changes with aging are poorly understood with respect to the relationship of muscle performance, body composition, and physical activity.

**PURPOSE:** The primary aim of this study was to investigate the relationship between body composition and physical activity to leg strength and fatigue in women across the lifespan.

**METHODS:** Seventy-two women were grouped into one of two age groups: Young (20-30 years;  $n=37$ ) or Old (61-84 years;  $n=35$ ). Each participant performed 25, maximal leg extensions (EXT) and flexions (FLX) at  $180^\circ \text{ sec}^{-1}$ . For each leg, a fatigue index (FI%) was determined from the peak and ending torque. Peak torque (TQ) was subsequently normalized to leg mineral free lean mass (MFLM) and used for age and limb comparisons of maximal strength. Body fat (BF%) and MFLM were measured using DXA and physical activity (STEPS) was assessed for 7 days using a step counter.

**RESULTS:** The Young had significantly ( $p < 0.05$ ) lower BF% and greater STEPS,  $\text{MFLM}_{\text{TOTAL}}$ , and  $\text{MFLM}_{\text{LEG}}$  compared to Old. Repeated measures ANOVA indicated that although there was no difference in FI% and TQ between limbs (dominant vs. non-dominant), there was a significant main effect for age (collapsed across limb) where the Young group had lower EXT-FI%, FLX-FI%, and greater EXT-TQ, FLX-TQ than the Old. Correlation analysis suggested that EXT-TQ and EXT-FI% had the highest correlation to AGE ( $r = -0.61$  and  $0.34$ ) while FLX-TQ had highest correlation with STEPS ( $r = 0.33$ ). EXT-TQ was also correlated to BF% ( $r = -0.39$ ),  $\text{MFLM}_{\text{LEGS}}$  ( $r = 0.39$ ), and STEPS ( $r = 0.27$ ). FLX-TQ was also correlated to AGE ( $r = -0.31$  and BF% ( $r = -0.24$ ), and EXT-FI% was also correlated to %BF ( $r = 0.30$ ). When controlling for AGE, no significant correlations were found.

**CONCLUSIONS:** The results indicate significant age-related differences in body composition, strength, and physical activity. However, once AGE is accounted for, body composition and physical activity can not fully explain the age-related changes in muscle function. Thus, it is possible that other factors such as muscle activation and/or muscle composition may contribute to the age-related changes in function observed.

Supported by: UIUC Research Board (PI: Ebersole).

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2863 Board #10 May 30 9:30 AM - 11:00 AM

**High-intensity Fatigue In The Soleus Of Young And Old Men**

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(No relationships reported)

In the soleus, the inherent low maximal motor unit firing rates (MUFRs) are unchanged with age, despite an age-related slowing in the contractile properties of the triceps surae. High intensity fatigue typically induces contractile slowing and lower MUFRs. The question here is in the aged soleus will high intensity fatigue induce further slowing and changes in MUFRs? **PURPOSE:** Thus, the effects of high-intensity sustained isometric fatigue on the MUFRs and contractile properties of the soleus were compared in 6 young (~24 years) and 6 old (~75 years) men.

**METHODS:** Various measures of the contractile function of the soleus and triceps surae were tested during 2-6 sessions via maximal voluntary isometric contractions (MVCs) and tibial nerve stimulation. Populations of MUFR trains were recorded from the soleus with tungsten microelectrodes during a high-intensity (75-100% MVC) sustained isometric fatiguing contraction task, and during MVCs prior to the fatigue task and at 1, 2, 5, and 10 minutes post task failure.

**RESULTS:** Old men had greater fatigue resistance than the young with a time to task failure of ~138 seconds and ~100 seconds, respectively. Voluntary activation of the triceps surae, as assessed by the interpolated twitch technique, was near maximal ( $> 99\%$ ) for all subjects. At task failure, voluntary activation decreased to ~89% for both age groups. Maximal MUFRs in both groups were reduced ~44% and contraction duration slowed by ~30% following the fatigue task. Contraction duration recovered equally in both groups within 2 minutes of recovery, but maximal MUFRs did not recover until 5 minutes in the old men compared with one minute for the young.

**CONCLUSION:** There is no relative age-related difference in the reduction of maximal MUFRs in response to high-intensity fatigue. However, recovery of maximal MUFRS was impaired in the old despite the recovery of contractile properties.

Supported by NSERC



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**2864 Board #11 May 30 9:30 AM - 11:00 AM****The In Vivo Human Patellar Tendon Mechanical And Collagen-cross-link Properties In Old And Young Men**

Christian Couppe<sup>1</sup>, Phillip Hansen<sup>1</sup>, Mads Kongsgaard<sup>1</sup>, Vuokko Kovanen<sup>2</sup>, Charlotte Suetta<sup>1</sup>, Lene Justesen<sup>1</sup>, Per Aagaard<sup>3</sup>, Michael Kjaer<sup>1</sup>, S. Peter Magnusson<sup>1</sup>. <sup>1</sup>*Institute of Sports Medicine-University of Copenhagen, Copenhagen, Denmark.* <sup>2</sup>*University of Jyväskylä, Jyväskylä, Finland.* <sup>3</sup>*University of Southern Denmark, Odense, Denmark.*

(No relationships reported)

Aging affects muscle mass and strength, which affects ADL performance, but it remains unknown if the tendon properties also deteriorate with aging. Cross-linking (x-link) of collagen molecules provides structural integrity to the fibrils in tendons, and it is known to change with age in animal models, but has never been examined in humans.

**PURPOSE:** To examine the mechanical properties of the patellar tendon, *in vivo*, and x-link properties in elderly (OM) and young males (YM).

**METHODS:** Seven OM (67±1yrs, 86±4 kg) and 11 YM (27±1yrs, 81±2 kg) with the same activity level (YM 5±2 hrs/wk, OM 6±1 hrs/wk) were included. MRI was used to assess the tendon structural properties. Patellar tendon mechanical properties were assessed using simultaneous force and ultrasonography samplings. Tendon biopsies were obtained and analyzed for x-link content: Collagen concentration (Coll), Hydroxylysyl-pyridinoline (HP), Lysyl-pyridinoline (LP), Pentosidine (Pent). Results are reported as Mean±SEM.

**RESULTS:** Tendon structural properties did not differ between OM and YM. Similarly, the tendon mechanical properties did not differ between OM and YM.

Collagen and Crosslinks properties

	Coll (mg/mg dry wt)	HP (mmol/mol coll)	LP (mmol/mol coll)	HP/LP	Pent (mmol/mol coll)
OM	0.49±0.10*	898±65*	49±14**	26±5	73±0.5**
YM	0.73±0.04	645±55	16±2	49±9	11±0.1

Significantly different from YM. p<0.05. \*\*p<0.01.

**CONCLUSION:** These data show that the structural and mechanical properties of the human patellar tendon, *in vivo*, do not differ in OM and YM. At the same time, these are the first data on humans that show an age-related difference in tendon x-link properties to our knowledge. OM displayed lower collagen content, but greater pentosidine x-links compared to YM. This age related increase in pentosidine x-link may serve to maintain the mechanical properties with aging.

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**G-13 Free Communication/Poster - Blood Lipids**

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

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**2865 Board #12 May 30 9:30 AM - 11:00 AM****Effects Of Complex Training And N-3 Polyunsaturated Fatty Acid Supplementation On Health-related Physical Fitness Components, Serum Lipoprotein Profiles And Inflammatory Markers In College Female Students.**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to investigate the effects of complex training and n-3 polyunsaturated fatty acid (n3PUFA) supplementation on health-related physical fitness tests, serum lipoprotein profiles and inflammatory markers in college female students.

**METHODS:** Thirty college females were randomly assigned to one of three groups: Group I (placebo, 3.6g/day, n = 10); Group II [n3PUFA (2.4g/day) + placebo (1.2g/day), n = 10]; Group III (n3PUFA, 3.6g/day, n = 10) with complex training for 12 weeks. The complex training indicates the combination of muscular resistance exercise (50-70% of 1RM, 3-4d/w, 3-20s/r) and aerobic exercise (40-75% of HRmax, 3-4d/w, 15-35min/d). All subjects were measured before and after 12 week of treatment including body weight, body fat mass, percent body fat, BMI, muscular strength, muscular endurance, cardiorespiratory endurance, flexibility, total cholesterol/HDL cholesterol ratio, LDL cholesterol, triglyceride, C-reactive protein(CRP), tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), leptin, red blood cell count (RBC), white blood cell count (WBC). Analysis of covariance, Duncan's post-hoc test, Pearson correlation, simple regression, and Durbin-Watson statistic were used to determine the statistical significance.

**RESULTS:** There were significant mean differences on BMI, body weight, flexibility and CRP among three groups. The group III had lower CRP, body weight, or flexibility values as compared with Place groups (I, II). (p=.05). There were significant associations between health-related fitness components and CRP (r=-.36, p=.01), triglyceride (r=.25, p=.01) and RBC (r=.30, p=.05). There were no significant mean differences in percent body fat, body fat mass, muscular strength, muscular endurance, cardiorespiratory endurance, total cholesterol/ HDL cholesterol ratio, LDL cholesterol, triglyceride, WBC, TNF- $\alpha$  and leptin values across three groups.

**CONCLUSIONS:** The combination of complex training and n-3 polyunsaturated fatty acid supplementation may be particularly important on health related physical fitness and inflammatory markers in college female students.

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**2866 Board #13 May 30 9:30 AM - 11:00 AM****Effects Of Breakfast Omission And An Acute Bout Of Exercise On Serum Lipid Concentrations**

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(No relationships reported)

Low-fat, high- fiber breakfast consumption may help lower serum low-density lipoprotein (LDL) and total cholesterol (TC) measurements as well as help control daily energy intake and insulin sensitivity while moderate exercise is an effective method for increasing high-density lipoprotein (HDL) and decreasing triglyceride (TG) measurements. A combination of these treatments may help maintain optimal blood lipid levels and prevent heart disease.

**PURPOSE:** To observe serum lipid changes immediately and 24 hr after breakfast or no breakfast treatments prior to a 30 min bout of aerobic exercise in middle aged males

with no history of dyslipidemia.

**METHODS:** Seven male subjects participated and ranged in age from 30 to 44 years old with an average  $\text{VO}_2$  peak of  $38.66 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} + 6.09$ . Data were collected over three testing sessions. During session 1, subjects performed a  $\text{VO}_2$  peak test and baseline measurements were collected. During sessions 2 and 3, subjects consumed either a low-fat, high-fiber breakfast or no breakfast, both of which were followed by a 30 min bout of exercise at 60% of  $\text{VO}_2$  peak. A fasting blood sample was collected prior to treatment and exercise. Samples were also collected immediately after exercise and 24 hr post exercise. Each subject also reported all dietary intake for 24 hr following both treatments.

**RESULTS:** No significant ( $p > .05$ ) differences between the breakfast and no breakfast treatments were found for TC, TG, HDL, and LDL when baseline measurements were compared to 24 hr post treatment and exercise measurements. TC, TG, and LDL values were slightly lower 24 hr post exercise than at baseline while HDL values were higher 24 hr after exercise than at baseline when breakfast was omitted. Between the two exercise sessions, no differences were found in 24 hr post exercise macronutrient or total caloric intake. No differences in exercise RER and  $\text{VO}_2$  were found between treatments.

**CONCLUSION:** A low-fat, high-fiber breakfast in conjunction with 30 min of acute exercise were not sufficient to alter lipid concentrations. Breakfast omission and 30 min of moderate intensity exercise exhibited a trend towards lower cholesterol levels 24 hr post exercise and treatment.

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**2867 Board #14 May 30 9:30 AM - 11:00 AM**

**Exercise Enhances Whole-body Cholesterol Turnover In Mice Via Changes In Bile Acid Metabolism**

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(No relationships reported)

**PURPOSE:** Exercise (EX) has long been prescribed for prevention or treatment of cardiovascular and metabolic diseases. Besides improving plasma lipid profiles, it has been shown to reduce hepatic steatosis and gallstone formation. Moreover, EX has recently been reported to induce beneficial changes in expression of genes of hepatic and intestinal cholesterol metabolism. However, underlying mechanisms are yet unclear. Bile acids (BA) are synthesized from cholesterol in the liver. BA facilitate intestinal fat absorption but also act as signaling molecules. Interventions targeting BA homeostasis potentiate changes in cholesterol metabolism. EX might exert its beneficial effects on cholesterol metabolism by modulating BA homeostasis. There are indications for EX to change BA metabolism. However, the direct effects of EX on BA metabolism have not been reported so far.

**AIM:** To investigate the effects of EX on BA metabolism and markers of cholesterol turnover in healthy mice.

**METHODS:** Two groups of 10 mice exposed to a voluntary running wheel for 2 wks starting at 11 wks of age (EX AM, EX PM) and 6 sedentary (SED AM and SED PM) mice on standard chow were sacrificed either at AM (06:30-08:30 h) or PM (18:30-20:30 h) for determinations of lipid profiles and gene expression patterns. 48 h feces was collected at 2 wks of EX (collected for SED at same time). Another 10 EX and 6 SED underwent a 30min gallbladder cannulation to determine bile flow and composition.

**RESULTS:** EX had decreased plasma total plant sterol / cholesterol levels (marker of cholesterol absorption), and increased plasma lathosterol / cholesterol levels (marker of cholesterol synthesis). EX had an increased feces production ( $p < 0.0001$ ), fecal BA output ( $p = 0.0012$ ), fecal secondary BA output ( $p = 0.02$ ) and total neutral sterol output ( $p = 0.0027$ ) vs. SED. EX induces specific changes in intestinal and hepatic gene expression patterns consistent with enhanced BA turnover. EX had an increased biliary BA secretion ( $p = 0.012$ ), while bile flow, biliary phospholipid or cholesterol excretion were not different.

**CONCLUSION:** Exercise appears to increase cholesterol turnover, decrease intestinal cholesterol absorption and promote de novo BA synthesis likely related to less ligand availability to activate pathways normally suppressing de novo BA synthesis.

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**2868 Board #15 May 30 9:30 AM - 11:00 AM**

**Short-term Changes In Ldl Density And Lipoprotein Particle Number In Trained Men After 3 Different Modes Of Exercise**

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(No relationships reported)

**PURPOSE:** To determine the short-term changes in LDL density and lipoprotein particle number after three different modes of exercise in trained men.

**METHODS:** Twenty seven subjects were randomly assigned to complete either (resistance [RE], endurance [EE], or combination resistance/endurance [CE]) exercise. Fasting blood samples were obtained 24 h before (baseline) and 24 h after exercise. The average group characteristics were as follows: [RE:  $n = 9$ , age =  $22 \pm 1$  yr, weight =  $75.7 \pm 4$  kg, %fat =  $14 \pm 1$ ,  $\text{VO}_{2\text{peak}} = 3.43 \pm 0.1 \text{ L/min}$ ], [EE:  $n = 9$ , age =  $23 \pm 1$  yr, weight =  $87.7 \pm 4$  kg, %fat =  $17 \pm 3$ ,  $\text{VO}_{2\text{peak}} = 4.0 \pm 0.10 \text{ L/min}$ ], [CE:  $n = 9$ , age =  $22 \pm 1$  yr, weight =  $99.7 \pm 5$  kg, %fat =  $21 \pm 3$ ,  $\text{VO}_{2\text{peak}} = 3.94 \pm 0.10 \text{ L/min}$ ].

**RESULTS:** of a 3 (GROUP) x 2 (TIME) ANOVA (repeated for TIME) for all dependent variables were as follows: No significant GROUP x TIME interactions were determined for any of the plasma volume adjusted dependent variables. A GROUP main effect was observed for LDL density. LDL density was significantly higher in both RE and EE groups compared to the CE group. A TIME main effect was observed for LDL density and the number of  $\text{LDL}_3$  and  $\text{LDL}_4$  particles. Significant increases in LDL density ( $1.0314 \text{ g/cm}^3$  to  $1.0316 \text{ g/cm}^3$ ), and the number of  $\text{LDL}_3$  (7.8%), and  $\text{LDL}_4$  (7.1%) particles occurred 24 h after exercise compared to baseline values.

**CONCLUSION:** These data show that regardless of exercise group, LDL density and the number of  $\text{LDL}_3$  and  $\text{LDL}_4$  particles were significantly elevated 24 h after a single exercise session in trained men.

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**2869 Board #16 May 30 9:30 AM - 11:00 AM**

**Non-fasting Triglyceride Level In Children: Relationship With Weight Status And Screen Time**

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(No relationships reported)

Recent research suggests that non-fasting triglycerides (TG) may better reflect cardiovascular disease (CVD) risk than fasting measures. While several prospective studies have examined the relationship between non-fasting TG and CVD risk in adults, few studies have examined non-fasting TG in children.

**PURPOSE:** The purpose of the present study was to examine the relationships among weight status, screen time, and non-fasting TG in 9-11 year old children.

**METHODS:** Participants included 100 children (39 boys, 61 girls; mean age  $10.6 \pm 0.4$  yrs). Non-fasting blood samples were obtained via finger stick and analyzed for total cholesterol, HDL-cholesterol, and TG. Time since last meal was recorded prior to blood sampling. Height and weight were assessed according to standard procedures. Body mass index ( $\text{kg/m}^2$ ) was calculated and used to create weight status categories based on age- and sex-specific CDC growth percentiles (i.e., normal weight, overweight, obese). Total screen time was determined by self-reported time spent watching TV, computer use, and playing video games per day; groups were determined based on average screen time per day, with the cut off between high and low at 4 hours. Partial correlations and ANCOVA, controlling for age and sex, were used to examine the associations among weight status, screen time, and non-fasting TG.

**RESULTS:** BMI was moderately correlated with non-fasting TG ( $r = 0.35$ ,  $p < 0.001$ ). Combined overweight/obese children showed significantly elevated TG levels ( $122.1 \pm 7.8 \text{ mg/dL}$ ) compared to normal weight children ( $92.6 \pm 6.2 \text{ mg/dL}$ ;  $p < 0.05$ ). The correlation between screen time and non-fasting TG was weak ( $r = 0.06$ ), and was further reduced when controlling for BMI ( $r = 0.01$ ). Non-fasting TG levels were significantly higher among children with  $> 4$  hrs/d of screen time ( $118.5 \pm 8.6 \text{ mg/dL}$ ) compared to those with

<4 hrs/d screen time ( $95.2 \pm 6.3$  mg/dL) ( $p < 0.05$ ); however, the difference was no longer significant when controlling for BMI ( $113.5 \pm 8.4$  mg/dL vs.  $97.9 \pm 6.1$  mg/dL, respectively;  $p = 0.15$ ).

**CONCLUSION:** Overweight and obese children exhibit higher non-fasting triglycerides than normal weight children, which may negatively contribute to CVD health status. This relationship does not appear to correlate directly with screen time.

*Supported by Blue Cross Blue Shield Foundation of Michigan.*

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**2870 Board #17 May 30 9:30 AM - 11:00 AM**  
**Influence Of Caloric Expenditure On Postprandial Triglyceride And Glucose Responses Following A High-carbohydrate Meal**

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*(No relationships reported)*

**PURPOSE:** To examine the effects of aerobic exercise expending 350 and 700 kcal of energy on postprandial triglyceride (Tg) and glucose responses following a high carbohydrate (CHO) meal.

**METHODS:** Non-active individuals ( $n = 9$  women/4 men; age =  $22.8 \pm 3.7$  yrs; Ht =  $169 \pm 10.4$  cm; Wt =  $75.7 \pm 22.4$  kg; BMI =  $26.1 \pm 5.8$  kg/m<sup>2</sup>; VO<sub>2</sub> max =  $34.1 \pm 6.9$  ml/kg/min) completed three trials in a random order: 1) control trial, 2) single exercise session expending 350 kcal (EX350), and 3) single exercise session expending 700 kcal (EX700). Exercise consisted of treadmill walking at 60% VO<sub>2</sub> max until 350 and 700 kcal of energy had been expended. The control session consisted of seated rest. The morning after each experimental session, a fasting (12hr) blood sample was collected followed by consumption of a high-CHO liquid meal (2.44 g/kg of fat free mass (CHO), 0.33 g/kg FFM fat, and 0.56 g/kg FFM protein. Blood was collected again at 1, 2, 3, 4, 5, and 6 hrs post-meal and analyzed for (Tg) and glucose concentrations. The areas under the curve (AUC) were calculated for both (Tg) and glucose concentrations. A repeated measures ANOVA was used to determine statistical significance ( $p < 0.05$ ).

**RESULTS:** Baseline glucose concentrations were not different between trials ( $p = 0.71$ ). Postprandial AUC for glucose concentrations were not different between trials ( $p = 0.38$ ) (rest =  $592.6 \pm 96.3$  mg/dl; 350 kcal =  $626.9 \pm 118.7$  mg/dl; 700 kcal =  $602.6 \pm 70.0$  mg/dl). Baseline Tg concentrations were not altered with exercise of 350 kcal or 700 kcal when compared with rest ( $p = 0.94$ ). Postprandial Tg concentrations following rest ( $937.3 \pm 928.4$  mg/dl) were not altered ( $p = 0.37$ ) following exercise of 350 kcal ( $807.1 \pm 605.1$  mg/dl) or 700 kcal ( $867.3 \pm 672.6$ ).

**CONCLUSION:** The glucose and Tg responses following a high-CHO meal were unaffected by a prior exercise session. The postprandial Tg response to prior exercise is different from the effect of exercise on the postprandial Tg response following a high-fat meal. There was substantial inter-subject variability in the exercise-induced change in the TG response, with the exercise induced change in the Tg AUC ranging from -27.4 to +17.4%.

*This study was Supported by Texas Woman's University's Research Enhancement Program.*

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**2871 Board #18 May 30 9:30 AM - 11:00 AM**  
**Does Baseline High Density Lipoprotein Cholesterol Influence Post-exercise Change Associated With Acute Exercise?**

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*(No relationships reported)*

**PURPOSE:** The purpose of this study was to determine if baseline levels of high density lipoprotein cholesterol (HDL) affects the change in HDL levels associated with an acute bout of exercise of varying energy expenditure.

**METHODS:** Two groups of healthy untrained male volunteers participated in this study. Subjects were assigned to one of two groups according to their baseline HDL levels. The LOW HDL group consisted of 13 subjects with clinically low HDL ( $< 40$  mg/dl) and the NORMAL HDL group consisted of 14 subjects with normal HDL ( $\geq 45$  mg/dl). Age, diet, VO<sub>2</sub>max and anthropometric data were collected prior to initiation of the experimental protocol and were similar for both groups. Age, height, weight, BMI, VO<sub>2</sub>max and resting HDL for LOW were  $21.9 \pm 2.0$  yrs,  $1.8 \pm 0.1$  m,  $80.9 \pm 7.9$  kg,  $25.2 \pm 2.2$  kg/m<sup>2</sup>,  $45.8 \pm 5.1$  ml/kg/min and  $35.7 \pm 2.7$  mg/dl, respectively while characteristics of the NORMAL group were  $23.4 \pm 7.1$  yrs,  $1.8 \pm 0.1$  m,  $78.6 \pm 7.6$  kg,  $24.3 \pm 2.5$  kg/m<sup>2</sup>,  $47.5 \pm 4.8$  ml/kg/min and  $53.9 \pm 5.8$  mg/dl. Subjects completed two nonconsecutive exercise sessions (on separate days) expending 500 and 700 kJ while running on a treadmill at 65% of VO<sub>2</sub>max. Venous blood was collected pre-exercise, immediately post-exercise (IPE), and 24 hours post-exercise (+24) and analyzed for HDL and subfractions of HDL (HDL<sub>2</sub> and HDL<sub>3</sub>) and corrected for any shift in plasma volume.

**RESULTS:** No differences in HDL or HDL subfractions were observed between NORMAL and LOW HDL groups at any post-exercise times. With both groups pooled HDL was significantly increased ( $p < 0.05$ ) by 2.5 mg/dl (5.6%) at IPE, but not at +24 when compared to pre-exercise values. The increase in HDL post exercise was due for the most part to increased HDL<sub>3</sub> (3.5 mg/dl, 13.6%) whereas the HDL<sub>2</sub> subfraction remained statistically unchanged.

**CONCLUSIONS:** Baseline HDL status does not appear to affect the magnitude of post-exercise HDL-C alterations in untrained men. Furthermore, post-exercise increases in HDL associated with acute exercise appear due to increased HDL<sub>3</sub> and not HDL<sub>2</sub> in the subjects of this study.

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**2872 Board #19 May 30 9:30 AM - 11:00 AM**  
**Responses Of Lipids And Lipoproteins Following Acute And Training Resistance Exercise In Obese Postmenopausal Women**

Ronique N. Pleasant<sup>1</sup>, Melinda Villarreal<sup>1</sup>, Joshua S. Wooten<sup>1</sup>, Robert M. Hein<sup>2</sup>, Robert D. Menzies<sup>2</sup>, Melody D. Phillips<sup>3</sup>. <sup>1</sup>Texas Woman's University, Denton, TX. <sup>2</sup>John Peter Smith Hospital, Forth Worth, TX. <sup>3</sup>Texas Christian University, Forth Worth, TX.

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*(No relationships reported)*

A single aerobic session and aerobic training can favorably modify lipids and lipoproteins in postmenopausal women, but the effects of a single resistance exercise session (RE) and resistance training (RT) remain equivocal.

**PURPOSE:** To determine the acute effects of RE and chronic effects of 12 weeks of RT on lipid and lipoprotein-cholesterol concentrations in obese, postmenopausal women.

**METHODS:** Sedentary, obese, non-smoking, postmenopausal women, not taking HRT, were divided into either an exercise group (E,  $n = 10$ ; age =  $65.7 \pm 1.8$  y; BMI =  $32.6 \pm 3.5$  kg/m<sup>2</sup>) or control group (C,  $n = 11$ ; age =  $66.1 \pm 3.0$  y; BMI =  $32.9 \pm 4.3$  kg/m<sup>2</sup>). Fasting (12 hr) blood samples were collected prior to and 24 hr after the first (BT) and last (AT) exercise session, and at the same time points for C. E performed ten upper and lower body resistance exercises (3 sets, 8 rep/set, 80% 1-RM) 3 times per week for 12 weeks; while C attended education classes twice per week for 12 weeks. Serum was assayed for total cholesterol, triglycerides, LDL-C, HDL-C, HDL<sub>2</sub>-C, and HDL<sub>3</sub>-C concentrations. A 2 x 2 x 2 (group x training period x time) MANOVA with repeated measures was used to determine changes in lipid and lipoprotein variables. A 2 x 2 (group x time) repeated measures ANOVA was used to assess body composition.

**RESULTS:** The MANOVA revealed no significant changes in serum lipids or lipoproteins following RE or RT. No changes in body composition were observed post-training ( $P > 0.05$ ).

Variable	Pre-BT	24 hr BT	Pre-AT	24 hr AT
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TC (mg/dl)	C	189 ± 28	205 ± 40	201 ± 48	206 ± 42
	E	217 ± 55	212 ± 49	207 ± 105	195 ± 106
Tg (mg/dl)	C	107 ± 42	96 ± 49	116 ± 49	112 ± 45
	E	114 ± 40	103 ± 25	129 ± 92	102 ± 48
LDL-C (mg/dl)	C	112 ± 26	129 ± 37	118 ± 40	124 ± 41
	E	140 ± 51	137 ± 41	127 ± 89	120 ± 88
HDL-C (mg/dl)	C	55 ± 16	57 ± 14	60 ± 13	60 ± 16
	E	55 ± 12	55 ± 16	53 ± 15	54 ± 17
HDL2-C (mg/dl)	C	36 ± 12	35 ± 10	35 ± 12	33 ± 16
	E	36 ± 10	34 ± 13	33 ± 14	35 ± 13
HDL3-C (mg/dl)	C	19 ± 9	21 ± 7	25 ± 6	26 ± 6
	E	19 ± 5	21 ± 6	20 ± 5	20 ± 7

**CONCLUSION:** These data suggest that a single RE session and a 12-week RT program have no effect on lipids and lipoproteins. Compared to the effects of aerobic training, resistance exercise related changes in body composition may be necessary to modify lipids and lipoproteins in obese, postmenopausal women.

**2873 Board #20 May 30 9:30 AM - 11:00 AM**

**Trans Fatty Acid Consumption And The Effect On Lipids In Young Adults: Jayhawk Observed Eating Study (joe)**

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(No relationships reported)

**INTRODUCTION:** Nutrient intake, body weight and increased body fat percent (BF) among young adults and the relationship among lipoproteins are of interest.

**PURPOSE:** The purpose of the current study was to determine if changes in trans fatty acid intake among young adults over a 12-week period results in changes in Total, LDL, non-HDL and HDL cholesterol.

**METHODS:** Two-hundred and sixty participants (163 men and 97 women) consumed ad-libitum diets in the Kansas University cafeteria over a 12-week period. Energy and nutrient content were measured using digital picture plate waste photography, and all meals and snacks taken outside of the cafeteria were measured by dietary recall.

**RESULTS:** Trans fatty acid consumption was positively correlated with HDL, LDL and Total cholesterol. For every one gram of Trans Fatty acid consumed there was an increase of 0.69 mg/dL in HDL, 2.38 mg/dL in LDL and 2.95 mg/dL in Total Cholesterol. Increased BF predicted an increase in LDL cholesterol and a decrease in HDL cholesterol. For every percent increase in BF there was a decrease of 0.77 mg/dL in HDL cholesterol and an increase of 1.89 mg/dL in LDL cholesterol.

**CONCLUSION:** In this population of young adults increased consumption of trans fatty acids resulted in higher levels of both HDL and LDL Cholesterol. Change in body fat on the other hand was associated with detrimental changes in both HDL and LDL cholesterol.

**G-14 Free Communication/Poster - Clinical Medicine II - Medical**

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

**2874 Board #21 May 30 8:00 AM - 9:30 AM**

**Incidence And Diseases Associated With Microorganisms Isolated From Protective Athletic Mouth-guards**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to isolate and identify the bacteria, yeasts, and molds found in protective athletic mouth-guards (PAM) and to correlate these microorganisms with potential oral and systemic diseases.

**METHODS:** After obtaining informed consent, 62 Division 1 football players were divided into 4 groups with 2 groups wearing their PAM all season and the other 2 groups having their PAM changed at mid-season. All PAM were collected at the end of the season. Clinical oral examinations were performed on each subject at pre-season and at season-end. Each device was aseptically cultured for the presence of bacteria, yeasts, and molds. The PAM were cut and their surfaces and depths were touched to Blood agar (BAP) and Sabouraud dextrose agar (Sab). The BAP were incubated at 37°C for 24 hours while the Sab were incubated for 2 weeks at ambient temperature (22-23°C). Positive cultures were identified using standard laboratory methods, including molecular biological techniques.

**RESULTS:** The 84 PAM retrieved during the entire study yielded a total of 164 gram positive cocci, 158 gram positive bacilli, 13 gram negative cocci, and 23 gram negative bacilli. Of the 164 gram positive cocci, 82 were methicillin-resistant. The PAM yielded a total of 21 yeast and 108 mold isolates. These microbes have been implicated in a wide range of oral and systemic diseases, including diseases of the heart, GI tract, bones, and lungs (pneumonias and exercise induced asthma).

**CONCLUSIONS:** The results of this study confirm that PAM are contaminated with a variety of bacteria, yeasts, and molds which may act as a source for both oral and systemic infectious diseases. While the authors of this study firmly advocate the required use of such devices, PAM should be sanitized daily to reduce the number of microorganisms and replaced at least every 2 weeks or when damaged.

**2875 Board #22 May 30 8:00 AM - 9:30 AM**

**Eccentric Resistance Exercise In Prostate Cancer Survivors: Does Androgen Deprivation Therapy Mitigate Training**



## Effects?

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(No relationships reported)

Men with prostate cancer treated with androgen deprivation therapy (ADT) suffer skeletal muscle wasting and a decline in functional status. Resistance exercise may be beneficial, but the optimal exercise mode and whether ADT blunts training effects is not clear in this population.

**PURPOSE:** To determine: 1) the feasibility of an eccentric resistance exercise training protocol in men with prostate cancer and 2) whether it improves strength and physical function. Finally, 3) to determine whether men with prostate cancer on ADT have a blunted effect to the training as compared to men with prostate cancer who are not on ADT.

**METHODS:** Ten men (mean age 66, range 48-86) with prostate cancer were enrolled, five were currently on ADT. All men underwent a 12-week resistance exercise training protocol using a recumbent, high-force eccentric, leg cycle ergometer three times per week at a "somewhat hard" perceived exertion for 12-15 minutes. Pre- and post-exercise changes were examined within and between groups to assess: quadriceps muscle volume (MRI), isometric knee extension strength, functional mobility (Timed Up and Go Test (TUG), 6-minute walk, health-related quality of life (FACT-P) and fatigue (FACIT-fatigue scale). Data were analyzed using t-tests and mixed effects linear regression, which accounted for three repeated measurements both pre- and post-treatment.

**RESULTS:** There was 100% compliance with the 12 week exercise protocol. The ADT group demonstrated significant within group improvements in the 6-minute walk ( $p=0.01$ ). The non-ADT group demonstrated significant within group improvements in the physical subscale of the FACT-P ( $p=0.03$ ), the TUG ( $p=0.01$ ) and an increase in quadriceps muscle volume ( $p=0.04$ ). Both groups had significant improvements in isometric knee extension strength ( $p<0.01$ ) with the between group assessment revealing significantly greater improvements in strength in the ADT group ( $p=0.01$ ). No other between-group differences existed.

**CONCLUSION:** Eccentric resistance was well tolerated and both groups derived some benefits in strength and functional mobility. Men on ADT did not appear to have a blunted response to the exercise as compared to prostate cancer survivors not on ADT, though a larger study is needed to verify this.

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### 2876 Board #23 May 30 8:00 AM - 9:30 AM

#### Impact Of Incentives On Dramatic Weight Loss And Cad Risk Reduction In Sedentary II/III Obese Individuals

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(No relationships reported)

Dramatic weight loss in sedentary class II/III obese patients has been documented on reality-TV in front of hundreds of millions of viewers worldwide; critics insist these results stem from filmed boot camps with ever-present trainers and cash prizes and are therefore not generalizable.

**PURPOSE:** To evaluate the impact of live-in camps, TV exposure and financial incentives on weight loss and CAD risk factor reduction.

**METHODS:** Sixty-two unfit participants  $31.4 \pm 7.0$  years old,  $132 \pm 27$  Kg and with a body mass index (BMI) of  $43.3 \pm 5.6$  Kg/m<sup>2</sup> were recruited; fourteen subjects (BL) lived in a filmed "boot camp" for one to three months of an eight-month TV show with cash prizes. Thirty-six subjects (H) received a three-day "weight-loss" seminar and then went home with no filmed live-in boot camp, no trainers and nominal financial inducements. Twelve subjects (C) were sent home with no weight loss instructions or incentives.

**RESULTS:** At eight months the total weight loss % for BL, H and C women and men respectively was  $-31.3 \pm 9.5$  and  $-38.6 \pm 11.9$ ;  $-22.3 \pm 9.7$  and  $-27.7 \pm 10.2$ ; and  $5.2 \pm 6.8$  and  $2.3 \pm 3.9$ . One year after the shows completion, total weight loss % for BL, H and C women and men was  $-25.9 \pm 7.8$  and  $-30.7 \pm 7.8$ ;  $-19.3 \pm 12.5$  and  $-20.7 \pm 11.6$ ; and  $1.0 \pm 5.3$  and  $0.7 \pm 12.9$ . The BL and H groups respectively had resolution of HTN (9/12; 20/28 (including 6/6 contestants who had anti-hypertensive meds discontinued)), low HDL cholesterol (4/9; 12/19), hypertriglyceridemia (3/3; 6/6), elevated CRP (9/12; 10/23), elevated fasting glucose or insulin (4/4; 14/14), "high risk" waist size (9/13; 8/35) and the metabolic syndrome (7/9; 18/22). Orthopedic and medical side effects were less frequent in the H group compared to the BL group injuries did not prevent intense exercise in either group.

**CONCLUSIONS:** In this study of unfit, class II/III obese participants, a three-day weight loss seminar followed by self-monitored two-a-day exercise and moderate caloric restriction at home with nominal financial incentives resulted in dramatic weight loss and CAD risk factor reduction comparable to filmed live-in boot camp participants, with trainers and large financial incentives. Side effects were tolerable and transient.

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### 2877 Board #24 May 30 8:00 AM - 9:30 AM

#### Primary Antiphospholipid Syndrome: Aerobic Capacity And The Effect Of Acute Physical Exercise On Prothrombin Time

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The effect of acute exercise on PT is still controversial on literature. It is known that acute and exhaustive physical exercise has an increased potential for coagulation. Studies on influence of physical exercise on coagulation parameters in primary antiphospholipid syndrome (PASP) are scarce.

**PURPOSE:** The aim of this study is to evaluate the effects of acute physical exercise on prothrombin time in patients with primary antiphospholipid syndrome (PAPS) under oral anticoagulation.

**METHODS:** Nine premenopausal women PAPS patients (Sapporo criteria) with exclusive deep venous thrombosis were enrolled in the study. All individuals were undergoing chronic anticoagulation therapy and PT was stable (INR between 2-3) for 2 weeks before the test. Drugs were also stable for 2 months and patients were on their regular diet for the same period. Exclusion criteria were diabetes, systemic hypertension, arterial thrombosis, congestive heart failure, secondary antiphospholipid syndrome, body mass index (BMI)  $>30$  and stroke. Prothrombin time (PT) was assessed using the CoaguChek XS (Roche Diagnostics, Indianapolis, USA) with capillary blood during a maximum cardiopulmonary stress test (RAMP protocol). PT was measured at: baseline, anaerobic threshold (AT), immediately after the test and 1 hour after the test. Comparisons between PT at baseline, AT, immediately after the test and 1 hour after, were analyzed using the Student t- test.

**RESULTS:** PAPS patients [mean age  $33 \pm 8.6$  years, mean body mass index (BMI)  $22.28 \pm 2.64$  Kg/m<sup>2</sup>] with mean disease duration of  $5.33 \pm 4.54$  years had an aerobic capacity within the predicted value for sedentary women according to ACSM's guidelines (mean VO<sub>2</sub> peak  $32.38 \pm 4.36$  ml/Kg/min). PT was stable throughout the studied period, with no significant changes in mean PT measured at baseline and AT time ( $2.17 \pm 0.21$  vs.  $2.17 \pm 0.23$ ,  $p=1.00$ ), baseline and immediately after AT ( $2.17 \pm 0.21$  vs.  $2.15 \pm 0.19$   $P=0.44$ ) and 1 hour after the test ( $2.15 \pm 0.19$  vs.  $2.23 \pm 0.25$   $p=0.09$ ). In addition, none of the patients had thrombosis and bleeding in a month follow up.

**CONCLUSION:** This is the first study to demonstrate that PAPS patients with venous complications have normal aerobic capacity. The acute and exhaustive exercise test was safe and did not affect the PT in these patients.

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### 2878 Board #25 May 30 8:00 AM - 9:30 AM

#### Acute Lymphoblastic Leukemia: Efficacy And Safety Of High-intensity Resistance Training In Children And Adolescents

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Children and adolescents with Acute Lymphoblastic Leukemia (ALL) during treatment present side effects such as anemia, infection, bleeding, muscle weakness, impaired motor coordination and fatigue. Side effects occur due to chemotherapy, lack of physical activity and the sickness itself. Studies show enhanced muscle strength and aerobic capacity in patients undergoing supervised exercise training programs. The optimal intensity of resistance training able to induce greater adaptations without adverse effects remains unknown.

**PURPOSE:** To investigate efficacy and safety of a high-intensity resistance training program in children and adolescents with ALL during the maintenance phase of treatment.

**METHODS:** Four patients (ages 6 to 16) were submitted to echocardiogram and VO<sub>2</sub>max at baseline. They underwent an intrahospital training program twice a week for 12 weeks. Training sessions consisted of 10 min treadmill warm-up followed by 30 min resistance training (4 sets of 6-10 repetition maximum [RM]), 20 min treadmill aerobic training and 5 min stretching exercises. Ten-RM tests were conducted with 4 exercises: bench press, lat pulldown, leg press and leg extension at baseline and after 12 weeks of training. Patients underwent hemogram, aspartate aminotransferase, creatine phosphokinase, aldolase, hemocrit, sedimentation rate, C-reactive protein and venous Lactate before and after training. Pediatric quality of life inventory (Peds QL) including cancer, multidimensional fatigue and generic core scale were carried out by parents and patients.

**RESULTS:** Significant 10-RM improvement in bench press (70%,  $p = 0.002$ ), lat pulldown (70%,  $p = 0.0005$ ), leg press (64%,  $p = 0.005$ ) and leg extension (57%,  $p = 0.01$ ) were observed as a result of intensive resistance training. During training none of the patients presented fatigue, pain, bleeding, infection or required hospital admittance. Patient's hemogram showed no change. Serum muscle enzymes or inflammatory markers didn't increase after training. Peds QL showed a tendency to improve in parent-answered questionnaires. The same did not happen in patient's questionnaires.

**CONCLUSIONS:** Progressive high-intensity resistance training may be an effective and safe intervention capable of improving strength and life quality in children and adolescents with ALL.

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**2879 Board #26 May 30 8:00 AM - 9:30 AM**  
**Developing A Wireless System For Athletes' Ekg And Running Pattern Monitoring And Analyzing**

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(No relationships reported)

Marathon is one of the most popular exercises in the world which attracts more than 450 thousand people per year to participate in with 1/87000 sudden death and many lower extremity injuries. EKG and running pattern monitoring and analyzing during marathon race have been suggested to reduce the injury rate and improve running performance.

**PURPOSE:** to develop a mini portable wireless system for athletes' EKG and running pattern monitoring and analyzing.

**METHODS:** One regular marathon (RM) runner and one ultramarathon (UM) runner were recruited to run on a treadmill with speed changed every 5 minutes. A 10g mini wireless device which including EKG leads, processor, 3 axis accelerometer, data processor and signal transmitter, was fixed on the lumbar-sacral joint and connected to EKG sensors on the athlete's chest wall during different running speeds (8, 9, 10, 12 and 14 km/hr). The wireless EKG was compared with traditional EKG to validate its reliability and HR was determined immediately by self-developed software. Variables computerized from 3D accelerometer data which including 3 axis acceleratory velocities, step frequency, step lengths and running stages during different speeds, were also presented immediately on the computer.

**RESULTS:** The wireless EKG had better resolution than traditional EKG, especially during higher running speed. The HR determined automatically from wireless EKG was highly corrected and matched with counts from traditional EKG ( $p < 0.05$ ). Different running patterns between the RM runner and the UM runner could be identified from variables created from 3D accelerator data. The UM runner had better L/R balance and smoother soaring period which indicated better running efficacy than the RM runner.

**CONCLUSION:** This wireless system could real time monitor and analyze the EKG and running pattern with accuracy and reliability. It could be applied to detect possible injury risks and running technology faults during competitions.

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**2880 Board #27 May 30 8:00 AM - 9:30 AM**  
**Developing A Questionnaire For Quantifying Illness In Elite Athletes**

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**PURPOSE:** To develop and evaluate a questionnaire that quantifies the self-reported frequency, duration and severity of illness in highly-trained athletes. We examined whether highly-trained runners had more frequent illness than recreationally active individuals, and whether runners more prone to illness were undertaking more strenuous training programs.

**METHODS:** A daily illness questionnaire was administered for three months to quantify the type, frequency, duration and severity of illness, and the functional impact on the ability to complete regular training or competition. A total of 35 participants (12 highly-trained national level runners living in a community setting and 23 age- and sex-matched recreationally active medical students) aged 20-40 y completed the questionnaire. Self-reported details of training or physical activity, injury and the impact of illness on athletic/exercise performance using a 3 point Likert scale (minimal, moderate or severe) were evaluated. Data were log- or root-transformed before analysis using a student's t-test for samples with unequal variance.

**RESULTS:** Runners had a similar frequency of illness ( $2.1 \pm 1.2$ ,  $1.8 \pm 2.3$  episodes, mean  $\pm$  SD) but substantially longer duration of symptoms ( $5.5 \pm 9.9$ ,  $2.8 \pm 3.1$  days, mean difference  $\pm 90\%$  confidence limits,  $49 \pm 28\%$ ) and higher illness load ( $7.7 \pm 16.2$ ,  $4.5 \pm 4.8$  units,  $42 \pm 30\%$ ) than control subjects respectively. Runners more prone to illness (three or more episodes) had similar training loads to healthier runners less prone to illness (two or fewer episodes).

**CONCLUSIONS:** Highly-trained runners experienced longer episodes of illness with a greater impact on daily activity than recreationally active individuals. The athlete illness questionnaire is useful for quantifying the pattern of self-reported symptoms of illness in field settings.

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**2881 Board #28 May 30 8:00 AM - 9:30 AM**  
**Effect Of Comprehensive Exercise On Lymphedema In Breast Cancer Survivors: A Pilot Study**

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One in nine women are diagnosed with breast cancer. Early diagnosis and better treatments are allowing women to survive longer. With this positive trend, greater attention is being focused on survivorship issues such as lymphedema, which affects 5-30% of patients who have undergone treatment for breast cancer. Previously there was a concern that aerobic exercise and resistance training in the effected arm may cause or worsen lymphedema. Limited studies have provided preliminary evidence to suggest that exercise may be safe.

**PURPOSE:** To examine changes in strength and arm circumferences (as a measurement of lymphedema) in 32 breast cancer survivors before and after undergoing a comprehensive exercise program.

**METHODS:** This retrospective study reviewed results of 32 breast cancer survivors (mean age 51, range 26-76) who voluntarily enrolled in a comprehensive fitness program. Twenty-two percent of the women had lymphedema at baseline. Cancer treatment included a combination of mastectomy (60%), lumpectomy (40%), axillary node dissection (69%), sentinel node biopsy (28%), radiation therapy (69%) and chemotherapy (88%).

Participants completed a supervised exercise program 2-3 times per week including aerobic and resistance exercise. Arm circumference (sub-axillary, upper arm and forearm) were obtained at baseline and after an average of 22 weeks (range 12-40 weeks) of training. Pre and post exercise measurements in arm circumference and biceps curl strength were assessed for all women as a group, as well as for subgroups by treatment type, using two-tailed t-tests.

**RESULTS:** Compliance with the training program was excellent (83%). There was no significant increase in arm circumference post exercise for the entire group, nor for any treatment subgroup. Interestingly, the sub-axillary measurement showed a significant decrease in circumference ( $p=0.05$ ) for the entire group. Biceps strength increased for the entire group as well as for all subgroups ( $p<0.05$ ).

**CONCLUSION:** Participation in a comprehensive exercise program for breast cancer survivors was well tolerated. The women demonstrated a decrease in sub-axillary arm circumference with concurrent improvements in biceps strength. This study supports the limited body of literature supporting the safety and efficacy of exercise in this population.

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**2882 Board #29 May 30 8:00 AM - 9:30 AM**

**Different Impacts And Recovery Courses Between Ultramarathon And Regular Marathon**

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Exercise-associated overtraining syndrome attributed to inappropriate recovery becomes an increasing problem among marathon competitions. Few researches have been conducted to study the prolong effects of ultramarathon on cortisol and systematic damages.

**PURPOSE:** (1) To investigate the influences of marathon competitions on cortisol and other physiological biomarkers; (2) To reveal the recovery courses of cortisol and other physiological biomarkers; and (3) To compare the immediate responses and relevant recovery courses of cortisol and other physiological biomarkers among different marathon competitions.

**METHODS:** Twenty-one runners in the 2006 Taipei IAU ultramarathon competition (24-hours ultramarathon, 24 UM, n=13; 12-hours ultramarathon, 12 UM, n=8) and 20 runners in Taipei ING 42 km regular marathon (RM) were recruited in this study. Blood and saliva samples were collected about one week before each race, immediately after each race and the 3<sup>rd</sup> and the 7<sup>th</sup> (only for UM runners) day after each race to represent the baseline, immediate responses and the recovery courses of mentioned biomarkers.

**RESULTS:** Saliva cortisol levels, which increased significantly from  $17.8 \pm 2.7$  nmol/L (RM) and  $25.5 \pm 5.0$  nmol/L (24UM) in baseline to  $44.3 \pm 3.9$  nmol/L (RM) and  $43.1 \pm 5.5$  nmol/L (24 UM) immediately after competitions with similar magnitude, returned to pre-competition in 3 days. Comparing the other immediate responses with baseline values, this study significantly showed the followings: (1) lactate dehydrogenase (LDH), representing global damage, increased in 12 UM and RM, (2) creatine kinase-MB (CK-MB), representing cardiac damage, increased only in 24 UM, and (3) aspartate aminotransferase (AST), representing liver damage, increased in 12 UM and 24 UM. Most biomarkers recovered to baseline values on the 3<sup>rd</sup> day after the RM, and on the 7<sup>th</sup> day for the 12 UM and 24 UM.

**CONCLUSIONS:** The present study demonstrated that (1) saliva cortisol changes was not related to the prolong effects of UM on systematic damages, (2) different types of marathons caused inconstant physiological stresses on biomarkers, and (3) compared with RM, UM indeed caused more profound physiological stress and physical load, so that a longer recovery process is needed.

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**2883 Board #30 May 30 8:00 AM - 9:30 AM**

**The Body Weight Loss And Core Temperature Regulation During And After Ultramarathon Running**

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(No relationships reported)

The elevating core body temperature (BTc) which also called hyperthermia after ultramarathon (UM) may develop a life threatening heat disorder. Some studies examining hydration status and BTc suggest that dehydration is not associated with increases in BTc, but the others do not agree with them.

**PURPOSE:** To investigate the body weight (BW) loss and BTc regulation during and after 12-hour UM (12UM) and 24-hour UM (24UM).

**METHODS:** Thirty two experienced UM runners, 19 subjects participating in 12UM and 13 subjects participating in 24UM, were recruited as experimental group subjects. Body temperature (tympanic temperature) and total body weight (TBW) were recorded every four hours in all subjects through the competition, and the weather conditions (dry bulb temperature, wet bulb temperature, humidity and wind speed) were also recorded. The BTc and BW loss were calculated afterward.

**RESULTS:** The TBW decreased in both 12UM (TBW: -5.57%) and 24UM groups (TBW: -2.08%). TBW significantly decreased through the whole 12UM timeframe, but TBW of the 24UM group decreased only in the first eight hours and the last eight hours. There is no hyperthermia and hypothermia after 12UM (BT: -0.005°C) and 24UM (BT: -0.029°C). BTc significantly decreased only during the first eight hours in the 12UM group, and BTc of the 24UM group only decreased from 8<sup>th</sup> to 20<sup>th</sup> hours.

**CONCLUSIONS:** Significant body weight loss after UM is not associated with increases in BTc and exercise duration. The BTc reducing is mainly affected by the chilling and raining weather conditions during UM. Taking part in the UM in appropriate weather condition may not cause hyperthermia.

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**2884 Board #31 May 30 8:00 AM - 9:30 AM**

**Diet, Mood, Iron Status And Bone Mineral Density Of Freshman Female Collegiate Athletes**

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( K. White, Pepsico, Salary; Pepsico, Ownership Interest.)

College-age women tend to have low dietary intakes of iron and nutrients related to bone health. Inadequate intakes of these nutrients may be especially problematic for female collegiate athletes due to increased risk of injury or decreased performance.

**PURPOSE:** To investigate dietary habits of female collegiate athletes that may influence bone mineral density and iron status, and to relate iron status to fatigue and depression.

**METHODS:** Female athletes entering their freshman year of competition were recruited. Blood hemoglobin (Hb) and serum ferritin, bone mineral density (BMD, by dual x-ray absorptiometry), dietary habits (Block 2005 food frequency questionnaire) and mood (Profile of Mood States survey) were assessed within their first two months in college. Data were analyzed for mean  $\pm$  standard error, and correlations investigated using the Spearman rank correlation coefficient.

**RESULTS:** For nutrients related to bone health, mean intake of calcium and vitamin K were above the RDA ( $1345.3 \pm 98.2$  mg/d and  $225.5 \pm 31.7$  mcg/d, respectively, n=33), whereas vitamin D intake was below adequate ( $141.4 \pm 12.8$  IU/d, n=33). BMD for the total body, spine, and total femur were  $1.21 \pm 0.02$ ,  $1.30 \pm 0.02$ , and  $1.21 \pm 0.02$  g/cm<sup>2</sup>, respectively (n=48), and in good agreement with literature for this population. The average Z-score for total body BMD ( $1.6 \pm 0.2$ ) was above normal. Total iron intake was above the RDA ( $37.5 \pm 5.0$  mg/d, n=33), with the majority from supplements ( $21.5 \pm 4.7$  mg/d). Intake of vitamin C, a promoter of iron absorption, was  $146.4 \pm 9.4$  mg/d

(n=33). Mean Hb was normal ( $13.3 \pm 0.1$  g/dL, n=59, range 9.3-15.8). 53% (32 of 60) had ferritin  $\leq 20$  ng/mL and classified as iron deficient. Hb was  $\leq 12.0$  g/dL, ferritin  $\leq 20$  ng/mL for 4 women. Dietary iron, from supplemental or food sources, was not correlated with ferritin level. A significant, negative correlation was found between ferritin and depression ( $\rho = -0.4$ ,  $p = 0.007$ ), fatigue ( $\rho = -0.3$ ,  $p = 0.04$ ) and total mood disturbance ( $\rho = -0.4$ ,  $p = 0.003$ ).

**CONCLUSION:** Freshman female athletes entered collegiate competition with adequate dietary habits and BMD. However, half of this population was iron deficient. Iron status was related to feelings of depression and fatigue but not to dietary iron. Interventions to improve iron status, beyond iron supplementation, should be developed.

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**2885 Board #32 May 30 8:00 AM - 9:30 AM**  
**Prevalence Of LVH In Athletes Classified By Race And Gender**

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(No relationships reported)

Evidence-based data support the role of the resting 12-lead electrocardiogram (ECG) in the pre-participation screening of young athletes, and is endorsed by the European Society of Cardiology (ESC) & International Olympic Committee (IOC) guidelines. Hypertrophic cardiomyopathy (HCM), is commonly associated with sudden cardiac arrest in young athletes. Unfortunately, it is usually not detected by history or physical examination. However, the ECG in HCM will often manifest left ventricular hypertrophy (LVH). Complicating this, physiological hypertrophy ("athletes heart") frequently manifests LVH on the ECG, as well.

**PURPOSE:** To document prevalence of LVH by 12-lead ECG in collegiate athletes and look for differences based on race and gender.

**METHODS:** We studied ECGs from a group of 365 US collegiate athletes presenting for pre-participation screening. All ECGs were evaluated and classified as either normal or abnormal according to the criteria established in the ESC guidelines. An ECG was classified as having LVH if it met one of the following three criteria. 1) S-wave in V1 or V2  $\geq 3$  mV 2) R-wave in lead V5 or V6  $\geq 3$  mV 3) R-wave or S-wave in lead I, II, III, aVR, aVL, or aVF  $\geq 2$  mV.

**RESULTS:** Among 365 subjects studied, 239 (65%) were male and 126 (35%) were female. Sixty nine percent (n=252) were Caucasian, 22% (n=79) were African-American and 5% (17) were Asian. Twenty-seven percent (n=99) of athletes demonstrated LVH on ECG; 74 (31%) were male and 25 (20%) were female (95% Confidence Interval, 2 to 20;  $p < 0.02$ ). LVH was present in 30% (n=77) of Caucasians, 19% (n=15) of African-Americans, and 23% (n=4) of Asian athletes (95% CI, 1 to 21;  $p < 0.04$ ).

**CONCLUSIONS:** Among athletes studied with 12-lead resting ECG, approximately 27% demonstrated LVH. LVH Prevalence was highest in Caucasians (30%), followed by African-American (19%) (95% CI, 1 to 21;  $p < 0.04$ ). Male athletes had higher prevalence of LVH compared to female athletes (31% v/s 20%; 95% CI, 2 to 20;  $p < 0.02$ ). Our study suggests that prevalence of LVH may be affected by race and gender.

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**2886 Board #33 May 30 8:00 AM - 9:30 AM**  
**Do Sumo Wrestlers Suffer Metabolic Syndrome?**

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**PURPOSE:** To determine whether a lot of sumo wrestlers suffer metabolic syndrome.

**METHODS:** Subjects were 20 severe obese sumo wrestlers of university student whose body weight was more than 100 kg, body mass index more than 30 kg/m<sup>2</sup>, waist circumference more than 90 cm, waist/height ratio more than 0.5. We took blood samples early morning, and measured HDL-cholesterol (HDL-C), triglyceride (TG), fasting blood sugar (FBS) and insulin (IRI). HOMA-R was calculated by the formula. We measured systolic and diastolic blood pressure (sBP, dBP) at the resting state early morning. Each data was evaluated as abnormal value in case of the follows: HDL-C < 40mg/dl; TG  $\geq 150$ mg/dl; FBS  $\geq 110$ mg/dl; sBP  $\geq 130$ mmHg; dBP  $\geq 85$ mmHg. We evaluated as 1) abnormal lipid metabolism in case of abnormal HDL-C and/or abnormal TG, as 2) abnormal glucose metabolism in case of abnormal FBS, and as 3) hypertensive state in case of abnormal sBP and/or dBP. In addition, we decided as metabolic syndrome when subjects possessed two in three above abnormal states with severe obesity, as metabolic syndrome reserve when they possessed one in three above abnormal states with severe obesity, as simple obesity when they did not possessed any other abnormality except obese state. We evaluated as abnormal value of IRI in case of over 12.2 micro IU/ml, and as abnormal value of HOMA-R in case of more than 2.0.

**RESULTS:** We admitted abnormal HDL-C in 3 subjects, abnormal TG in 1 subject, normal FBS in all subjects, abnormal sBP in 8 subjects, abnormal dBP in 4 subjects. And we admitted abnormal lipid metabolism in 4 subjects, hypertensive state in 11 subjects. As the result, we discovered 3 subjects with metabolic syndrome and 9 subjects of metabolic syndrome reserve and 8 subjects of simple obesity. We admitted abnormal value of IRI in 8 subjects, and abnormal value of HOMA-R in 14 subjects.

**CONCLUSIONS:** Unexpectedly sumo wrestlers with metabolic syndrome were a few even if they were severe obese, but sumo wrestlers of metabolic syndrome reserve accounted for about a half of all subjects. Because it is estimated that 70 % of all subjects possess insulin resistance, it might be important for severe obese sumo wrestlers to reduce extra body fat.

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**2887 Board #34 May 30 8:00 AM - 9:30 AM**  
**Injury Incidence During 12 Months Of Performance Training**

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**PURPOSE:** Increasing numbers of youth and adult athletes are enrolling in performance training institutes to improve sport performance and overall fitness. Training at a performance training institute may require an increase in total training time, with the possibility of increasing exposure for injury. CATZ™ training mimics the neuromuscular demands of sport in a controlled setting in order to improve speed, agility, flexibility, & strength, and to prevent injury. The purpose of this study was to identify the incidence of injury during CATZ™ performance training.

**METHODS:** An injury was defined as any injury resulting in a cessation of training. Injury data was recorded by coaches prospectively using a standard form. Follow-up data was obtained in person or by telephone on all injured athletes within 1 week.

**RESULTS:** During a 12 month period of continuous surveillance, CATZ™ clients logged 11,472 hours of training. Ten injuries were reported during the 12 month period for an overall injury incidence of 0.87 injuries per 1000 training hours. Of the ten injuries, 8 resulted in the client seeking medical attention or lost playing time. All injured clients were between the ages of 12 and 20. The training activity associated most commonly with injury was back pedaling (3/10).

**CONCLUSION:** Overall the injury incidence is lower than those reported for the sports our clients normally participate in, indicating that CATZ™ sports performance training is a safe adjunct to regular sports training. All but one injury occurred during the first 30 minutes of the 60 minute session, suggesting that fatigue was not a factor in most injuries.

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**2888 Board #35 May 30 8:00 AM - 9:30 AM**  
**Massage Impairs Rather Than Enhances Lactic Acid Removal From Muscle After Strenuous Exercise**



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(No relationships reported)

Sports massage has been widely accepted among the athletic community as an aid to promote muscle recovery from exercise. The Canadian Sports Massage Therapists Association (CSMTA) website ([www.csmta.ca](http://www.csmta.ca)) states that it "relieves soreness and assists in the removal of lactic acid and other waste products". To date no studies have investigated the claim about lactic acid removal.

**PURPOSE:** To test the hypothesis that massage improves muscle lactic acid removal post exercise.

**METHODS:** Twelve healthy young University undergraduate male subjects lay supine and performed 2 min of isometric handgrip at 40% maximal voluntary contraction (MVC). Forearm blood flow (FBF; Doppler and Echo ultrasound of the brachial artery) and deep venous forearm blood lactate concentration (DV[La<sup>-</sup>]; StatProfile M Blood Gas Analyzer, Nova Biomedical) were measured every 30 s for 10 min post-handgrip under three conditions: Control (passive rest), Massage (effleurage and petrissage), and Active Recovery (rhythmic exercise at 10% MVC).

**RESULTS:** Data are mean ±SE. DV[La<sup>-</sup>] at 30 s post handgrip increased by a similar amount above baseline across conditions (Control 6.1 ±0.5, Massage 5.5 ±0.6, Active Recovery 5.7 ±0.6 mmol/L). From 4.5 min post handgrip onwards, it was lower in Active Recovery than Control or Massage, P<0.05. FBF was highest in Control vs. Massage and Active Recovery for the first 3.5 min post-handgrip, all P<0.05. Examination of beat by beat flow tracings revealed markedly reduced flow during limb compression with rhythmic Massage and during the contraction phase of rhythmic exercise in Active Recovery. Total FBF area under the curve (AUC; ml) for 10 min post handgrip was significantly higher in Control vs. Massage (4203 ±531 vs. 3178 ±304) but not vs. Active Recovery (3584 ±284, P=0.217). La<sup>-</sup> efflux (mmol; FBF x DV[La<sup>-</sup>]) AUC mirrored FBF AUC (Control 20.5 ±2.8 vs. Massage 14.7 ±1.6, P=0.03 vs. Active Recovery 15.4 ±1.9, P=0.064).

**CONCLUSIONS:** Massage impairs lactic acid removal from muscle following strenuous exercise by mechanically impeding blood flow.

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**2889 Board #36 Abstract Withdrawn**

**2890 Board #37 May 30 8:00 AM - 9:30 AM**  
**Cardiac Dimensions In Professional Soccer Players**

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Soccer training may determine some specific cardiac findings. Echocardiogram alterations can be related both to pathological conditions and physiological adaptations.

**PURPOSE:** To determine the most frequent echocardiographic patterns in 41 professional soccer players.

**METHODS:** Echocardiographic data were obtained from 41 consecutive male professional players of a Brazilian soccer team. The group characteristics were: mean ±SD, age: 23,15 ± 4,05 years; body mass index (BMI): 23,5 ± 1,19 kg/m<sup>2</sup>; body surface area (BSA): 1,93 ± 0,13m<sup>2</sup>. Echocardiographic parameters analyzed: left atrium (LA), aortic root (Ao), right ventricular end diastolic (RVEDd), left ventricular end diastolic (LVEDd), left ventricular end systolic (LVESd) diameters. Also investigated interventricular septal thickness (IVT), left ventricular posterior wall thickness (PWT), ejection fraction (EF), left ventricular mass index (LVMI) and relative wall thickness (RWT). Cardiac dimensions were defined as normal (LVMI ≤ 115g/m<sup>2</sup> and RWT ≤ 0,42); eccentric left ventricular hypertrophy (LVMI > 115 g/m<sup>2</sup> and RWT ≤ 0,42); concentric left ventricular remodeling (LVMI ≤ 115 g/m<sup>2</sup> and RWT ≥ 0,42); concentric left ventricular hypertrophy (LVMI > 115 g/m<sup>2</sup> and RWT > 0,42).

**RESULTS:** Echocardiographic parameters (mean ± SD) were observed: Ao 33,5mm (± 2,64), LA 37,5mm (± 3,54), RVEDd 20,49mm (± 4,8), LVEDd 52,46mm (± 4,83), LVESd 33,54mm (± 3,20), PWT 11,0mm (± 1,25), EF 69,83% (± 6,14). Mean LVMI observed was 142,20 g/m<sup>2</sup> (± 25,68) and mean RWT was 0,42 (± 0,07). Considering cardiac geometry, six athletes (14,6%) were classified as "normal" while "concentric remodeling" was present in one (2,4%). Seventeen (41,5%) had "eccentric left ventricular hypertrophy" and equal number were characterized as "concentric left ventricular hypertrophy".

**CONCLUSIONS:** This study establishes the variety of echocardiogram presentations found in top level athletes. Considering that heart adaptations to physical activity vary with different types of exercise one suppose that different echocardiographic patterns will also be found according to the main function of the athlete in the field (e.g., midfielder, defender, goalkeeper and so forth). Additional studies with greater number of athletes must consider this variable.

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**2891 Board #38 May 30 8:00 AM - 9:30 AM**  
**Perceived Pain, Fear Of Falling And Physical Function In Women With Osteoporosis**

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(No relationships reported)

**PURPOSE:** Spinal osteoporosis, a significant medical and socioeconomic problem, leads to loss of bone density, reduced pulmonary function, disability and pain. The present study evaluated the extent to which pain intensity affects physical function and falls-related self-efficacy in elderly women with osteoporosis.

**METHODS:** The study included a randomly recruited sample of 82 (age 73.8±8.1 years) community living postmenopausal women with diagnosed osteoporosis (T-score < -2.5 by DXA) with and without vertebral fractures. Numeric rating scale (NRS) measures (0 = no pain, 10 = unbearable) were applied to obtain actual self-perceived pain intensity and to stratify between patients with mild (0-3), moderate (4-6) and severe (7-10) pain. Activity-related fear of falling was evaluated with the Falls-Efficacy-Scale International Version (FES-I). Physical performance measures included dominant quadriceps strength, postural sway and temporal gait parameters. The highest value of three isometric voluntary contractions, recorded by a strain gauge force transducer, was considered to be representative of the maximum knee extensor strength. Center-of-pressure (COP) signals in quiet stance with eyes open were used to compute the range of postural sway (95. Percentil). For gait recordings subjects were required to walk across a computerized electronic walkway at their natural cadence.

**RESULTS:** Controlling for age and history of falls in the previous 6 month ANCOVA indicated significant (p<0.05) slower walking velocities and impaired balance capacity for patients with severe pain. Furthermore, significant (p<0.05) between-group differences could be detected for lower extremity muscle strength and fear of falling. The covariate vertebral fracture demonstrated no significant influences on all the parameters obtained. Patients with more intense pain (NRS>4) were 6.4 times (95%-CI: Odds Ratio: 1.5-26.7) more likely to score below average in fall-related self-efficacy and all physical performance tests.

**CONCLUSION:** In osteoporosis actual pain intensity seems to influence fear of falling and physical performance irrespective of vertebral fractures and history of falls. These results have implications for intervention programs designed for fall prevention and functional performance improvement.

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**2892 Board #39 May 30 8:00 AM - 9:30 AM**  
**A Metabolic Evaluation Of A Novel Spring-loaded Crutch Design**

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Increased energy expenditure is one challenge for active individuals who use crutches and desire to remain mobile. A relatively novel spring-loaded crutch design is currently being marketed. One of the multiple proposed advantages of this new crutch design is decreased energy consumption during crutch ambulation, however, this idea has not yet been objectively tested.

**PURPOSE:** The primary purpose of this study was to determine if the novel spring-loaded crutch design decreases oxygen consumption during crutch ambulation, relative to traditional crutches. The secondary purpose of this study was to determine whether this hypothesized decrease in oxygen consumption is related to the spring, located within the post of the spring-loaded crutch, or the unique shape of the spring-loaded crutch.

**METHODS:** Twenty healthy subjects ambulated at a standardized speed (0.97 m/s) while using three different crutch designs: traditional, spring-loaded, and modified spring-loaded (spring-loaded shape, with no spring). Following a familiarization period, subjects ambulated for five minutes with each crutch design, in a randomized order. Oxygen consumption was measured during the fifth minute of each test and compared, between each of three crutches, using a one-way ANOVA ( $p = 0.05$ ).

**RESULTS:** Oxygen consumption during crutch ambulation was not significantly different ( $p = 0.529$ ) among the traditional ( $16.72 \pm 2.12$  ml/kg/min), spring-loaded ( $17.23 \pm 2.29$  ml/kg/min), and modified spring-loaded crutch ( $17.43 \pm 1.65$  ml/kg/min) designs.

**CONCLUSION:** The present data indicate that neither the spring within the post of the spring-loaded crutch, nor the unique shape of the spring-loaded crutch decrease oxygen consumption during crutch ambulation, relative to traditional-crutch ambulation.

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**2893 Board #40 May 30 8:00 AM - 9:30 AM**

**The Spectrum Of Methicillin-resistant Gram Positive Cocci Isolated From Protective Athletic Mouth-guards**

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**PURPOSE:** The purpose of this study was to isolate and identify the gram positive cocci found in protective athletic mouth-guards and to determine their level of methicillin sensitivity/resistance.

**METHODS:** After obtaining informed consent, 62 division 1 football players were divided into 4 groups with 2 groups wearing their mouth-guards all season and the other 2 groups having their mouth-guards changed at mid-season. All mouth-guards were collected at season-end. The mouth-guards were cut aseptically and their surfaces and depths were touched to Blood agar plates. The plates were incubated at 37°C for 24 hours. Positive cultures were identified using standard laboratory methods, including molecular biological techniques. Antibiotic sensitivities were determined for all isolates of gram positive cocci using standard procedures.

**RESULTS:** The 84 mouth-guards yielded a total of 164 gram positive cocci with the most common species being *Staphylococcus* spp. and *Micrococcus* spp. Of the gram positive cocci, 82 (50%) were methicillin-resistant. Surprisingly, only 5 of the gram positive cocci were *S. aureus* with only 2 of those being MRSA. The remaining 80 methicillin-resistant cocci were divided between various *Staphylococcus* spp.(49) and *Micrococcus* spp.(31). While all of these gram positive cocci have been implicated in a wide range of oral and systemic diseases, they may either be overlooked or ignored in a clinical setting because they are not *S. aureus*.

**CONCLUSIONS:** The results of this study confirm that mouth-guards are contaminated with a wide variety of gram positive cocci which may act as a source for both oral and systemic infectious diseases. While this study supports the required use of such devices, mouth-guards should be sanitized daily to reduce the number of microorganisms and replaced at least every 2 weeks or when damaged. If disease occurs, isolation of the microorganisms and antibiotic susceptibilities should be performed so that proper treatment can be rendered immediately.

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**2894 Board #41 May 30 8:00 AM - 9:30 AM**

**Diagnosis Of Left Ventricular Hypertrophy By Lead Criteria In The Analysis Of ECGs Over Time In Young Athletes**

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(No relationships reported)

Sudden cardiac death in young athletes is a subject that has been studied extensively. As a result of such studies, it has previously been determined that abnormal left ventricular hypertrophy (LVH) is the single most common cause of sudden cardiac death athletes younger than 35. This has contributed to current recommendations made by the European Society of Cardiology (ESC) and the International Olympic Committee (IOC) for pre-participation screening. Because HCM may not manifest hypertrophy until exercise volume increases, the ESC and the IOC have recommended the use of electrocardiograms (ECGs) every 1-2 years as a screening tool in active athletes. There have been no studies to determine if certain ECG criteria for LVH might be more sensitive to detect changes in the athlete's heart once training has begun.

**PURPOSE:** To document differences in the resting 12-lead ECG performed at two different times in college athletes.

**METHODS:** We studied the ECGs from a group of 155 college athletes who presented for pre-participation screening at least 1 year apart. ECGs were determined reflect changes secondary to LVH based on the following criteria. Precordial leads: 1) S-wave in V1 or V2  $\geq 3$  mV 2) R-wave in lead V5 or V6  $\geq 3$  mV; Limb leads: 3) R-wave or S-wave in lead I, II, III, aVR, aVL, or aVF  $\geq 2$  mV.

**RESULTS:** Among the 155 athletes studied, 55 patients (35%) exhibited ECG changes consistent with LVH, 28 (18%) of which were abnormal on initial presentation, and later reclassified as normal, and vice versa for the remainder (17%). On further analysis, more abnormalities were detected using criteria that focused on differences in precordial leads rather than limb lead criteria.

**CONCLUSIONS:** In studying the temporal relationship in a cohort of student athletes, 35% of athletes demonstrated changes consistent with LVH, divided equally between those classified as normal to abnormal, and classified from abnormal to normal. On further analysis, it was noted that more ECGs using precordial lead criteria were more likely to become abnormal than those using limb lead criteria, suggesting that precordial lead criteria might be more sensitive in detecting heart abnormalities than limb lead criteria. This conclusion of course requires further evaluation including correlation with echocardiographic findings which we are currently researching.

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**G-15 Free Communication/Poster - Endurance Training and Performance**

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

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**2895 Board #42 May 30 9:30 AM - 11:00 AM**

**Habitual Exercise Decreases Serum Angiopoietin-related Growth Factor Levels In Healthy Human Subjects**

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It is known that angiotensin-related growth factor (AGF/Angptd6) potentially regulates lipid, glucose, and energy metabolism. Previous studies in animal subjects suggest that AGF might be a potential regulator of metabolic homeostasis by counteracting obesity. However, human studies are lacking and the effect of regular exercise in AGF levels in humans has not yet been reported.

**PURPOSE:** The objective of this study was to determine whether an association exists between AGF levels and exercise in healthy human subjects.

**METHODS:** 18 healthy subjects (age 45.33±10.43) performed 50 minutes of supervised aerobic exercise four to five times per week for 12-weeks. Pre and post-training measurements were made. Body composition and body fat were measured by BoCA X1 analyzer. The predicted VO<sub>2</sub>max was determined using a treadmill test. Enzyme-linked immunosorbent assay (ELISA) was used to measure the AGF level in human serum.

**RESULTS:** After the 12-week training program, there was a significant increase in maximal exercise capacity (VO<sub>2</sub>max=37.75±0.42) compared to before training (VO<sub>2</sub>max=33.54±0.36). Serum AGF concentrations decreased after 12 weeks training from 364.08±5.7 to 308.4±3.96 ng/ml (P=0.012). The decrease was inversely related to changes in BMI (P<0.0001), body fat (P<0.0001), waist-to-hip ratio (P<0.0007) and serum triglycerides (P<0.0029). In contrast, changes in serum AGF were positively related to serum HDL cholesterol (P<0.0012). Insulin sensitivity was also improved post training compared to before training from 4.29±0.15 to 2.25±0.09, as indicated by HOMA-IR.

**CONCLUSIONS:** There have been no previous studies on AGF levels in healthy human subjects. Our study shows that habitual exercise significantly decreases serum AGF levels in humans. This finding is contrary to many former animal studies. Further studies in human subjects are warranted to validate these findings. In the future, AGF may be used as a therapeutic target for metabolic syndrome.

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**2896 Board #43 May 30 9:30 AM - 11:00 AM**  
**Comparison Of Anthropometric Measures For Adherers And Non-adherers Following A 24-week Walking Intervention**

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(No relationships reported)

A common reason for initiating an exercise program is to improve body composition (BC). While there is great debate about the ideal amount of daily physical activity (PA) necessary to impact BC, many U.S. adults have difficulty achieving minimal PA recommendations. The 10,000 steps/day (10k/day) walking recommendation is a unique approach as it allows PA to be built into one's day without an emphasis on duration or intensity. However, the impact that a 10k/day program has on BC is currently under studied.

**PURPOSE:** To determine anthropometric changes in previously inactive women during a 24-week walking intervention utilizing the 10k/day recommendation.

**METHODS:** 55 previously sedentary women (45.6 ± 5.8 y) completed a 24-week walking intervention. At baseline and at week 24, body mass, body fat, and waist and hip circumference (WC & HC) were assessed. Those who averaged ≥ 9500 steps/day throughout the intervention were classified as adherers (n = 25). Independent t-tests were used to determine BC differences between adherers and non-adherers at week 24. Pearson correlations were used to determine relationships between average steps/day and BC variables.

**RESULTS:** There was no difference for steps/day between adherers and non-adherers at baseline (5327 ± 948 and 5435 ± 1388, respectively, p = 0.735). There was a difference for steps/day throughout the 24-week intervention with adherers averaging 9921 ± 642 steps/day, and non-adherers averaging 8339 ± 1101 steps/day (p < 0.001). There was a difference between adherers and non-adherers at week 24 for change in fat mass (kg) with adherers losing 4.3 ± 4.0 kg and non-adherers losing 1.3 ± 2.6 kg (p = 0.002) and in HC reduction with adherers losing 3.9 ± 3.1 cm and non-adherers losing 1.2 ± 2.1 cm (p = 0.001). There was a correlation between average steps/day and fat mass lost r = 0.328, p = 0.015, and average steps/day and HC reduction, r = 0.369, p = 0.006.

**CONCLUSIONS:** Overall, adherers were significantly more active and benefited from more favorable BC changes. The 10k/day recommendation may be an appropriate approach for inactive people initiating an exercise program for weight loss. Future research in this area should include examinations of what impacts adherence to an exercise program and why non-adherers regress back to sedentary lifestyles.

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**2897 Board #44 May 30 9:30 AM - 11:00 AM**  
**Comparison Of Aerobic Training Methods On V02 Max, Body Composition And Anaerobic Power.**

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(No relationships reported)

**PURPOSE:** To investigate the potential impact of various aerobic training methods on VO<sub>2</sub>, body composition and anaerobic power.

**METHODS:** Thirty-four healthy male & female subjects (18-30yrs) participated in an equated volume supervised running workout for six weeks utilizing two alternate training methods. Group one (N = 17, 21 ± 3 yr) participated in Interval Training Distance (ITD) and group two (N = 17, 21 ± 3 yr) participated in Long Slow Distance (LSD). All subjects participated in a familiarity session (FAM), a Pre-Test (T1) and a Post-Test (T2). Each testing session consisted of a VO<sub>2</sub> Max, a 30 second Wingate and body composition assessment. Data were analyzed by a two-way ANOVA with repeated measures. Significance was set at p < 0.05 and adopted throughout.

**RESULTS:** The ITD and LSD groups experienced significant increases (p < 0.001) in VO<sub>2</sub> max, with 9.05% (4.19 ± 4.15 ml/kg/min) and 3.18% (1.39 ± 3.67 ml/kg/min) increases respectively. A significant interaction (p < 0.05) in VO<sub>2</sub> max occurred between groups, as the ITD group displayed a 302% greater increase when compared to the LSD group. Body fat percentage significantly decreased (p < 0.01) in the ITD (1.08 ± 1.90%) and LSD (1.55 ± 3.21%) groups, while a significant reduction (p < 0.05) in total body weight was also observed. There was no change in Wingate peak or mean power at a p < 0.05 significant level.

**CONCLUSIONS:** The findings of this study suggest that the ITD training method has a greater impact on aerobic capacity than LSD training method. However, both ITD and LSD training methods had a significant impact on aerobic capacity, body weight, and body composition.

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**2898 Board #45 May 30 9:30 AM - 11:00 AM**  
**Effect Of Moderate Altitude On Lactate Clearance During Active And Passive Recovery**

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(No relationships reported)

**PURPOSE:** To determine the effect of moderate altitude exposure on lactate clearance during active and passive recovery following maximal exercise.

**METHODS:** Six healthy, active subjects (age= 20.7 ± 1.5 yrs, weight = 80.8 ± 19.5 kg) were asked to complete two graded-exercise tests to exhaustion on a cycle ergometer at sea level (SL1), upon acute exposure to 3400 m (ALT1), two weeks following acclimatization at 3400 m (ALT2), and upon return to sea level (SL2). Workloads were increased every two minutes following a two-minute warmup until volitional fatigue. Following the exercise tests at each location, subjects participated in either an active or passive recovery trial. During the active trial, subjects exercised at 35% of their VO<sub>2</sub>max while venous blood lactate measurements were taken every two minutes until lactate levels were decreased to half of their maximum values (T 1/2). This protocol was repeated during passive recovery while a subject sat in a chair and the same measurements were performed.

**RESULTS:** T1/2 (in minutes) was significantly faster (P<.05) during the active trial vs. the passive trial in all four locations (SL1: 14.3 ± 3.2 vs. 22.3 ± 4.2, ALT1: 12.6 ± 7.3 vs. 20.6 ± 7.2, ALT2: 11.2 ± 6.3 vs. 22.3 ± 6.9, SL2: 11.1 ± 1.0 vs. 18.2 ± 6.6). However, there were no differences in the active or passive trials between locations except that

T1/2 for the active trial in SL2 (11.1 ± 1.0) was significantly faster ( $P < .05$ ) than SL1 (14.3 ± 3.2).

**CONCLUSION:** These data suggest that active recovery is beneficial for the removal of blood lactate even after acute exposure to moderate altitude and altitude acclimatization.

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**2899 Board #46 May 30 9:30 AM - 11:00 AM**

**Effect Of Jogging Training On Oxidative Stress Responses And Antioxidant Capacity In Middle-aged Persons**

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(No relationships reported)

Physical training has been suggested to reduce oxidative stress by decreasing a generation of reactive oxygen species or increasing antioxidant capacity. However, we still need more information concerning influences of age, gender, fitness level or training modalities on the training-induced adaptation to oxidative stress.

**PURPOSE:** The purpose of this study is to examine the effects of slow speed jogging training for four months on oxidative stress and antioxidant capacity in blood in middle-aged persons.

**METHODS:** The subjects were 26 middle-aged persons (male n=7, woman n=19, 56.8 (SD 7.2) yr.) they were members of a university marathon club for the regional resident. They jogged 1-5 times a week for about 1 hour at slow speed of 7-8 minutes/km for four months. Plasma samples were collected on two occasions, one at an early stage (July), the other at maintenance stage (November) in the training period. The collected samples were analyzed for reactive oxygen metabolites-derived compounds (d-ROMs) and trolox equivalent antioxidant capacity (TEAC). In addition, the correlation between TEAC and antioxidants intake in their meals by questionnaire survey was examined.

**RESULTS:** Although slow speed jogging training for four months induced no significant change in resting plasma d-ROMs concentrations, it increased TEAC significantly ( $p < 0.05$ ). There was a positive correlation between TEAC at the early stage and that at the maintenance stage of the training period ( $r = 0.46$ ,  $p < 0.05$ ). There was a negative correlation between increased TEAC values at the maintenance stage and TEAC at the early stage ( $r = 0.61$ ,  $p < 0.01$ ). There were no significant correlations between antioxidants intake and d-ROMs or TEAC.

**CONCLUSIONS:** The present study suggested that slow speed (7-8 km/min) jogging training might improve antioxidant capacity, especially might be effective for those having low antioxidant capacity in middle-aged persons.

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**2900 Board #47 May 30 9:30 AM - 11:00 AM**

**Autonomic Adaptation And Aerobic Performance In Endurance Athletes Analyzed By Heart Rate Variability**

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Heart rate variability (HRV) has recently been proposed to detect the autonomic adaptations to endurance training. However, the effect of training on HRV indexes remains inconclusive.

**PURPOSE:** To assess whether the morning short-term HR recording in clinostatic and orthostatic position may be useful in evaluating the training-induced autonomic changes and can predict the maximal aerobic performance.

**METHODS:** Eight high-level endurance athletes (biathlon) and 8 healthy sedentary subjects, matched for age and anthropometry, were enrolled. RR series were recorded after awakening in supine (10 min) and standing (10 min) positions. The HRV parameters considered were RMSSD, pNN50, SD<sub>1</sub>, LF and HF (Low [0.04-0.15 Hz] and High [0.15-0.40 Hz] Frequencies: absolute and normalized) powers, LF/HF ratio, and the non-linear index ApEn (Approximate Entropy, m=2, r=0.2SD, n=500). The maximal aerobic performance (VO<sub>2</sub>max) was also measured in the athletes.

**RESULTS:** HRV tended to be higher in the athletes than in sedentary subjects in clinostatic position (RMSSD: 68±32 vs 43±22 ms, respectively; pNN50: 42±24 vs 24±18%, and SD<sub>1</sub>: 48±22 vs 30±15 ms), but the statistical significance was reached in orthostatic position only. Normalized LF and HF powers did not differ between groups in both conditions. Conversely, LF absolute power was significantly increased in athletes group both at rest (1002±565 vs 387±229 ms<sup>2</sup>,  $p < 0.05$ ) and during standing (1106±697 vs 403±189 ms<sup>2</sup>,  $p < 0.05$ ), whereas HF power was significantly higher during standing only (165±137 vs 27±12 ms<sup>2</sup>,  $p < 0.05$ ). ApEn was similar at rest in athletes and sedentary subjects (1.27±0.05 vs 1.21±0.10, respectively) and was reduced similarly during standing (1.01±0.19 vs 1.13±0.13,  $p = ns$  between groups). In the athletes group, the difference between clinostatic and orthostatic values of normalized LF power positively correlated ( $r = 0.66$ ) with VO<sub>2</sub>max, whereas the clino-orthostatic transition in HF negatively correlated ( $r = -0.77$ ) to VO<sub>2</sub>max.

**CONCLUSIONS:** HRV may be useful in detecting the autonomic changes induced by endurance training. However, the autonomic system has to be slightly stimulated with standing. The clino-orthostatic adaptation of LF and HF normalized powers seems to be able to predict the maximal aerobic performances in the athletes.

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**2901 Board #48 May 30 9:30 AM - 11:00 AM**

**Comparison Of Vastus Lateralis And Medial Hamstring Electromyographic Activity Across Five Cardiovascular Exercises**

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(No relationships reported)

Greater emphasis on the value of incorporating cardiovascular training into rehabilitation programs has heightened the need to define normative muscle activation patterns across cardiovascular exercises. This study's findings will help guide clinical decision-making regarding selection of appropriate exercises to meet not only the cardiovascular fitness goals but also the muscle strengthening needs of clients recovering from a variety of orthopedic and neurologic disorders.

**PURPOSE:** To compare vastus lateralis (VL) and medial hamstring (MH) muscle activity patterns across five cardiovascular exercises.

**METHODS:** Six males and four females participated (mean age 25±5 yrs). Subjects engaged in three equipment familiarization sessions and then performed each of the following exercises for 5 minutes in random order: treadmill jogging (J), stair stepping (S), elliptical training (E), treadmill walking (W) and recumbent biking (B). Subjects were instructed to perform each at an intensity that could be maintained for 30-min. Kinematic (8 camera), foot-floor contact pattern (footswitches), and VL and MH surface electromyography (EMG) data were recorded simultaneously during the final minute on each device. Cycles were defined using kinematic (B, S, E) and footswitch (W, J) data. For each muscle and exercise, 10 representative cycles were used to calculate the average peak (expressed as % maximum voluntary contraction, % MVC), mean (% MVC) and duration (expressed as % cycle) of EMG activity. Separate 5x1 ANOVAs with repeated measures identified significant differences in EMG activity (peak, mean, duration) across exercises for each muscle.

**RESULTS:** All data expressed as mean ± SD. VL: Peak: J, S > E, W, B (105±52, 95±37 > 51±30, 43±34, 35±25;  $p < 0.001$ ). Mean: S, J > E, W, B (41±13, 40±15 > 26±14, 20±8, 19±9;  $p < 0.001$ ). Duration: E, S > W (61±18, 53±18 > 29±22;  $p < 0.001$ ). MH: Peak: J > B, E, S (56±46 > 15±11, 11±9, 8±5;  $p < 0.001$ ) and W > S (21±11 > 8±5;  $p < 0.001$ ).



Mean: J > B, E, S ( $25 \pm 15 > 9 \pm 6$ ,  $7 \pm 5$ ,  $5 \pm 4$ ;  $p < 0.001$ ) and W > S ( $13 \pm 6 > 5 \pm 4$ ;  $p < 0.001$ ). Duration: J > S, E ( $49 \pm 23 > 17 \pm 27$ ,  $14 \pm 14$ ;  $p < 0.001$ ).

**CONCLUSION:** When greater VL activation is warranted, consider S and J. When VL protection is needed (e.g., post-polio overuse), then B and W appear beneficial. J consistently provided the greatest MH activation, while S offered greater MH protection.

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**2902 Board #49 May 30 9:30 AM - 11:00 AM**  
**Daily Exercise Prescription Based On Heart Rate Variability Among Males And Females**

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Daily measurement of heart rate variability (HRV) is a unique tool to optimize exercise training among highly active males. However, this has not been assessed in less active males and females.

**PURPOSE:** To assess the utility of HRV in daily exercise prescription among moderately active (~2 exercises/wk) males and females.

**METHODS:** Twenty-one males (age:  $35 \pm 3$  yrs,  $VO_{2max}$ :  $49 \pm 6$  ml/kg/min) and twenty-two females (age:  $34 \pm 4$  yrs,  $VO_{2max}$ :  $37 \pm 6$  ml/kg/min) were divided into standard training (ST,  $n=7$ ), HRV guided training (HRV,  $n=7$ ) and control group ( $n=7$ ). Eight-week aerobic training period included exercises lasting 40-min each at either low or high intensity level (70% or 85% of maximal heart rate). ST-group was instructed to perform  $\geq 2$  sessions at low and  $\geq 3$  sessions at high intensity weekly. HRV-group trained based on the changes in vagally mediated HRV (SD1) measured every morning in standing position (3-min). Increase or no change in SD1, compared to previous days, resulted in high intensity training on that day. Low intensity exercise or rest was prescribed if SD1 had decreased significantly.  $VO_{2max}$  and maximal workload ( $W_{max}$ ) were measured by maximal bicycle ergometer test before and after the intervention. Training load was assessed by calculating TRIMP.

**RESULTS:** In males,  $W_{max}$  and  $VO_{2max}$  increased in both ST- (from  $275 \pm 28$  to  $294 \pm 35$  W and from  $3.96 \pm 0.52$  to  $4.14 \pm 0.53$  l/min,  $p < 0.01$  for both) and HRV-group (from  $270 \pm 29$  to  $300 \pm 25$  W and from  $4.03 \pm 0.35$  to  $4.33 \pm 0.31$  l/min,  $p < 0.01$  for both). The change in  $W_{max}$  was higher in HRV-group compared to ST-group ( $30 \pm 8$  vs.  $18 \pm 10$  W,  $p = 0.038$ ). The change in  $VO_{2max}$  did not differ between ST- and HRV-group ( $p = 0.204$ ). In females,  $W_{max}$  and  $VO_{2max}$  increased in both ST- (from  $179 \pm 32$  to  $198 \pm 35$  W and from  $2.33 \pm 0.46$  to  $2.48 \pm 0.48$  l/min,  $p < 0.05$  for both) and HRV-group (from  $174 \pm 28$  to  $189 \pm 25$  W and from  $2.28 \pm 0.43$  to  $2.46 \pm 0.38$  l/min,  $p < 0.05$  for both). No differences were found in the changes in  $W_{max}$  and  $VO_{2max}$  between ST- and HRV-group. Training load did not differ between ST- and HRV-group in males or females. No significant changes were observed in control group.

**CONCLUSIONS:** Aerobic training prescription based on daily HRV is more beneficial than standard training instruction for moderately active males. Different HRV-based training may be required for moderately active females.

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**2903 Board #50 May 30 9:30 AM - 11:00 AM**  
**Comparison of Ankle Muscle Electromyographic Activity Across Five Cardiovascular Exercises**

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(No relationships reported)

Expanded access to fitness equipment in rehabilitation settings has enabled clinicians to more frequently incorporate these devices therapeutically. However, a better understanding of how muscle demands vary across cardiovascular exercises is essential for optimizing therapeutic usage of the devices.

**PURPOSE:** To compare ankle muscle activity patterns during five common cardiovascular exercises.

**METHODS:** Ten healthy adults participated (6 male, 4 female;  $25 \pm 5$  yrs). After completing 3 familiarization sessions, each subject performed 5 exercises in random order: recumbent biking (B), stair stepping (S), elliptical training (E), treadmill walking (W), and treadmill jogging (J). Subjects performed each at an intensity that could be maintained for 30-min. Footswitch, kinematic, and tibialis anterior (TA) and medial gastrocnemius (MG) surface electromyography (EMG) data were recorded simultaneously during the final minute of a 5-min workout on each device. Cycles were defined using footswitch (W, J) and kinematic (B, S, E) data. EMG data were normalized to the maximum voluntary contraction (MVC) and expressed as % MVC. For each muscle, the peak (% MVC), mean (% MVC), and duration (expressed as % cycle) were calculated from the average of 10 representative cycles recorded during the respective activity. Separate ANOVAs with repeated measures identified significant differences in EMG activity (peak, mean, duration) across exercises for each muscle.

**RESULTS:** All data expressed as the mean  $\pm$  SD. TA: Peak: J > S, W, B, E ( $89 \pm 34 > 31 \pm 26$ ,  $23 \pm 6$ ,  $20 \pm 11$ ,  $17 \pm 10$ ;  $p < 0.001$ ). Mean: J, W > B, E ( $32 \pm 12$ ,  $23 \pm 6 > 11 \pm 5$ ,  $10 \pm 5$ ;  $p < 0.001$ ) and J > S ( $32 \pm 12 > 16 \pm 12$ ;  $p < 0.001$ ). Duration: J, W > B, S, E ( $78 \pm 17$ ,  $60 \pm 16 > 33 \pm 28$ ,  $32 \pm 29$ ,  $26 \pm 28$ ;  $p < 0.001$ ). MG: Peak: J > W, S, E, B ( $133 \pm 36 > 85 \pm 30$ ,  $80 \pm 50$ ,  $65 \pm 46$ ,  $54 \pm 11$ ;  $p < 0.001$ ). Mean: J > B, S, E ( $48 \pm 15 > 28 \pm 7$ ,  $27 \pm 10$ ,  $25 \pm 15$ ;  $p < 0.001$ ). Duration: B, S, J > E ( $69 \pm 15$ ,  $65 \pm 25$ ,  $57 \pm 13 > 36 \pm 26$ ;  $p < 0.001$ ) and B > W ( $69 \pm 15 > 50 \pm 14$ ;  $p < 0.001$ ).

**CONCLUSION:** Peak TA activity varied greater than 5-fold across exercises while duration varied 3-fold. If the therapeutic goal is maximizing TA activation, J should be considered. In contrast, E minimized TA demand compared to other exercises. MG peak and duration varied to a lesser extent across exercises (maximum 2-fold), with J requiring the greatest activation and E affording lesser activity.

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**2904 Board #51 May 30 9:30 AM - 11:00 AM**  
**Effects Of Aerobic Exercise Training On The Anthropometry And Blood Biochemistry In Health Young Women**

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(No relationships reported)

Aerobic exercise is beneficial to health. It improves insulin-resistant status and cardiorespiratory fitness, and reduces the incidence of obesity, type 2 diabetes and cardiovascular diseases. Eotaxin is a secretory product of the adipose tissue and its expression is reversibly increased in obesity. In addition, levels of eotaxin could contribute to the signs and symptoms of asthma. However the relationship between eotaxin and anthropometry and blood biochemistry in young women has not been investigated.

**PURPOSE:** To study the effect of aerobic exercise training on anthropometry and blood biochemistry in sedentary health young women.

**METHODS:** Ten healthy young sedentary women (20-23 yr) underwent aerobic exercise training for 8 weeks. The subjects were directed to run on a treadmill at 60-70%  $VO_{2max}$ , 3 days per week. Duration of each session started from 20 min in first week, and was increased by 5 min per week until 45 min/session. After exercise training subjects returned their sedentary lifestyle for 8 weeks to wash out the training effect. The same subjects then served as their own untrained control during the next 8 weeks.  $VO_{2max}$ , weight, body fat (BF), heart rate in rest (HRr), resting blood pressure, waist circumference (WC), waist-to-hip ratios (WHR), heart rate in every level of testing ( $HR_{level}$ ), and plasma eotaxin, glucose, total cholesterol (TC), and high-density lipoprotein cholesterol (HDL-C) were measured before and after training in both groups.

**RESULTS:**  $HR_{level}$  was decreased after aerobic exercise training. Plasma eotaxin, glucose, TC, HDL-C were not changed after long-term aerobic training. Weight, BF, and  $VO_{2max}$  were increased, but HRr, systolic blood pressure (SBP), WC, and WHR were not changed when compared with control. However, there was a positive correlation between plasma eotaxin levels and WC and WHR, and eotaxin was negatively correlated to HDL-C levels. There was also a negative correlation between SBP and HDL-C.

**CONCLUSION:** Aerobic exercise training can improve cardiorespiratory fitness. In addition the positive correlation between plasma eotaxin and WC suggest that eotaxin can

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**2905 Board #52 May 30 9:30 AM - 11:00 AM**

**The Effects Of FATmax Endurance Training On Maximal Fat Oxidation Rate And Aerobic Power**

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It is recognized that facilitation of fat metabolism is important for health-related aspect of exercise. Intensity at which maximal fat oxidation occurs is defined as FATmax that can be applied for exercise prescription; however, the training effects at FATmax intensity was not well established.

**PURPOSE:** To compare the training effects of 8 weeks of running at FATmax intensity and heart rate control intensity corresponding to FATmax (HRC<sub>FATmax</sub>) on maximal fat oxidation and aerobic power (VO<sub>2max</sub>).

**METHODS:** Fourteen male and nineteen female college students [age: 21.40 (4.54) yrs; height: 166.70 (10.58) cm, weight: 63.22(14.08) kg] were recruited in this study. Incremental exercise to determine FATmax intensity and VO<sub>2max</sub> were performed pre- and post- training for each participant. All participants were assigned into three groups, FATmax, HRC<sub>FATmax</sub> and control groups with comparable VO<sub>2max</sub> and FATmax intensity. Training groups underwent eight weeks (3 times/week and 30mins/time) of running program at different intensities whereas control group was asked not to engage any regular exercise during the study. Two-way split-plot ANOVA was employed to determine the difference of FATmax, FATmax intensity, and VO<sub>2max</sub> among three groups pre- and post- training.

**RESULTS:** FATmax was improved in both FATmax and HRC<sub>FATmax</sub> groups (0.47±0.19 g/min and 0.56±0.18 g/min ; 0.48±0.19 g/min and 0.58±0.22 g/min) after training ( $p<.05$ ) whereas there was no significant change (0.47±0.13 g/min and 0.43±0.11 g/min) in control group. In addition, there was no significant difference in FATmax intensity (expressed by VO<sub>2</sub> or % VO<sub>2max</sub>) between groups after training. For VO<sub>2max</sub>, FATmax and HRC<sub>FATmax</sub> group were both improved ( $p<.05$ ) after training (FATmax: 43.22±8.94 ml/kg/min to 45.77±9.11 ml/kg/min ; HRC<sub>FATmax</sub>: 42.19±6.70 ml/kg/min to 44.99±7.37 ml/kg/min) whereas there was no significant change in control group (45.40±10.24 ml/kg/min to 44.19±8.21 ml/kg/min). Moreover, there was no significant difference on VO<sub>2max</sub> between groups after training.

**CONCLUSIONS:** 8 weeks of endurance training at FATmax and HRC<sub>FATmax</sub> intensity were both improved at maximal fat oxidation rate and aerobic power, but not FATmax intensity.

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**2906 Board #53 May 30 9:30 AM - 11:00 AM**

**Effect Of Endurance Training On Cardiorespiratory And Muscle Oxygenation Responses During Ramp Exercise Testing**

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Endurance training improves exercise performance, which is associated with central and peripheral adaptations that lead to enhanced delivery of oxygen (O<sub>2</sub>) to working muscle and greater oxidative capacity. To date, no comprehensive studies of oxygen transport and muscle oxygenation have been conducted to characterize training-induced adaptations combining noninvasive technologies, such as indirect calorimetry (IC), near infrared spectroscopy (NIRS) and bioimpedance cardiography (BC).

**PURPOSE:** To characterize the O<sub>2</sub> uptake (VO<sub>2</sub>), heart rate (HR), minute ventilation (VE), cardiac output (CO), and muscle oxygenation dynamic responses to ramp exercise before and after endurance training.

**METHODS:** Eight subjects (23.1±3.2 yrs., 169±10 cm, 61.6±13.1 kg) performed maximal ramp exercise tests before and after eight weeks of training (5x/wk, 1h/session). A continuous wave NIRS device was used to measure relative changes in oxy- and deoxy- Hb/Mb in the vastus lateralis of the right leg during ramp exercise. Additionally, the cardiorespiratory responses (VO<sub>2</sub>, CO, HR, and VE) were obtained using IC and BC. Muscle oxygenation during exercise was normalized to the maximal drop observed during arterial cuff occlusion. The statistical analysis used was paired t-test.

**RESULTS:** After training, peak work rate (203±66 vs. 246±71 W), peak VO<sub>2</sub> (2.5±0.8 vs. 3.0±0.9 L/min), and peak VE (93±22 vs. 101±20 L/min) improved significantly ( $p<0.05$ ). However, there were no significant changes in muscle oxygenation (26±15 vs. 27±16 %) and cardiac output (18.9±4 vs. 18.4±4 L/min) after maximal exercise. The slopes of the relationships between CO and work rate (0.065±0.01 vs. 0.05±0.01 L/min/W, and VO<sub>2</sub> and HR (0.02±0.006 vs. 0.025±0.006 L/beat) during the ramp test were also significantly different after training.

**CONCLUSIONS:** Eight weeks of endurance training improve power output with no change in CO, which suggests an enhanced O<sub>2</sub> extraction by muscle. Although changes in venous O<sub>2</sub> concentration were not measured, these results indicate that muscle oxygenation obtained via NIRS may not be a reliable index of O<sub>2</sub> extraction during maximal exercise. Other factors altered with training (e.g., mitochondrial and capillary density, O<sub>2</sub> diffusion, Mb) may affect the overall muscle oxygenation response after training.

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**2907 Board #54 May 30 9:30 AM - 11:00 AM**

**The Effect Of Maximal Sprint Training On Measures Of Endurance Performance**

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**PURPOSE:** To determine the effects of two weeks of maximal sprint interval training (SITmax) on variables of endurance running performance; including peak oxygen uptake (VO<sub>2peak</sub>), the velocity associated with VO<sub>2peak</sub> (vVO<sub>2peak</sub>), progressive time to fatigue measure (TTF), and a 5km time trial (TT), in well trained runners.

**METHODS:** Twelve trained collegiate runners (4 males, 8 females) were assigned to a sprint group (SG) (n = 6; age 23 ± 2 yrs; VO<sub>2peak</sub> 67.6 ± 7.5 ml·kg<sup>-1</sup>·min<sup>-1</sup>) or endurance control group (CG) (n = 6; age 22 ± 2 yrs; VO<sub>2peak</sub> 59.4 ± 6.5 ml·kg<sup>-1</sup>·min<sup>-1</sup>). Endurance performance measures were assessed before and after two weeks of SITmax. Treadmill protocols utilizing indirect calorimetry were used to determine VO<sub>2peak</sub>, vVO<sub>2peak</sub>, and TTF. Time trials were performed on either a synthetic 200 m indoor or 400 m outdoor track, with surface and weather conditions consistent for pre and post trials. SITmax consisted of 3 sprint sessions per week for 2 wks. The number of sprints performed progressed from 4 during week 1 to 6 during week 2. Each session consisted of a 15 minute submaximal warm-up run, followed by 4-6 30 s treadmill sprints and a 15-30 minute submaximal running cool-down. The running velocity for each sprint corresponded to 120-125% of the individual's VO<sub>2peak</sub>. Control subjects were asked to maintain a normal training volume during the 14 day period.

**RESULTS:** Participants recorded training time and average HR throughout the intervention period. The SG (315±62 min-wk) performed more ( $p<0.05$ ) submaximal running throughout the study compared to the CG (250±45 min-wk). Prior to intervention, SG had higher ( $p<0.05$ ) VO<sub>2peak</sub> than CG. Following the 14 day intervention no differences in vVO<sub>2peak</sub>, TTF, or TT performance were found between the CG and SG. However, the change in VO<sub>2peak</sub> was greater ( $p<0.05$ ) in SG (3.1%; 67.6±7.5 to 69.7±7.7 ml·kg<sup>-1</sup>·min<sup>-1</sup>) compared to CG (-3.9%; 59.4±6.5 to 57.1±6.8 ml·kg<sup>-1</sup>·min<sup>-1</sup>).

**CONCLUSION:** Although SITmax resulted in an increase in aerobic power compared to controls, there was no effect on vVO<sub>2peak</sub>, TTF or TT performance, suggesting that performance adaptations in response to SITmax may take longer than 14 d to occur in well trained runners.

**2908 Board #55 May 30 9:30 AM - 11:00 AM**  
**Effects Of Aerobic Fitness On Blood Buffering And Maximal Cycling Power During Variable Intensity Exercise.**  
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Variable intensity exercise (VAR = short bouts of high-intensity exercise followed by low intensity for recovery) is typically used by aerobically-trained (A<sub>E</sub>T) and untrained people (UT) to improve endurance performance. However VAR lowers blood pH which is associated with reductions in muscle force.

**PURPOSE:** To determine if acid-base regulation during VAR differs between UT and A<sub>E</sub>T and its effects on maximal cycling power.

**METHODS:** Ten A<sub>E</sub>T and ten UT ( $= 64 \pm 6$  vs  $55 \pm 6$  mL·kg<sup>-1</sup>·min<sup>-1</sup>;  $P < 0.05$ ) pedaled alternating high (1.5 min) with low (4.5 min) exercise intensity for 24 min. Exercise intensity was normalized to their ventilatory threshold (VT) resulting in 3 trials; VAR<sub>LOW</sub> = 87.5-37.5% VT; VAR<sub>MODERATE</sub>, 125-25% VT; and VAR<sub>HIGH</sub> 162.5-12.5% VT. Total work was the same for all trials ( $213 \pm 8$  and  $149 \pm 23$  kJ for A<sub>E</sub>T and UT). Arterialized-blood samples and expired gas were obtained during exercise and maximal cycling power (P<sub>MAX</sub>) was measured prior and after exercise.

**RESULTS:** Table 1 shows the mean  $\pm$  SD for blood pH (pH<sub>blood</sub>) and bicarbonate concentration ([HCO<sub>3</sub><sup>-</sup>]<sub>blood</sub>), ventilatory equivalent for CO<sub>2</sub> (VE · VCO<sub>2</sub><sup>-1</sup>) and change in P<sub>MAX</sub> at the end of each protocol. \* Different from VAR<sub>LOW</sub> at  $P < 0.05$ . † Different from VAR<sub>MODERATE</sub> at  $P < 0.05$ . ‡ Different from A<sub>E</sub>T at  $P < 0.05$

	VAR <sub>LOW</sub>		VAR <sub>MODERATE</sub>		VAR <sub>HIGH</sub>	
	A <sub>E</sub> T	UT	A <sub>E</sub> T	UT	A <sub>E</sub> T	UT
pH <sub>blood</sub>	7.43 $\pm$ 0.02	7.43 $\pm$ 0.01	7.39 $\pm$ 0.02*	7.36 $\pm$ 0.03*	7.21 $\pm$ 0.05*†	7.18 $\pm$ 0.08*†
[HCO <sub>3</sub> <sup>-</sup> ] <sub>blood</sub> (mM)	24.9 $\pm$ 1.2	24.0 $\pm$ 1.0	19.7 $\pm$ 5.1*	19.1 $\pm$ 3.0*	11.4 $\pm$ 3.2*†	10.5 $\pm$ 3.4*†
VE · VCO <sub>2</sub> <sup>-1</sup>	27.3 $\pm$ 1.5	27.7 $\pm$ 2.2	31.1 $\pm$ 2.6*	32.1 $\pm$ 3.0*	40.0 $\pm$ 5.8*†	41.2 $\pm$ 3.5*†
Δ P <sub>MAX</sub> (%)	-1.7 $\pm$ 1.5	-3.5 $\pm$ 1.2	-1.6 $\pm$ 1.3	-2.5 $\pm$ 1.3	-2.0 $\pm$ 0.8	-14.1 $\pm$ 1.4‡

**CONCLUSIONS:** To increase the exercise intensity during VAR produced similar decrease in blood pH and bicarbonate concentration and comparable increase in the respiratory compensation between A<sub>E</sub>T and UT. This suggests that blood-respiratory buffering systems are not impaired in UT people during VAR. However, despite similar low blood pH, only UT reduced the maximal cycling power after VAR<sub>HIGH</sub>. Thus, training may confer adaptations to withstand low pH without losing neuromuscular power.

**2909 Board #56 May 30 9:30 AM - 11:00 AM**  
**Muscle Damage Following an Ultra-marathon Downhill Running in Runners who were not Prepared for Downhill Running**  
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 (No relationships reported)

**PURPOSE:** The purpose of this study was to examine the magnitude of Exercise-induced muscle damage (EIMD) and potential danger of Rhabdomyolysis following marathon and ultra-marathon downhill running in runners who do not prepare for the race on downhill roads.

**METHODS:** Competitive male runners ( $n = 16$ ) who finished in top 10 positions of Dead Sea annual ultra marathon (52Km) ( $n = 5$ ) and marathon (42Km) ( $n = 3$ ) were recruited to participate in the study. The road of the race starts from 800m and 700m above sea level respectively and ends at -385m below sea level. Runners from the 21&10 Km who ran on an almost level road in the second half of the race served as control group. Participants were asked to voluntarily give blood samples 24hrs after the race after signing consent form. Creatine kinase (CK) levels were measured to evaluate EIMD 24hrs after the race. Participants were asked not to take any supplements after the race and were excluded from the test if they have taken any before the race.

**RESULTS:** CK levels increased significantly after running (downhill and level running) 24 hr after the end of the race. No differences in CK levels between 10 and 21K runners. However, CK levels in downhill runners were twice the value of their counterpart level runners. CK Levels averaged 5087 u/l and 3541 24hrs after the ultra marathon and marathon respectively after excluding outlier participants.

**CONCLUSIONS:** Dead Sea ultra marathon "Run to lowest point on earth" with its 18k of downhill running increases muscle damage markers to alarming levels when participants do not practice on similar roads. Unaccustomed muscles for this kind of events have the potential of triggering some serious problems. Further investigations needed to examine the effect of preparing for the race on similar conditions and how to reduce muscle damage.

**2910 Board #57 May 30 9:30 AM - 11:00 AM**  
**Maintenance Of Running Economy In Highly Successful Distance Runners: A Cross-sectional Aging Study.**  
 Timothy J. Quinn, FACSM<sup>1</sup>, Michelle J. Manley<sup>1</sup>, Jason Aziz<sup>2</sup>, Jamie L. Padham<sup>3</sup>, Allison M. MacKenzie<sup>1</sup>. <sup>1</sup>University of New Hampshire, Durham, NH. <sup>2</sup>Concord Hospital, Concord, NH. <sup>3</sup>Husson School of Graduate and Professional Studies, Bangor, ME.  
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 (No relationships reported)

Running economy (RE) is the steady-state VO<sub>2</sub> for a given running velocity and has been shown to be strongly correlated to distance running performance. The impact of aging on RE in runners of high caliber has not been fully studied.

**PURPOSE:** To determine whether aging affects RE in a cross-sectional cohort of age-group winning runners.

**METHODS:** Subjects were recruited from large (>1,000 finishers), local road races and had to be an age group winner (1<sup>st</sup>, 2<sup>nd</sup>, or 3<sup>rd</sup> place finisher) in order to be considered for the study. Three groups were established based on age: Young (Y) (18-39 yrs,  $n=18$ ), Masters (M) (40-59 yrs,  $n=22$ ), and Old (O) (>60 yrs,  $n=11$ ). Each runner reported to the laboratory three times and completed a lactate threshold test followed by a VO<sub>2</sub> max test (Day 1) and on a separate day completed a RE test (Day 2). The RE test was conducted at four running speeds: 161, 188, 214, and 241 m/min. Each runner ran for four minutes at each speed and the steady state VO<sub>2</sub> was determined from the last minute of exercise. Complete recovery was allowed between running speeds. The VO<sub>2</sub> at each speed was plotted and a regression equation was determined and the slopes were then compared. Day 3 included body composition assessment and measurements of flexibility, muscle power, muscle strength, and muscle endurance. A 1 X 3 ANOVA was used to test for differences and significance was established at the  $p < 0.05$  level.

**RESULTS:** Upper body strength and power were significantly lower in the O group ( $p < 0.05$ ). The O group ran at a slightly lower relative VO<sub>2</sub> at each speed compared to Y

and M, however, this was accomplished at a significantly higher fraction of  $\dot{V}O_{2\max}$  ( $p < 0.05$ ). The following regression lines were calculated:  $Y = 0.1827(X) - 0.2974$ ;  $R^2 = 0.9511$  (Young);  $Y = 0.1988(X) - 1.0416$ ;  $R^2 = 0.9697$  (Master);  $Y = 0.1727(X) + 3.0252$ ;  $R^2 = 0.9618$  (Old). The slopes were not significantly different from each other.

**CONCLUSIONS:** The results from this cross-sectional study suggest that RE is maintained in age-group winning runners and that aging by itself does not limit performance-related RE. However, this maintained RE does come at a higher  $O_2$  cost.

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**2911 Board #58 May 30 9:30 AM - 11:00 AM**  
**Cycling Efficiency In A Pro Tour Champion: A Case Study**

David T. Martin<sup>1</sup>, Marc J. Quod<sup>2</sup>, Hamilton Lee<sup>1</sup>, Christopher J. Gore, FACSM<sup>1</sup>. <sup>1</sup>Australian Institute of Sport, Belconnen, Australia. <sup>2</sup>Edith Cowan University, Perth, Australia.

(No relationships reported)

The hypothesis that cycling efficiency improves with years of heavy training is not Supported by cross-sectional data from recreational and elite cyclists. However, longitudinal data presented in two case studies describes improved cycling efficiency in a Tour de France champion and improved running efficiency in a marathon world record holder with maturation.

**PURPOSE:** To examine cycling efficiency over multiple years of training in a cyclist that became a UCI ProTour Champion.

**METHODS:** From 1995 - 2001, a maximal graded exercise test (GXT) was performed annually on a dynamically calibrated electromagnetic cycle ergometer (accuracy  $\pm 1.8\%$  between 100-800W). The test protocol began at 100W and increased 50W every 5min until volitional exhaustion. Expired gas analysis was performed using an automated first principles indirect calorimetry system incorporating gas analyzers calibrated against 3 alpha grade gases ( $\pm 0.03\%$  accuracy) and direct measurements of expired gas volume via a Tissot gasometer every 30s. Data from the last 2 min of 150W-400W stages ( $RER < 1.00$ ) were averaged for analysis.  $\dot{V}O_2$ , RER and Lusk equations were used to calculate Gross Efficiency (GE) and the inverse of the energy produced - energy expended regression was used to calculate Delta Efficiency (DE).

**RESULTS:** Between 18-24yrs this cyclist can be characterized as: 62-68kg; 172-173cm; 380-455 W and 6.1-7.3  $W \cdot kg^{-1}$  at  $\dot{V}O_{2pk}$ ; 4.59-5.65  $L \cdot min^{-1}$  and 73-87  $ml \cdot kg^{-1} \cdot min^{-1}$   $\dot{V}O_{2pk}$ . Economy (mean $\pm$ SD; range) was 80.2 $\pm$ 1.9; 77.5-82.5  $W \cdot (\dot{V}O_2 \cdot L \cdot min^{-1})^{-1}$  or 401 $\pm$ 10; 387-413W at 5  $L \cdot min^{-1}$   $\dot{V}O_2$ . GE was 22.6  $\pm$  0.6; 21.8-23.4% and DE was 23.6 $\pm$ 1.1; 21.9-25.4%. The correlation between GE and DE was low ( $r = 0.20$ ;  $p = 10$ ;  $n = 7$ ). Correlations between age and GE ( $r = -0.67$ ), and age and DE ( $r = 0.05$ ) did not reflect improvements in cycling efficiency with maturation.

**CONCLUSIONS:** These data do not support the hypothesis that years of heavy training improve cycling efficiency.  $\dot{V}O_{2pk}$  and corresponding power output in this champion cyclist were exceptional when expressed per kg body mass. However, measures of cycling efficiency were not unique. Accurate data describing how physiological characteristics respond to years of training in elite athletes are difficult to obtain and need to be interpreted with caution because of the challenges of maintaining calibrated equipment.

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**2912 Board #59 May 30 9:30 AM - 11:00 AM**  
**Can Two Weeks Of Sprint Interval Training Improve Health Related Fitness In Overweight/obese Sedentary Males?**

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(No relationships reported)

Physical activity is known to be beneficial to health and many studies have investigated the efficacy of moderate and high intensity exercise to improve health related parameters (e.g. Houtard et al., J Appl Physiol 96: 101-6, 2004). However, little is known as to whether shorter duration, higher intensity exercise (e.g. "all-out" sprinting) also provides health benefits.

**PURPOSE:** To investigate whether very high intensity sprint interval training (SIT) improves health related fitness.

**METHODS:** Nine sedentary males (Age: 31.3  $\pm$  8.8 yrs, body mass index (BMI): 31.1  $\pm$  3.9  $kg/m^2$ , percentage fat: 28.7  $\pm$  5.1%) were recruited. Fasted, resting metabolic assessment, plus anthropometric and fitness measurements were made before and after subjects completed a two week SIT intervention. The SIT involved six sessions of 4-6 repeats of 30 sec Wingate Anaerobic sprints on an electromagnetically controlled ergometer, with 4.5 min of recovery between repetitions.

**RESULTS:** Two weeks of SIT improved fitness as both Wingate Anaerobic mean power (567  $\pm$  69 vs. 587  $\pm$  61 W;  $P = 0.037$ ) and  $\dot{V}O_{2\max}$  (2.95  $\pm$  0.50 vs. 3.18  $\pm$  0.44  $l/min$ ;  $P = 0.029$ ) were significantly improved from pre to post intervention. Furthermore, several health related parameters also changed: mean blood pressure (94.8  $\pm$  9.63 vs. 89.7  $\pm$  9.46 mmHg;  $P < 0.001$ ), fasted resting respiratory exchange ratio (0.77  $\pm$  0.04 vs. 0.73  $\pm$  0.04;  $P = 0.036$ ) and waist to hip ratio (0.92  $\pm$  0.07 vs. 0.90  $\pm$  0.07;  $P = 0.044$ ) were all significantly reduced. BMI, weight and the sum of 4 sites skinfold thickness did not change significantly (31.1  $\pm$  3.88 vs. 30.7  $\pm$  4.02  $kg/m^2$ ;  $P = 0.054$ , 92.9  $\pm$  13.12 vs. 91.9  $\pm$  13.63;  $P = 0.067$  and 110.4  $\pm$  21.9 vs. 105.3  $\pm$  26.8;  $P = 0.073$  respectively). In addition, the area under the curve (AUC) for blood glucose during an oral glucose tolerance test (OGTT) was unchanged (845.6  $\pm$  348.8 vs. 802.7  $\pm$  338.0 mmol/L.min;  $P = 0.59$ ). However, fasted triglyceride concentration was significantly reduced (1.35  $\pm$  0.56 vs. 1.17  $\pm$  0.31 mmol/L;  $P = 0.028$ ) and non-esterified fatty acid concentration AUC during an OGTT significantly decreased (39.68  $\pm$  26.05 vs. 16.42  $\pm$  9.63 mmol/L.min;  $P = 0.018$ ).

**CONCLUSIONS:** Two weeks of a SIT intervention substantially improves many health related parameters in overweight/obese sedentary males.

Supported in part by the Carnegie Trust and University of Glasgow, UK.

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**2913 Board #60 May 30 9:30 AM - 11:00 AM**  
**Associations Between Olympic Distance Triathlon Timed Segments: Longitudinal Data From 19 World Championships**

Angel Delgado<sup>1</sup>, Edgardo Diaz<sup>1</sup>, Carlos Perez<sup>1</sup>, Cesar Gomez Ruiz<sup>1</sup>, Miguel A. Rivera, FACSM<sup>2</sup>. <sup>1</sup>University of Puerto Rico, Rio Piedras, Puerto Rico. <sup>2</sup>School of Medicine University of Puerto Rico, San Juan, Puerto Rico.

(No relationships reported)

The Olympic triathlon consists of a 1.5 km swim, 40 km bike ride, and a 10 km run. The relative importance of each segment in determining the total time in Olympic distance triathlon performance is unclear.

**PURPOSE:** This study examined the relationship between segmental times in swimming, cycling and running and the total time in the triathlon using data from 19 consecutive Olympic distance triathlon championships (1989 to 2008).

**METHODS:** Official results for world championships were gathered from the International Triathlon Union public domain database. Variables included gender (women;  $n = 815$  and men;  $n = 923$ ), swimming time (ST), cycling time (CT), running time (RT), total time (TT), and event year (EY). Pearson correlation ( $r$ ) coefficients between TT-ST, TT-CT and TT-RT were calculated after sorting the data by gender and adjusting for EY.

**RESULTS:** In women, correlations were TT-ST,  $r = 0.46$ ; TT-CT,  $r = 0.70$ ; and TT-RT,  $r = 0.69$  (TT-ST  $<$  TT-CT and TT-RT;  $P < 0.01$ ). In men, correlations were TT-ST,  $r = 0.39$ ; TT-CT,  $r = 0.55$ ; and TT-RT,  $r = 0.62$  (each  $r$  different from the others;  $P < 0.01$ ).

**CONCLUSION:** Marked gender differences existed in the contribution of swimming, cycling and running to total time in elite Olympic distance triathletes.

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**2914 Board #61 May 30 9:30 AM - 11:00 AM**



## Associations Between Sprint Distance Triathlon Timed Segments In World Class Elite 16 To 19 Year-old Triathletes

Carlos Perez<sup>1</sup>, Angel Delgado<sup>1</sup>, Edgardo Diaz<sup>1</sup>, Cesar Gomez Ruiz<sup>1</sup>, Miguel A. Rivera, FACSM<sup>2</sup>. <sup>1</sup>University of Puerto Rico, Rio Piedras, Puerto Rico. <sup>2</sup>School of Medicine University of Puerto Rico, San Juan, Puerto Rico.  
(No relationships reported)

This report was part of a longitudinal study on the triathlon. The first world championship of the International Triathlon Union (ITU) for the 16 to 19 year-olds (Juniors) was held in 1995. The event, known as the sprint distance triathlon, consists of a 750m swim, 20km bike ride, and 5km run. The relative contribution of the swimming, cycling and running segments to total time in sprint distance triathlon is unclear.

**PURPOSE:** This study examined the relationship between performance in the swimming, cycling and running segments with total time in sprint distance triathlon world championships contested between 1995 and 2008.

**METHODS:** Official results for Juniors in the sprint distance triathlon world championships were collected from the International Triathlon Union public domain database. Variables included gender (women; n=566 and men; n=805), swimming time (ST), cycling time (CT), running time (RT), total time (TT), and event year (EY). Pearson correlation (*r*) coefficients were calculated between TT-ST, TT-CT and TT-RT after sorting the data by gender, and adjusting for EY.

**RESULTS:** In Junior women, correlations were TT-ST, *r* = 0.55; TT-CT, *r* = 0.84; and TT-RT, *r* = 0.74. In Junior men, correlations were *r* = 0.58, TT-ST; *r* = 0.69, TT-CT; and *r* = 0.77, TT-RT. Within each gender, the three coefficients were statistically different from the others (*P* < 0.01), and the running and swimming segments had the highest and lowest correlations with total time in the triathlon.

**CONCLUSION:** The study revealed gender differences in the contribution of swimming, cycling and running timed segments to total time in sprint distance triathlons in world-class 16 to 19 year-old triathletes.

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### 2915 Board #62 May 30 9:30 AM - 11:00 AM Comparison Of Metabolic Responses To High Intensity Interval Training In Trained And Well-trained Males

Ken J. Hetlelid, Eva Herold, Stephen Seiler, FACSM. University of Agder, Kristiansand, Norway.  
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(No relationships reported)

**PURPOSE:** During steady state exercise, well-trained endurance (WT) athletes oxidize more fat at the same relative intensity compared to recreationally trained people (RT). However, less is known about substrate oxidation during high intensity intermittent exercise. We have compared total energy expenditure (TEE) and fat oxidation during a fixed duration, high-intensity, self-paced interval training prescription in WT and RT subjects.

**METHODS:** Nine WT (VO<sub>2</sub>max 71 ± 5 ml min<sup>-1</sup> kg<sup>-1</sup>) and 9 RT (VO<sub>2</sub>max 55 ± 5 ml min<sup>-1</sup> kg<sup>-1</sup>) runners performed preliminary testing followed by a 34 min interval-training session consisting of six, 4 min work bouts separated by 2 min recovery periods on a motorized treadmill with a constant 5 % incline. The session was prescribed as a high-intensity workout with the goal being to achieve the highest possible average running speed for the work bouts. Energy expenditure and fat oxidation were calculated from continuous measurements of VO<sub>2</sub> consumption and CO<sub>2</sub> production. Due to some net CO<sub>2</sub> contribution from bicarbonate buffering during intermittent high intensity exercise, fat oxidation rates are presumably underestimated and should be considered minimum estimates.

**RESULTS:** Blood lactate (6.2 ± 2.1 vs 6.4 ± 2.5 mmol.L<sup>-1</sup>) and RPE (16.2 ± 1.4 vs 16.2 ± 1.7) responses throughout the interval session were not different between WT and RT. However, VO<sub>2</sub> during the last 3 minutes of each work bout was higher in WT (92 ± 1 vs. 87 ± 2 % VO<sub>2</sub>max, *p* < 0.01). Mean RER for the entire session was higher in RT (0.97 ± 0.03 vs 0.91 ± 0.02 *p* < 0.001). TEE in the 34 min interval session was higher in WT (641 ± 46 Kcal vs. 552 ± 75 Kcal (*p* = 0.009)). Fat oxidation during the interval session was 23.2 ± 4 g in WT vs. 9.4 ± 3 g in RT *p* < 0.001). Estimated fat oxidation accounted for 35 ± 6 % of TEE in WT vs. 17 ± 7 % in RT.

**CONCLUSIONS:** When provided a verbal and written exercise description, WT and RT perform interval training at similar perceived intensity. However, WT oxidize more fat despite higher relative oxygen consumption rates. These results suggest that the superior fat oxidation of well trained athletes seen during low intensity continuous exercise extends to high intensity intermittent exercise, accepting the limitations associated with respiratory gas exchange measurements during intermittent exercise above the lactate threshold.

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### 2916 Board #63 May 30 9:30 AM - 11:00 AM The Cardiovascular And Metabolic Response To Arm Cranking At Three Cadences On An Upper Body Independent Crank Cycle.

Allyson Stein, Robert M. Otto, FACSM, Tara Plusch, Cortney Whitebay, Josh O'Brien, Sarah Wright, John W. Wygand. Adelphi University, Garden City, NY.  
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Group exercise sessions seldom involve vigorous upper body exercise, but often contain a myriad of calisthenics and light resistance apparatus. In an effort to provide a substantial upper body stimulus for use in a group exercise setting, we used an arm crank exercise cycle with independent crank arms, a short (170 mm) crank arm length and a narrower crank axis, than most upper body exercise cycles. These characteristics allow for a variety of movement patterns and a faster cadence than previously observed on upper-body exercise.

**PURPOSE:** The purpose of this study was to determine the cardiovascular and metabolic response to arm cranking at cadences of 80, 100, and 120 rpm at a fixed resistance.

**METHODS:** Familiarization trials were conducted to ensure compliance to a split crank position of 180 degrees and within 2 rpm of the assigned cadence. One female and nine male subjects (age 26.2 ± 7.1 yr, body mass 92.4 ± 15.7 kg and ht. 179.5 ± 6.7 cm.) were randomly assigned to perform steady state trials of 80, 100 and 120 rpm using open circuit spirometry. Pilot testing revealed that smaller subjects (<70 kg) fail to achieve steady state at any cadence at the fixed resistance (~40% of maximal resistance).

**RESULTS:** ANOVA revealed no significant difference (*p* < .05) in BR, HR, RER and RPE among all cadences, but significant differences in Ve (64 vs 84 and 97 l/min), and VO<sub>2</sub> (26.2 vs 32.7 and 35 ml/kg/min<sup>-1</sup>) at 80 rpm versus 100 and 120 rpm, respectively. Intensity ranged from 80% to 89% of APMHR, with 120 rpm eliciting the highest intensity.

**CONCLUSION:** Arm cycle exercise can elicit substantial metabolic demand of 7.3 to 9.8 METS at cadences between 80 to 120 rpm, respectively.

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### 2917 Board #64 May 30 9:30 AM - 11:00 AM Session RPE Following Cycling And Treadmill Exercise With Varying Intensities But Equal Caloric Expenditure

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(No relationships reported)

**PURPOSE:** Examine session RPE (overall, [SRPE-O]; legs [SRPE-L]; breathing [SRPE-B]) following 4 exercise sessions (2 cycling, 2 treadmill) with varying intensity but equated energy expenditure (400 kcals) in a hot (~28°C) environment.

**METHODS:** Five males performed 4 (counterbalanced) trials; high-intensity cycling (HIC), low-intensity cycling (LIC), high-intensity run (HIR), low-intensity run (LIR). High and low-intensity trials were at 80% and 50% mode-specific  $\dot{V}O_{2max}$ , respectively. Prior to trials, a 5 min exercise bout was completed to determine duration needed to expend 400 kcal. Change in rectal temperature (DTrec) (start to finish) was calculated and analyzed. RPE was recorded after 5-minutes (RPE<sub>5</sub>), at the midpoint (RPE<sub>mid</sub>), and conclusion (RPE<sub>end</sub>) of exercise with overall and differentiated Session RPE estimated 20-min after each trial.

**RESULTS:** A series of one-way RM-ANOVAs revealed significant main effects for SRPE-L ( $p=0.04$ ), with SRPE-O approaching significance ( $p=0.06$ ) but no significance for SRPE-B. SRPE-L for HIC ( $8.2\pm1.3$ ) was significantly higher than LIC ( $4.6\pm0.5$ ), HIR ( $5.6\pm0.9$ ) and LIR ( $4.2\pm1.3$ ). SRPE-O was significantly higher for HIC ( $7.6\pm1.1$ ) vs. LIC ( $3.8\pm0.4$ ) and LIR ( $4.2\pm1.3$ ) while HIR ( $6.6\pm1.5$ ) was significantly higher vs. LIC and approached significance ( $p=0.06$ ) for LIR. Significant main effects were found for DTrec ( $p=0.01$ ), with post hoc analyses showing significantly higher DTrec for HIR ( $1.5\pm0.3$  °C) vs. LIC ( $0.7\pm0.2$  °C), LIR ( $1.1\pm0.4$  °C), and approaching significance for HIC ( $1.0\pm0.5$  °C) ( $p=0.06$ ). Additionally, LIR produced significantly higher DTrec vs. LIC. Significant main effects were found for RPE<sub>end</sub> ( $p=0.04$ ) but not for RPE<sub>5</sub> or RPE<sub>mid</sub>. Post-hoc analyses revealed RPE<sub>end</sub> for HIC ( $7.8\pm1.1$ ) was significantly higher vs. LIC ( $4.6\pm0.6$ ) and LIR ( $4.2\pm1.1$ ). HIR ( $6.6\pm1.5$ ) yielded significantly higher RPE<sub>end</sub> vs. LIC and approached significance for LIR ( $p=0.06$ ).

**CONCLUSION:** S-RPE was more sensitive to intensity than total caloric expenditure. Similar to RPE during exercise, Session RPE following cycling (vs. treadmill) appears to be magnified possibly due to comparatively greater localized feelings of leg strain and exertion. DTrec did not appear to have as large an influence on RPE as mode, under these conditions.

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**2918 Board #65 May 30 9:30 AM - 11:00 AM**  
**Impact Of Swimming On Antioxidant Enzyme Status And Oxidative Markers In Old Rats**

Ming-Fen Hsu, Tsai-Wei Shen, Tsung-Hsien Lu, Hsien-Tang Lin, Chia-Chen Yang, Jo-Ping Lee, Mallikarjuna K, Chia-Hua Kuo. *Taipei Physical Education College, Taipei, Taiwan.* (Sponsor: John L. Ivy, FACSM)  
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(No relationships reported)

**PURPOSE:** Advancing age is associated with accumulated oxidative damage to proteins, lipids and mitochondria. In this study we tested the hypothesis that swimming exercise training could revert the age dependent oxidative damages in liver.

**METHODS:** Young (3 months) and old (12 months) Sprague-Dawley rats were divided into four groups; young control ( $n=5$ ), young exercise ( $n=5$ ), old control ( $n=5$ ) and old exercise ( $n=5$ ). 90 minutes of swimming exercise was given to the exercise group for a period of two weeks.

**RESULTS:** The estimated antioxidant enzyme activities including, superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GSH-Px) and glutathione reductase (GR) were decreased with age and significantly ( $p<0.05$ ) increased with exercise training. However, elevated protein carbonyls and MDA levels were noticed in old animals, which indicate that old liver had greater accumulated oxidative damages. The significant drop in protein carbonyl content and increase in mitochondrial succinate dehydrogenase (SDH) activity was observed with response to swim training in old rats.

**CONCLUSIONS:** This data implied that swim exercise training could revert the oxidative damages in liver. This was also proven by enhanced antioxidant enzyme status with response to exercise training in old rats. From these results it is cleared that age induced detrimental effects to the liver might be reversed by regular swimming exercise training in old rats.

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**2919 Board #66 May 30 9:30 AM - 11:00 AM**  
**The Energy Cost And Hemodynamic Response To Arm Crank Exercise Using Three Movement Patterns On An Independent Crank Cycle**

Josh O'Brien, Allyson B. Stein, Sarah Wright, Tara Plusch, Cortney Whitebay, Robert M. Otto, FACSM, John W. Wygand. *Adelphi University, Garden City, NY.*  
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(No relationships reported)

The cardiovascular and metabolic stimulus derived from upper body cycling exercise is purportedly altered with different movement patterns. Asymmetrical single arm cycling (SA), double arm cycling (DA [both arms matched at identical points in the range of motion]) and split crank pattern (SP [180 degrees of separation between hands]) may require different muscle recruitment patterns, which could alter the intensity of specific muscles. This investigation used an arm crank exercise cycle with independent crank arms, a short (170 mm) crank arm length and a narrower crank axis, than most upper body exercise cycles. These cycle characteristics allow the aforementioned movement patterns.

**PURPOSE:** The purpose of this study was to determine the energy cost and hemodynamic response to arm cranking using three movement patterns at a fixed cadence of 80 rpm at a fixed resistance.

**METHODS:** Familiarization trials were conducted to ensure compliance to the different movement patterns. One female and nine male subjects (age  $26.2 \pm 7.1$  yr, body mass  $92.4 \pm 15.7$  kg and ht.  $179.5 \pm 6.7$  cm.) were randomly assigned to perform steady state trials of SA, DA and SP using open circuit spirometry. Pilot testing revealed that smaller subjects ( $<70$  kg) fail to achieve steady state at any cadence at the fixed resistance ( $\sim 40\%$  of maximal resistance).

**RESULTS:** ANOVA revealed no significant difference ( $p>.05$ ) in any variable among all trials (i.e.  $\dot{V}O_2$  2.2, 2.6, and 2.4 L/min for SA, DA, and SP trials, respectively).

**CONCLUSION:** Regardless of the arm movement pattern (SA, DA, or SP), a similar metabolic and hemodynamic response occurs at the same workload. The inclusion of a variety of movement patterns at the same resistance can provide a similar stimulus, yet keep the exercise experience novel.

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**2920 Board #67 May 30 9:30 AM - 11:00 AM**  
**Improvements In Balance And Agility After High Intensity Water Exercise For Land-based Athletes**

John Whitehill, Jr, Nora L. Constantino, FACSM, Mary E. Sanders, FACSM, Mary E. Sanders, FACSM, Minggen Lu, Minggen Lu. *University of Nevada Reno, Reno, NV.*  
(No relationships reported)

The extent to which water training affects athletic performance on land is unclear. Agility and balance performance responses to water exercise are not well documented.

**PURPOSE:** To determine effectiveness of water-based exercise on agility and balance performance by land-based competitive athletes during off-season training.

**METHODS:** Twenty-nine healthy, competitive athletes ( $23.7 \pm 6.5$  years) were recruited to either a water exercise (WE,  $n=14$ ), or control (C,  $n=15$ ) group. The WE group trained 9 weeks, a minimum of 3 days per week, 90 minutes a session. WE exercises included: cardiovascular resistance and stretching in shallow and deep water using running, jumping, cadence and interval sets; aquatic cycling; underwater running. The control group maintained land-based, off-season training and recorded activity. Agility and balance were measured at, baseline, midway and at the end of training.

**RESULTS:** No injuries were reported for either group. For all measures the WE group significantly improved greater than the C group. Wilcoxon Rank Sums Test was used to test the difference between EX and C groups for compass clockwise, compass counter clockwise, hexagon clockwise, hexagon counter clockwise, sway and stability.

Assessment	Difference Between Post and Pre Testing (Post - Pre)		Difference Between Two Groups
	C Group	WE Group	

	n	mean $\pm$ std	n	mean $\pm$ std	Control - Ex	P - Value*
Compass Clkwise	15	-0.27 $\pm$ 0.26	14	-1.51 $\pm$ 0.52	1.24	< .0001
Compass CntrClkwise	15	-0.33 $\pm$ 0.24	14	-1.45 $\pm$ 0.49	1.12	< .0001
Hexagon Clkwise	15	-0.57 $\pm$ 0.54	14	-3.50 $\pm$ 1.03	2.93	< .0001
Hexagon CntrClkwise	15	-0.64 $\pm$ 0.39	14	-3.22 $\pm$ 1.49	2.58	< .0001
Stability	15	-0.10 $\pm$ 0.30	14	-1.02 $\pm$ 0.50	0.92	< .0001
Sway	15	1.47 $\pm$ 4.36	14	13.00 $\pm$ 6.28	-11.53	< .0001

\* Wilcoxon Rank Sums test

**CONCLUSION:** This water exercise program conducted during off-season for a variety of competitive land-based athletes resulted in greater improvements in all measures for agility and balance when compared to controls. While both groups had improvements, the WE group improved significantly more than the C group. Water exercise appears to show promise as an effective training option for healthy competitive athletes who want to improve balance and agility.

## G-16 Free Communication/Poster - *Epidemiology of Injury*

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

### 2921 Board #68 May 30 8:00 AM - 9:30 AM

#### Risk Of Overuse Injury And Stress Fracture Among Female U.S. Army Recruits Exceeding Body Fat Limits

David N. Cowan<sup>1</sup>, Sheryl A. Bedno<sup>1</sup>, Yuanzhang Li<sup>1</sup>, Christine T. Scott<sup>2</sup>, Weiwei Han<sup>1</sup>, David W. Niebuhr<sup>1</sup>. <sup>1</sup>Walter Reed Army Institute of Research, Silver Spring, MD. <sup>2</sup>Department of Defense Medical Evaluation Review Board, Colorado Springs, CO.

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(No relationships reported)

**PURPOSE:** To compare the risk of musculoskeletal injury among female Army recruits who were over body fat (OBF) standards on accession and were able pass a pre-accession physical fitness test, to those who met body fat standards (fully qualified, FQ) and were not required to pass a fitness test. Overuse injuries (OUI) in general and stress fractures (StFx) in particular are among the most common and serious training related injuries among men and women in the military, leading to substantial morbidity, direct medical costs, and indirect personnel and administrative costs. Trainees developing OUI and StFx are more likely to receive an early discharge from the military.

**METHODS:** Each incident OUI and StFx event was identified from electronic medical records and was defined as the first outpatient encounter with an OUI or StFx diagnosis. The risk of OUI and StFx at 90 days was compared between 319 OBF subjects who passed a pre-accession physical fitness test and the population of 1656 FQ recruits. The fitness test comprised a 5-minute step test and a 1-minute push-up test, with results on each scored as pass or fail.

The association between OBF status and injury was expressed as the relative risk (RR) with the 95 percent confidence interval (95% CI).

**RESULTS:** Within the first 90 days of service, there were 172 first OUI among OBF (54%), and 836 among FQ (50%). There were 14 first StFx among OBF (4.4%), and 132 among FQ (8.0%). For OBF the OUI relative risk was 1.07 (0.95-1.20), and for StFx the relative risk was 0.55 (0.32-0.94).

**CONCLUSIONS:** In the first 90 days of military service we observed a slight but not statistically significant ( $p=0.14$ ) increase in risk of OUI, and a significantly decreased risk of StFx among OBF females. These patterns differ somewhat from those seen among men. The decrease in risk of stress fracture among OFB women may be physiologically plausible given the association of increased risk of stress fracture among individuals with low body mass index. The findings associated with OBF women and these injuries present interesting challenges for Army accession policy makers in balancing increased accessions of females with lower stress fracture risk, while controlling for costs to include possibly more overuse injuries and weight control programs.

### 2922 Board #69 May 30 8:00 AM - 9:30 AM

#### Gender-specific Incidence And Prevalence Of Anterior Knee Pain In A Military Population

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(No relationships reported)

Anterior knee pain (AKP) is one of the most commonly diagnosed chronic knee conditions, however, there is a lack of recent epidemiologic data regarding the prevalence and incidence of this condition. Additionally, AKP is frequently reported to be more common in females compared to males, but there is scant recent epidemiologic data supporting this oft-quoted gender discrepancy.

**PURPOSE:** To determine the association between gender and the prevalence and incidence of AKP.

**METHODS:** One-thousand five-hundred and twenty-five participants from the United States Naval Academy were followed for up to 2.5 years for the development of AKP (incidence). Physicians and certified athletic trainers documented the cases of AKP. Anterior knee pain was defined as retropatellar pain during at least two of the following activities: ascending/descending stairs, hopping/jogging, prolonged sitting, kneeling, and squatting, negative findings on examination of knee ligament, menisci, bursa, and synovial plica, and pain on palpation of either the patellar facets or femoral condyles. A history of anterior knee pain (prevalence) prior to admission to the Academy was evaluated through the use of a baseline questionnaire. Poisson and logistic regressions were performed to determine the association between gender and the incidence and prevalence of AKP, respectively.

**RESULTS:** The incidence rate for AKP was 22/1000 person-years. Females were 2.23 times (95% confidence interval (CI): 1.19, 4.20) more likely to develop AKP compared to males ( $P=0.01$ ). While not statistically significant, the prevalence of AKP at study enrollment tended to be higher in females (15%) than in males (12%) ( $P=0.09$ ).

**CONCLUSIONS:** Females at the USNA were significantly more likely to develop AKP than males; however, at the time of admission to the academy, the prevalence of AKP was not significantly different between genders. Ongoing research within this cohort is being performed to examine biomechanical and anatomical characteristics as potential risk factors for AKP.

Supported by NIH grant R01 AR050461 and the National Academy of Sports Medicine.

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**2923 Board #70 May 30 8:00 AM - 9:30 AM**

**Longitudinal Foot Arch Height And Risk Of Injury In Us Army Basic Combat Training**

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(No relationships reported)

A prior study (Cowan, Arch Fam Med, 2:773, 1993) suggested that high longitudinal foot arches were associated with injury incidence during military training; however, another study (Kaufman, Am J Sports Med, 27:585, 1999) using different methods showed little relationship between arch height and injury risk.

**PURPOSE:** This study examined the relationship between a direct measurement of longitudinal foot arch height and injury incidence during United States Army Basic Combat Training (BCT).

**METHODS:** Bilateral arch height was measured in 2,691 male and 1,270 female U.S. Army recruits prior to beginning BCT. Arch height was defined as the distance from the standing surface to the inferior border of the navicular tuberosity. Injuries occurring during the 9-week BCT cycle were obtained from medical records. Cox regression was used to examine injury risk among individuals with the highest 20% of arch heights (H) and individuals with the lowest 20% of arch heights (L) relative to the middle 60% of the arch height distribution (M). The M group was defined as baseline injury risk (equal to 1.00). Cox regression was used to determine hazard ratios (HRs) and 95% confidence intervals (95% CIs).

**RESULTS:** For men, the L group was at slightly higher injury risk for the left arch height (HR (L/M)=1.13, 95%CI= 0.99-1.34) but not for right arch height (HR (L/M)=1.02, 95%CI= 0.87-1.20). The male H group showed injury risk similar to the M group for both the left (HR (H/M)=1.02, 95%CI= 0.87-1.19) and right foot (HR (H/M)=0.98, 95%CI= 0.84-1.15). For women, the L group showed little increased risk of injury relative to the M group for the left (HR (L/M)=1.11, 95%CI= 0.94-1.32) or right (HR (L/M)=1.09, 95%CI= 0.92-1.29) foot. The female H group also showed little increased risk relative to the M group for either the left (HR (H/M)=1.11, 95%CI= 0.94-1.32) or right (HR (H/M)=1.09, 95%CI= 0.92-1.29) foot.

**CONCLUSION:** Direct measurement of the height of the longitudinal foot arch indicated that subjects with high and low arches were not at substantially elevated injury risk during Army BCT. These findings are in consonance with those of Kauffmann, et al. (Am J Sports Med, 27:585, 1999).

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**2924 Board #71 May 30 8:00 AM - 9:30 AM**

**Risk Of Heat Illness Among Male U.S. Army Recruits Exceeding Body Fat Limits**

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(No relationships reported)

**PURPOSE:** To compare the risk of heat illness among male Army recruits who were over body fat (OBF) standards on accession and were able pass a pre-accession physical fitness test, to those who met body fat standards (fully qualified, FQ) and were not required to pass a fitness test.

**METHODS:** Incident heat illness was identified from electronic medical records and was defined by the first outpatient encounter with a heat illness diagnosis. The risk of heat illness at 90 days of service was compared between 827 OBF subjects, who passed a pre-accession physical fitness test, and the population of 8858 FQ recruits was evaluated. The test comprised a 5-minute step test and a 1-minute push-up test, with results on each scored as pass or fail. The odds ratio (OR) (with the 95 percent confidence interval (95% CI)) was used to measure the association between OBF status and heat illness. Logistic regression was used to evaluate the adjusted OR controlling for potential confounding with other risk factors.

**RESULTS:** There were 44 first episodes of heat illness among FQ (0.5%) and 19 among OBF (2.3%). When other potential confounding factors (e.g., age, race, training site, season of year, and smoking) were controlled the adjusted OR for heat illness among OBF was 3.26 (1.82, 5.87). Most heat illnesses were minor, but all types occurred more frequently among OBF men.

**CONCLUSION:** Although there were relatively few heat illness events, there was a statistically significant three-fold greater risk among men who exceeded body fat limits. Each year thousands of men enter the Army, and a substantial number exceed body fat standards and are allowed to enter if they pass the fitness test. These findings may have implications for military accession and training policy should the level of risk identified in this study exist in the general recruit population. However, the finding of increased risk of heat illness among OBF men alone does not adequately address the situation. It may be possible to reduce the risk among OBF men by strict adherence to training and heat illness prevention guidelines. Cost benefit analyses should be conducted to determine if the benefits of allowing additional recruits to enter the Army offset the additional costs imposed by increased risks of heat illness.

Supported by US Army Accession Command.

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**2925 Board #72 May 30 8:00 AM - 9:30 AM**

**Risk Factors For Time-loss Injuries In The United States Army Ordnance School Advanced Individual Training**

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(No relationships reported)

Only one previous study (Henderson, Milit Med 165, 9:647, 2000) has examined risk factors in Advanced Individual Training (AIT) where soldiers go to receive their specialty training after Basic Combat Training (BCT).

**PURPOSE:** This study examined risk factors for time loss injuries during United States Army Ordnance School AIT.

**METHODS:** Participants were soldiers (n= 3759 men, n=498 women) attending Ordnance AIT. Injuries were obtained from an injury surveillance system in the medical clinic serving the AIT soldiers. Potential injury risk factors included entry-level fitness, demographics, and lifestyle variables. Fitness variables included maximal effort performance on push-ups, sit-ups and a 2-mile run. A health questionnaire provided data on age, race, rank, previous injury, previous illness, and tobacco use. Fitness variables were converted to four quartiles (Q) based on the distribution of scores where Q1=high performance and Q4=low performance. AIT entry and completion dates were obtained from an Army Personnel system. Backward stepping Cox regression examined associations between time loss injury and potential injury risk factors. Multivariate hazard ratios (HR) and 95% confidence intervals (95%CI) were calculated.

**RESULTS:** For men, higher risk of injury was independently associated with race (HR (Native American/Caucasian) = 1.3, 95%CI = 1.1-1.7), previous injury (HR (yes/no) = 2.1, 95%CI = 1.8-2.6), frequent cigarette use before entering the Army (HR (yes/no) = 1.5, 95%CI = 1.3-1.7), lower push-up performance (HR (Q4/Q1) = 1.3, 95%CI = 1.1-1.5), lower sit-up performance (HR (Q3/Q1) = 1.3, 95%CI = 1.1-1.5) and slower 2-mile run time (HR (Q4/Q1) = 1.3, 95%CI = 1.1-1.6). For women, higher risk of injury was independently associated with race (HR (Asian/Caucasian) = 0.6, 95%CI = 0.5-0.9), previous injury (HR (yes/no) = 1.7, 95%CI = 1.2-2.3), and slower 2-mile run time (HR (Q4/Q1) = 2.0, 95%CI = 1.4-2.9).

**CONCLUSIONS:** Modifiable risk factors for time loss injury in Ordnance AIT include prior BCT injury, tobacco use, and aerobic fitness. Enhanced injury prevention in BCT, smoking cessation and fitness training prior to entry are potential strategies to reduce injuries.

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**2926 Board #73 May 30 8:00 AM - 9:30 AM****The Prevalence Of Work-related Musculoskeletal Disorders In Certified Members Of The National Athletic Trainer's Association**

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(No relationships reported)

**PURPOSE:** To examine the prevalence of work-related musculoskeletal disorders among certified athletic trainers (ATC) who are members of the National Athletic Trainers' Association.

**METHODS:** A random sample of 6,500 ATC representing three employment settings was sampled using the Nordic Musculoskeletal Questionnaire. A response rate of 34.4 % was achieved using an electronic survey via email.

**RESULTS:** Female ATC reported significantly ( $p<0.006$ ) more WRMD in the past 12 months than males in the neck, shoulders, wrist/hand, upper back, and hip/thigh, whereas male ATC reported significantly ( $p=0.013$ ) greater WRMD in the elbow/forearm. Female ATC reported a significant lifetime prevalence of WRMD in the neck and wrist/hand ( $p<0.016$ ). Younger ATC (20-30 year old v. 30-66+ year old) reported significantly ( $p<0.043$ ) greater WRMD in the neck, shoulder, elbow/forearm, upper back, low back, and hip/thigh regions. ATC employed for 0-5 years reported significant WRMD for the neck, shoulders, and upper back ( $p<0.044$ ), while those employed for more than 6 years reported significant WRMD for the elbow/forearm and hip/thigh ( $p<0.003$ ). No significant differences were seen between the number of hours worked per week and WRMD, nor ATC employment setting (clinical, college/university, and high school). Finally, low back had the highest prevalence rate of WRMD at 67.9%, followed by the neck 60.0%, the shoulder 46.3%, the knee 38.3%, the upper back 34.9%, the wrist/hand 31.0%, the ankle/foot 30.9%, the hip/thigh 16.5%, and finally the elbow/forearm 15.8%.

**CONCLUSIONS:** ATC do suffer a high prevalence of WRMD in several body regions. Factors such as gender, age, and the number of years employed in the profession revealed a significant relationship between ATC and WRMD. Based off this current study, the need to spread awareness of WRMD in ATC, the need to incorporate WRMD discussions into the education process of athletic training student's, and the need to incorporate education of WRMD and safety measures in the clinical setting to prevent WRMD from occurring in the workplace are suggestions for the athletic training profession.

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**2927 Board #74 May 30 8:00 AM - 9:30 AM****Relative Isometric Shoulder Strength Norms In Young, Active Males And Females**

Michele L. Duffey<sup>1</sup>, Kenneth L. Cameron<sup>2</sup>, Christopher J. Jones<sup>3</sup>, Thomas M. DeBerardino<sup>2</sup>, Brett D. Owens<sup>4</sup>. <sup>1</sup>Penn State University, University Park, PA. <sup>2</sup>Keller Army Hospital, West Point, NY. <sup>3</sup>United States Military Academy, West Point, NY. <sup>4</sup>William Beaumont Army Medical Center, El Paso, TX.

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(No relationships reported)

It is common clinical practice to draw strength comparisons between an injured and uninjured shoulder following acute glenohumeral instability events. This information is often used to monitor rehabilitation outcomes and determine return to activity; however, little is known about baseline isometric strength in the uninjured shoulder.

**PURPOSE:** The purpose of this study was to describe isometric shoulder strength for active college-aged men and women with no history of glenohumeral joint instability.

**METHODS:** During their initial two months at the United States Military Academy, 546 males ( $18.8\pm1.0$  yr,  $75.3\pm12.2$  kg) and 73 females ( $18.7\pm0.9$  yr,  $62.6\pm7.0$  kg) completed bilateral isometric strength tests using a hand-held dynamometer. Strength measures included internal and external rotation (IR, ER) and abduction (ABD) in the neutral position, IR and ER at 45° abduction (IR45, ER45), and flexion in the prone position (PF). Means  $\pm$ SD normalized by body mass were calculated by gender and hand dominance (table). Percentiles were calculated for all measures by gender.

**RESULTS:** All strength measures were normally distributed. Baseline measures of isometric shoulder strength indicated significant side-to-side differences ( $p\leq0.01$ ) for IR, IR45, ABD, and PF in uninjured college-aged males and in IR45 and PF for uninjured college-aged females.

	Males		Females	
	Dominant	Non-Dominant	Dominant	Non-Dominant
ER	$0.43 \pm 0.09$	$0.42 \pm 0.10$	$0.35 \pm 0.08$	$0.34 \pm 0.09$
IR	$0.60 \pm 0.13$	$0.59 \pm 0.13$	$0.47 \pm 0.11$	$0.47 \pm 0.13$
ABD	$0.78 \pm 0.17$	$0.77 \pm 0.17$	$0.64 \pm 0.19$	$0.63 \pm 0.21$
ER45	$0.48 \pm 0.10$	$0.48 \pm 0.10$	$0.39 \pm 0.09$	$0.39 \pm 0.09$
IR45	$0.58 \pm 0.12$	$0.56 \pm 0.12$	$0.47 \pm 0.11$	$0.45 \pm 0.11$
PF	$0.26 \pm 0.07$	$0.25 \pm 0.07$	$0.23 \pm 0.07$	$0.21 \pm 0.06$

**CONCLUSION:** These data may provide normative distributions for isometric shoulder strength measures which can be used by clinicians to identify strength deficiencies. Also, clinicians may use these data to monitor recovery from injury as well as functional outcomes of rehabilitation. Whether or not strength deficiencies are related to risk of glenohumeral instability warrants further study.

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**2928 Board #75 May 30 8:00 AM - 9:30 AM****Balance, Gait, Knee Extensor Strength, And Functional Performance Among Fallers And Non-fallers With Parkinson's Disease**

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(No relationships reported)

Falling is a common problem for individuals with Parkinson's disease (PD). However, there is insufficient information regarding what differentiates fallers from non-fallers. Such information is important for targeted rehabilitation interventions to reduce risk of falling in individuals with PD.

**PURPOSE:** To characterize differences in balance, gait, knee strength, and functional performance between individuals with PD who are fallers or non-fallers.

**METHODS:** The study used a cross-sectional design. Twenty-seven adults with mild to moderate PD (Hoehn and Yahr [H&Y] stage I-III) (7 female, 20 male, mean age=69 years old, UPDRS Motor III=28, mean H&Y Stage=2.3) participated in this study. Outcome measures were: balance (limits of stability: maximum endpoint excursions, movement velocity, directional control), gait (velocity, stride length), knee extensor strength (isokinetic quadriceps peak torque performed at  $60^\circ\cdot s^{-1}$ ), and functional performance (50-foot walk, Up&Go).

**RESULTS:** Of the 27 participants, fourteen reported one or more falls during the previous six months. There was no significant difference in the mean H&Y stages of fallers vs. non-fallers. Analyses of mean differences in outcome measures are shown below. Fallers showed significantly lower or worse scores on limits of stability, gait, knee extensor strength, and functional performance.

**CONCLUSION:** Individuals with PD who experience falls have diminished physical capacities in balance, gait, knee extensor strength, and functional performance. Exercise interventions should target these characteristics to improve the physical abilities of individuals with PD to reduce their risk of falling.

	Fallers (n = 14)	Non-Fallers (n = 13)	
Outcome Measures	Mean (SD)	Mean (SD)	P value
Maximum endpoint excursions (%)	38.0 (12)	63.6 (13)	0.001
Movement velocity (deg/sec)	1.81 (1.4)	2.72 (1.1)	0.05
Directional control (%)	48.7 (13)	72.8 (1.0)	0.01
Knee extensor peak torque (ft-lbs)	49.37 (19)	50 (18)	0.05
Velocity (cm/sec)	97.7 (23)	113.3 (14)	0.05
Stride length (cm)	104 (23)	121 (13)	0.03
50-foot walk (sec.)	16.5 (4.1)	14.3 (2.5)	0.05
Up&Go (sec.)	10.9 (3.1)	8.5 (1.5)	0.04

Supported by NIH Grant R01 NS047130

## 2929 Board #76 May 30 8:00 AM - 9:30 AM Shoulder Pain And Gender In Manual Wheelchair Users

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(No relationships reported)

**PURPOSE:** The purpose of this investigation was to quantify the presence of shoulder pain in physically active manual wheelchair users and examine whether the presence and level of shoulder pain varied across genders.

**METHODS:** 55 manual wheelchair users (17 male, 38 female) who regularly participate in wheelchair athletics completed three separate surveys indexing the shoulder pain and difficulty performing functional activities.

**RESULTS:** 54.5% of the respondents reported shoulder pain, 36% reported taking pain medication and only 7% received some form of therapy. There were no gender differences in the incidence of shoulder pain (58.8% of males and 52.2 % of females). However, female respondents reported more severe shoulder pain and difficulty during numerous activities of daily living ( $p < .05$ ). Most of these activities required significant amounts of muscular strength and/or were composed of significant internal and external shoulder rotation.

**CONCLUSIONS:** The findings suggest that a gender disparity in shoulder pain severity, but not incidence persists in physical active wheelchair users. Further work is needed to understand the mechanisms that contribute to gender differences in shoulder pain severity.

## 2930 Board #77 May 30 8:00 AM - 9:30 AM Hyperlordosis Retraining Method Relieves Lumbar Disc And Stenosis Pain - An Unexpected Finding

Jolie Bookspan. *Neck and Back Pain Sports Medicine, Philadelphia, PA.* (Sponsor: Catherine G. R. Jackson, F.A.C.S.M. and LtCol Kelly Hill, M.D., F.A.C.S.M., FACSM)

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(No relationships reported)

**PURPOSE:** Previous work has identified hyperlordotic lumbar posture as causal in lower back pain (LBP). By comparison, main source of disc lesion is identified as flexion, and stenotic pain, constriction. Patients seen for LBP with radiographically identified disc lesions and stenosis had significant pain relief using a hyperlordosis reduction technique, The Ab Revolution (AR).

The purpose of this study was to identify effectiveness of The Ab Revolution (AR), for chronic LBP with disc degeneration, herniation, or stenosis as presenting component.

**METHODS:** 47 participants (19 M, 28 F, 17 - 89) seen through the sports medicine center and University classes for LBP (pain > 6 months, orthopedic origin) with diagnosed discogenic and/or stenotic pain. All were taught AR. Control Group (N=13) was free to pursue treatment other than AR (PT, massage, surgery, Pilates, acupuncture, yoga, other) or no intervention. Participants were reassessed for LBP (better, gone, worse, same,) at day 1 and one-month follow-up. Data were analyzed using Chi-Square and non-parametric sign test.

**RESULTS:** Significant reduction of LBP using AR ( $P < .0001$ ) at each stage with no gender difference. At 1 month follow-up, 42 of 47 subjects in AR completely resolved back pain, 4 reported significant improvement, compared to 4 of 13 in the control group completely resolving pain.

**CONCLUSIONS:** AR has been previously found to reduce chronic LBP from hyperlordotic loading. A mechanism for relief from the separate problems of discogenic and stenotic pain appears to lie in direct reduction of compression through positional retraining of the space-occupying disc, and surrounding irritated and constrained nerve distributions, with crossover to daily activity where the majority of loading occurs. A second consideration is unrecognized hyperlordotic pain from hyperlordosis co-occurring with disc lesion and stenosis. Reduction of that separate source obviates or reduces total pain. Hyperlordotic posture creates foraminal narrowing, further restricting areas already compromised by stenosis LBP may also be misattributed to disc involvement or stenosis, which frequently appear radiographically, but of no clinical significance. Another hitherto unrecognized possibility is that chronic hyperlordosis mechanically contributes to disc injury.

## G-17 Free Communication/Poster - Exercise and Muscle Damage

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

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2931 Board #78 May 30 9:30 AM - 11:00 AM

**Effects Of  $\alpha$ -hydroxyisocaproic Acid On Body Composition, Doms And Performance In Athletes**

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(No relationships reported)

**$\alpha$ -Hydroxyisocaproic acid ( $\alpha$ -HICA)** is an end product of leucine metabolism in human tissues such as muscle and connective tissue. According to the clinical and experimental studies,  $\alpha$ -HICA can be considered as an anti-catabolic substance.

**PURPOSE:** To investigate the effects of  $\alpha$ -HICA supplementation on body composition, delayed onset of muscle soreness (DOMS) and physical performance of athletes during a training period.

**METHODS:** Fifteen healthy male football players (age  $22.1 \pm 3.9$  yr) volunteered for the 4-week double-blind study during an intensive training period. The subjects in the group HICA (n=8) received 583 mg of sodium salt of  $\alpha$ -HICA (corresponding 500 mg of  $\alpha$ -HICA mixed with liquid three times a day for 4 weeks, and those in the group PLACEBO (n=7) received placebo (650 mg of maltodextrin) three times a day for the same period. According to a training schedule they practiced football four times a week, strength training two times a week and had one football game a week during the study. The subjects were required to keep diaries on training, food and symptoms of DOMS. Body composition was evaluated with DEXA before and after the 4-week period. Muscle strength and running velocity were measured with field tests. Statistical comparisons were made using ANOVA.

**RESULTS:** The  $\alpha$ -HICA supplementation increased compared to placebo significantly lean whole body mass ( $p < 0.001$ ) and whole body muscle mass ( $p < 0.01$ ) while fat mass remained constant. The muscle mass of lower extremities increased by 400g in HICA but decreased by 150g in PLACEBO. The  $\alpha$ -HICA supplementation decreased significantly ( $p < 0.01$ ) the whole body DOMS symptoms in the 4<sup>th</sup> week of the treatment when compared to placebo. Muscle strength and running velocity did not differ between the groups.

**CONCLUSION:** The  $\alpha$ -HICA supplementation increases muscle mass and decreases muscle soreness during an intensive training period in athletes.

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2932 Board #79 May 30 9:30 AM - 11:00 AM

**The Effect Of Antioxidant Cherryflex Supplementation On Doms, Biomarkers Of Tissue Damage, And Oxidative Stress**

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( G.M. Kastello, Brownwood Acres Inc., Contracted Research.)

**PURPOSE:** The purpose of this crossover, double blind study was to examine the effects of CherryFlex supplementation on eccentric exercise induced inflammation, tissue damage, oxidative stress biomarkers and delayed onset muscle soreness (DOMS).

**METHODS:** Four males and ten females (ages:  $21 \pm 0.76$  years; weight:  $72.21 \pm 3.7$  kg) performed five sets of 10 maximal eccentric contractions of the elbow flexor on a Biodex isokinetic dynamometer. The placebo and CherryFlex supplemental groups each ingested tablets 16 days prior to exercise and continued through the study. Venous blood samples were obtained at 16 and 1 day prior to exercise and 0, 2, 4, 24, 48 and 72 hours post exercise. Samples were measured for creatine kinase (CK), myoglobin, protein carbonyls (PC), thiobarbituric acid (TBARS), and C-Reactive proteins (CRP). Data for limb volume, limb girth, arm hang angle, peak torque, peak work, punctuated tenderness gauge (objective pain) and visual analog scale (subjective pain) were collected at 0, 12, 24, 48, and 72 hours post exercise. Time by treatment and treatment effects were measured using MANOVA repeated measures with Tukey's post-hoc at specific time points.

**RESULTS:** Moderately significant treatment effect were observed in TBARS ( $\pm$  SE;  $P_{24} 4.15 \pm 0.43$  vs.  $S_{24} 3.42 \pm 0.29$ ;  $p = 0.1062$ ), 12 hour objective pain at 4 cm site ( $P_{12} 1.25 \pm 0.13$  vs.  $S_{12} 1.63 \pm 0.20$ ;  $p = 0.139$ ), 12 hour relaxed arm hang angle ( $P_{12} 145.67 \pm 2.15$  vs.  $S_{12} 150.18 \pm 1.69$ ;  $p = 0.100$ ) and percent of maximum torque loss ( $S_{24} 21 \pm 4.2\%$ ,  $P_{24} 29 \pm 4.2\%$ ,  $p = 0.11$ ). Statistically significant time by treatment interactions between groups at  $p \leq 0.05$ , were observed for CRP ( $P_{24} 5.02 \pm 2.02$  vs.  $S_{24} 2.85 \pm 0.95$ ;  $p = 0.047$ ), objective pain ( $P_{12} 1.41 \pm 0.06$  vs.  $S_{12} 1.52 \pm 0.08$ ;  $p = 0.040$ ) and subjective pain ( $P_{48} 4.86 \pm 0.39$  vs.  $S_{48} 4.14 \pm 0.41$ ;  $p = 0.026$ ). The cherry supplemental group demonstrated no significant differences in protein carbonyls, creatine kinase, myoglobin, limb volume, limb girth, flexed arm hang angle, peak torque and peak work.

**CONCLUSIONS:** These findings suggest that ingestion of the CherryFlex supplement prior to and during eccentric exercise may have a protective effect on oxidative stress (TBARS), inflammation (CRP), range of motion, contractile force loss, and perceived pain.

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2933 Board #80 May 30 9:30 AM - 11:00 AM

**Efficacy Of Tart Cherry Juice In Reducing Muscle Damage, Inflammation And Oxidative Stress Following Marathon Running**

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(No relationships reported)

**PURPOSE:** Tart cherries (*Prunus Cerasus*) are known to contain a variety of phenolic compounds and are particularly rich in anthocyanins that may help to reduce muscle damage, oxidative stress and inflammation following strenuous physical activity, and help to accelerate recovery. The purpose of this study was to determine the efficacy of a tart cherry juice blend in aiding recovery, and reducing muscle damage, inflammation and oxidative stress.

**METHODS:** Twenty recreational Marathon runners volunteered to participate. Volunteers were equally, but randomly assigned to two groups and consumed 16 fl oz of a commercially available cherry juice (CherryPharm, Geneva, NY) or placebo (PL) everyday for 5 days prior to, and for 48 h following the Marathon. Measures of muscle damage [creatine kinase (CK), delayed onset muscle soreness (DOMS) and maximum voluntary contraction (MVC)], inflammation [interleukin 6 (IL-6), C-reactive protein (CRP) and uric acid], total antioxidant status (TAS) and oxidative stress [TBARS and protein carbonyls (PC)] were taken pre-supplement, pre-race, immediately post-race, 24 h and 48 h post-race. A repeated measures ANOVA was used to ascertain differences over time and between groups.

**RESULTS:** MVC recovered significantly faster in the cherry juice group (101% versus 91% at 48h). Markers of inflammation were reduced in the cherry juice versus PL group (IL-6 post race 49% lower,  $P < 0.001$ ; CRP at 24 and 48 hr 33% lower,  $P < 0.01$ ; uric acid post race and at 24 hr 22% and 29% lower,  $P < 0.05$ ). TAS was approximately 10% greater in the cherry juice than the PL group for all post supplementation measures ( $P < 0.05$ ). TBARS at 48h post-race was 29% lower in the cherry juice than the PL at 48h ( $P < 0.05$ ). DOMS, CK and PC were not different between groups.

**CONCLUSIONS:** The cherry juice increased total anti-oxidative capacity following 5 days supplementation, and reduced inflammation, lipid peroxidation, and aided in the recovery of muscle function. This drink appears to provide athletes and exercisers with a viable means to aid recovery by increasing antioxidant capacity and reducing inflammation and oxidative stress. Perhaps more importantly, the cherry juice may have applications for the management of other clinical pathologies that incur oxidative stress and inflammation.

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2934 Board #81 May 30 9:30 AM - 11:00 AM

**Effects Of Chocolate Milk Consumption On Markers Of Muscle Recovery During Intensified Soccer Training**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to determine the effectiveness of chocolate milk (CM) as a post-exercise recovery beverage during intensified training in competitive soccer players.

**METHODS:** Thirteen collegiate soccer players (184±7 cm, 79±10 kg) completed two intervention periods, each consisting of one week of 'normal' training followed by four days of intensified-training (IT). Immediately following each day of IT, subjects received either a high-carbohydrate (CHO: 1.77g CHO·kgBW<sup>-1</sup>; 0.03g Fat·kgBW<sup>-1</sup>) or CM (1.2g CHO·kgBW<sup>-1</sup>; 0.4g Pro·kgBW<sup>-1</sup>; 0.1g Fat·kgBW<sup>-1</sup>) recovery beverage. Treatment beverages were isocaloric, and delivered in a randomly-counterbalanced double-blind protocol. Serum creatine kinase (CK) and myoglobin (Mb) levels, muscle soreness, mental and physical fatigue, peak isometric force of the quadriceps (MVC), and leg-extension repetitions at 70% 1-RM (Reps) were obtained prior to IT, and following 2- and 4-days of IT. Soccer-specific performance tests (t-drill, vertical jump and 1.5 mile run speed) were performed within the training sessions.

**RESULTS:** Average daily training times (85.3±5.0; 95.3±7.9 min) and HR (141.8±12.1; 145±10.9 bpm) increased significantly ( $p<0.05$ ) between baseline and IT periods, with no differences between treatment periods. Soreness, CK, Mb, MVC and Reps were all significantly altered over time during the IT period. No significant treatment\*time interactions were observed. However, serum CK levels during the CM treatment were significantly lower ( $p<0.05$ ) than CHO following two (343.5±199.8; 449.9±364.8 U/L) and four (316.9±188.3; 431.6±310.8 U/L) days of IT. Mean changes in isometric MVC values for CM (+52.7 N) tended to be greater than those for CHO (+24.6 N), although this was not statistically different between treatments. No significant differences in soccer-specific performance tests were observed between treatment beverages.

**CONCLUSIONS:** Post-exercise CM consumption provided equal or possibly superior muscle recovery responses to an isocaloric, high-carbohydrate recovery beverage following a four-day period of intensified soccer training. Performance in soccer-specific field tests were similar between beverages.

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2935 Board #82 May 30 9:30 AM - 11:00 AM

**Acute Effects Of Chocolate Milk And A Commercial Recovery Beverage On Post-exercise On Muscle Damage And Endurance Cycling Performance**

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**PURPOSE:** This study compared chocolate milk (CHOC) vs. a commercial recovery beverage (CRB) as a recovery aid after intense exercise regarding performance and muscle damage in trained cyclists.

**METHODS:** Ten, competitive cyclists ( $\text{VO}_{2\text{peak}}$  55.2 ± 7.3 ml/kg/min.) completed a high-intensity intermittent exercise protocol, then 15 to 18 h later performed a performance trial @ 85% of  $\text{VO}_{2\text{peak}}$  to exhaustion. Participants consumed 1.0g carbohydrate (CHO)/kg/h of a randomly assigned isocaloric beverage (CHOC, or CRB) following the first high intensity intermittent exercise session. The same protocol was repeated one week later with the other beverage.

**RESULTS:** A one-way ANOVA revealed no significant difference ( $p = .91$ ) between trials for cycling time to exhaustion at 85% of  $\text{VO}_{2\text{peak}}$  (CHOC 13 ± 10.2 min., CRB 13.5 ± 8.9 min.) A significantly higher increase ( $p < 0.05$ ) was observed from CKpre-to-post in the CRB trial compared to the CHOC trial (increase CHOC 27.9 ± 134.8 U/L<sup>-1</sup>, CRB 211.9 ± 192.5 U/L<sup>-1</sup>); with differences not significant ( $p = .35$ ) for CKpost (CHOC 394.8 ± 166.1 U/L<sup>-1</sup>, CRB 489.1 ± 264.4 U/L<sup>-1</sup>) between the two trials.

**CONCLUSIONS:** These findings indicate no difference between chocolate milk and this commercial beverage as potential recovery aids for cyclists between intense workouts. Comparatively, CHOC is more economical per serving while providing similar benefits in recovery.

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2936 Board #83 May 30 9:30 AM - 11:00 AM

**The Effects Of Adding Leucine To A Carbohydrate-electrolyte Beverage On Muscle Damage, Soreness, And Performance**

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(No relationships reported)

Recent studies have examined the independent and combined importance of essential amino acid and carbohydrate ingestion after resistance training. However, no studies have examined the effects of adding leucine to a commercially available sports drink on muscle damage and delayed-onset muscle soreness (DOMS). If leucine ingestion reduces muscle damage after a single training bout, athletes should be able to perform at a higher level during an ensuing training bout.

**PURPOSE:** To evaluate the efficacy of adding leucine to pre- and post-exercise carbohydrate-electrolyte beverages on blood markers of muscle damage, DOMS, and strength-endurance after a single lower-body resistance training bout.

**METHODS:** Seventeen males (age 22.9 ± 2.9 y, height 171.6 ± 28.0 cm, body mass 92.8 ± 27.2 kg) and three females (age 21.6 ± 2.6 y, height 161.7 ± 6.7 cm, body mass 61.4 ± 8.7 kg) performed 6 sets of squats to complete fatigue using 75% of their pre-determined 1-RM with 3 minutes of rest between sets. All subjects were resistance trained and familiar with the squat exercise (male 1-RM squat 151.9 ± 27.5 kg, female 1-RM squat 67.4 ± 1.3 kg). Each subject consumed carbohydrate-electrolyte beverages 30 minutes before and immediately after exercise with (LCHO) or without (CHO) the addition of leucine in randomized, double-blind fashion. Blood creatine kinase (CK), lactate dehydrogenase (LDH), and subjective surveys of DOMS were analyzed immediately before (TIME1), 24 (TIME2), 48 (TIME3), and 72 (TIME4) hours after exercise. Subjects repeated the squat protocol at TIME4 to test short-term recovery.

**RESULTS:** No differences were observed between groups for squat performance, as defined by the number of repetitions performed over 6 sets of squats to fatigue, during both TIME1 and at TIME4. The addition of leucine did not significantly decrease CK and LDH activity or subjective ratings of DOMS. Furthermore, CK values and DOMS ratings for the LCHO and CHO groups demonstrated similar patterns across all time points.

**CONCLUSIONS:** These findings suggested that adding leucine to carbohydrate-electrolyte beverages did not affect the pain associated with DOMS, blood markers of muscle damage, and squat performance during both acute testing and 3 days after the initial resistance training bout in resistance trained subjects.

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2937 Board #84 May 30 9:30 AM - 11:00 AM

**Carbohydrate-Protein Beverage Improves Recovery From Muscle Damage Induced By Downhill Running**

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(No relationships reported)

Downhill running has been shown to induce muscle fiber damage, delayed-onset muscle soreness, and various functional deficits. Consumption of carbohydrate-protein beverages during or immediately following strenuous exercise have been shown to reduce muscle damage, however its effects on performance recovery following downhill running have yet to be elucidated.

**PURPOSE:** This study examined the effects of CHO+PRO vs. CHO on multiple aspects of muscle recovery following one bout of unaccustomed novel eccentric exercise (downhill running).

**METHODS:** 20 physically active but untrained participants were randomly assigned to either CHO or CHO+PRO (n=10/group). Subjects consumed either 1.2 g·kg<sup>-1</sup> CHO (CHO) or 1.2 g·kg<sup>-1</sup> CHO + 0.3 g·kg<sup>-1</sup> protein (CHO+PRO) daily for 7 days prior to eccentric exercise, and for 2 days following exercise. For eccentric exercise, subjects performed a 30-min downhill run (DHR) at 75% of their maximal heart rate on a -18% gradient. Creatine kinase activity (CK), lower extremity muscle soreness (SOR), and maximal isometric and isokinetic torque, were all assessed prior to 24 hr post, and 48 hr post DHR. Athletic performance was also assessed including 20-m sprint time, gross motor skills, vertical jump, and multistage fitness test prior to DHR and 48 hr post DHR.

**RESULTS:** CK was increased at 24 hr and 48 hr post DHR (P<0.05) but there was no differences between the two treatments. SOR ratings from all three different lower body exercises were significantly elevated over time compared to pre exercise (PRE) and magnitude of hamstring soreness was attenuated at both 24 hr and 48 hr post exercise in the CHO+PRO group (P<0.01). CHO+PRO significantly reduced the deterioration in maximal isokinetic hamstring torque compared to CHO at 24 and 48 hr post DHR (P<0.05) but there were no treatment differences in maximal isometric torque. CHO+PRO treatment also resulted in better 20-m sprint performance 48 hr post DHR.

**CONCLUSION:** The results of this study reveal that short term consumption of CHO+PRO beverage before and after one bout of eccentric exercise can enhance multiple aspects of muscle recovery which may have important implications for athletes and military personnel.

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**2938 Board #85 May 30 9:30 AM - 11:00 AM**  
**Attenuation Of Exertional Muscle Damage With A Nutritional Supplement**

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(No relationships reported)

Previous research suggests that glutamine (GLN) administration either during or following strenuous exercise modulates post-exercise inflammatory responses and may facilitate recovery.

**PURPOSE:** This study studied the effects of GLN added to a beverage containing a carbohydrate (CHO) and an essential amino acid (EAA) mixture consumed during and after exercise on markers of EMD and performance in subjects following a strenuous physical training event.

**METHODS:** Male subjects (n = 33; mean age of 24 years ± 1) completed this blinded-crossover study. Subjects were randomized to ingest either a placebo or treatment beverage during and after two identical events (modified physical fitness test), with the alternate beverage provided at the second event. Beverages were matched for CHO and EAA content (42 grams of CHO, 6 grams of EAA per liter) providing 192 calories. The GLN containing (4 grams) treatment beverage provided 208 calories per liter.

**RESULTS:** No significant differences were noted (p ≤ 0.05) between groups with respect to muscle damage or inflammation, to include changes in creatine kinase, lactate dehydrogenase, white blood cell counts, C-reactive protein and select pro- and anti-inflammatory cytokines, as measured at baseline and after exercise. Creatine kinase, the primary variable of interest, increased after the training event in both groups indicating muscle damage had occurred. The treatment beverage did not significantly attenuate the response (p = 0.28). Plasma GLN levels remained relatively unchanged between placebo and treatment conditions, with both beverages blunting post-exercise induced decreases in GLN levels. Physical performance measures and pain scores were not significantly affected by the addition of GLN.

**CONCLUSIONS:** Our findings suggest that the addition of GLN to a CHO/EAA beverage provided during and after exercise does not confer any significant benefit over a CHO/EAA beverage alone. The intervention failed to alter circulating GLN levels or measurably affect markers of EMD and the inflammatory response, and did not improve physical performance.

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**2939 Board #86 May 30 9:30 AM - 11:00 AM**  
**Acute Timing Effects Of HMB Supplementation On Serum Indices Of Muscle Damage**

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(No relationships reported)

Acute Timing Effects Of B-Hydroxy B-Methylbutyrate (Hmb) Supplementation On Serum Indices Of Muscle Damage

Previous studies suggest that chronic b-hydroxy b-methylbutyrate (HMB) supplementation (>2 wk) lowers serum indices of muscle damage such as creatine kinase (CK) and lactate dehydrogenase (LDH) via a possible increase in sarcolemmal integrity. However, HMB's acute or timing effects have not yet been examined.

**PURPOSE:** Therefore, the purpose of this study was to investigate the acute timing effects of HMB on changes in serum CK and LDH after a bout of eccentric exercise.

**METHODS:** Sixteen non-resistance trained men (22±2 yrs) were assigned to HMB-Pre or HMB-Post groups. All subjects performed 55 maximal eccentric knee extension/flexion contractions on 2 occasions on either the right or left leg, in a crossover design. HMB-Pre (N=8) randomly received 3 grams of either a placebo or HMB before and a placebo after exercise. HMB-Post (N=8) received a placebo before and either 3 grams of HMB or a placebo after exercise. Blood was drawn for the determination of CK and LDH before, at 8, 24, 48, and 72 hrs post exercise.

**RESULTS:** Serum indices of damage increased, peaking at 48 hrs for CK (773%, p<0.001) and 72 hrs for LDH (180%, p<0.001). While there were no time x group effects of HMB on CK and LDH, post hoc analysis revealed that only HMB-Pre showed no significant increase in LDH levels following exercise.

**CONCLUSION:** Our findings suggest there are no acute or timing effects of HMB supplementation on indices of muscle damage. However, consuming HMB before exercise appeared to prevent increases in LDH, suggesting further research is warranted.

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**G-18 Free Communication/Poster - Gait Analysis**

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

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**2940 Board #87 May 30 8:00 AM - 9:30 AM**  
**The Effects Of Continuous Hiking Pole Use On Acute Static And Dynamic Balance Of Men And Women Hikers**

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**PURPOSE:** Many hikers use trekking poles, which allow for an increase in overall stability and a reduction in joint forces. However, the International Mountaineering and Climbing Federation (UIAA) suggest continuous pole use has an adverse effect on acute balance. They suggest if a hiker must put the poles away, their balance may be worse than if they had not used poles at all. The purpose of this study was to examine the effects of continuous hiking pole use on acute static and dynamic balance of hikers.

**METHODS:** Eighteen hikers were recruited (9 male, 9 female; ages 21-62). University IRB approval was obtained and informed consents were signed. A foam pad was used for static balance, while the dynamic balancing task used a simulated 3.3m log. Knee angles, stride length and time, arm elevation, and m/l and vertical trunk motion were analyzed. EMG recorded the erector spinae (ES), bicep femoris (BF), vastus lateralis (VL), tibialis anterior (TA), and the gastrocnemius (GA). The hikers participated in all conditions, by first performing baseline static and dynamic balance tasks. They then walked for 15 minutes with or without trekking poles (counter-balanced) to achieve a steady state pace, before repeating the balancing tasks. The poles were set down, if in use, and the task performed as though they had come to a log on a hike. Five trials of each task were completed, while continuing to walk with or without poles between each trial. Repeated measures ANOVAs were used ( $\alpha = 0.05$ ).

**RESULTS:** Results showed fewer errors on average in the pole condition for the static balance task, though not statistically significant. No significant differences were noted for knee flexion, stride length or time, arm elevation or trunk sway. Statistically significant overall muscle activity was elicited for BF, VL, and the GA. Pairwise comparisons showed only statistical significance between baseline and the pole conditions.

**CONCLUSIONS:** The primary implication of this study was for hiker safety. UIAA suggested that trekking pole use could lead to injury while hiking. Since no statistical significance was found that trekking pole use has a negative effect on subsequent balance tasks, it is suggested that hikers should continue to use trekking poles while hiking to increase stability and lessen the forces placed on the lower extremity.

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2941 Board #88 May 30 8:00 AM - 9:30 AM

**The Relationship Of Active Ankle Stiffness With Obesity, Hormonal Replacement Therapy And Menopause**

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Little information is available relating stiffness, obesity, hormone replacement therapy (HRT) and menopause (natural or induced). Literature suggests that higher and lower values of stiffness can lead to bone and soft tissue injuries, respectively. Once menopause is associated with biological changes in human body (e.g. bone mineral density loss), it is important to understand how some of these changes can affect stiffness.

**PURPOSE:** To investigate the relationship of active ankle stiffness (AAS) with obesity, HRT and menopause.

**METHODS:** Maximal voluntary isometric contraction (MVIC) was measured for the right leg plantar-flexion. Free oscillation data representing active ankle stiffness was obtained for 112 post menopause women ( $57.8 \pm 5.7$  years) using external pure gravitational mass equivalent to 30% of MVIC. Active ankle stiffness was computed from kinetic data recorded in response to plantar flexion/dorsiflexion perturbations, resulting from the application of a controlled impulse (100 N) that disturbs the foot-ankle angle. If individual BMI was equal or greater than 30 kg/m<sup>2</sup> they were considered obese. The data of HRT and menopause (natural or induced) was obtained through medical consultation.

**RESULTS:** Neither the group submitted to HRT ( $19391 \pm 4117$  N/m) or the group where menopause was induced ( $20469 \pm 4705$  N/m) show statistical differences for the active ankle stiffness in relation to the control group (respectively  $20676 \pm 4958$  N/m and  $19746 \pm 4378$  N/m). However, obese group show higher values ( $21529 \pm 4062$  N/m) of active ankle stiffness than non obese group ( $18906 \pm 4803$  N/m), with ( $p = 0.008$ , 95%). As greater forces are imparted to the body, greater resistance to movement is needed to produce controlled movements. Since obese have high inertia, these results could suggest that obese subjects developed some adaption's on movement control that lead to AAS higher values.

**CONCLUSION:** The data suggest that higher values in active ankle stiffness are related with obesity; however there is no evidence it happens the same either among HRT submission/non submission groups or between subjects in natural or induced menopause.

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2942 Board #89 May 30 8:00 AM - 9:30 AM

**Gait Parameters And Risk Of Falls In Patient With Fibromyalgia**

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(No relationships reported)

Fibromyalgia includes symptoms of widespread pain (axial, upper and lower quadrant, left and right side pain), in combination with the presence of 11 out of 18 tender point sites. Patients with fibromyalgia syndrome are characterized by their chronic pain, reduced physical work capacity, muscular fatigue, difficulties with concentrating on cognitive tasks and neurological complaints, that impair the locomotion and mobility.

**PURPOSE:** To determine spatial-temporal gait parameters of patients with fibromyalgia.

**METHODS:** Ten women (age,  $55.1 \pm 5.3$  years; height,  $154.5 \pm 6.9$  cm; weight,  $76.8 \pm 8.7$  kg) were diagnosed with fibromyalgia using the American College of Rheumatology criteria volunteered to participate of the study. Kinematics were performed using an optoelectronic system (VICON, UK), sampling at 100 Hz. The right lower limb joint range of motion (hip, knee and ankle), stride length and gait velocity were determined. Subjects walked for 12 meters and the mean of three gait cycles were time-normalized and used to obtain the ensemble average.

**RESULTS:** Kinematic analysis revealed decreased mean joint range of motion of ankle, knee and hip ( $24.2^\circ \pm 3.9^\circ$ ,  $54.6^\circ \pm 4.0^\circ$ ,  $26.4^\circ \pm 6.5^\circ$ , respectively), reduced stride length ( $0.96 \pm 0.2$ m) and gait velocity ( $0.93 \pm 0.2$ m/s<sup>-1</sup>).

**CONCLUSIONS:** Subjects with fibromyalgia showed a decreased mobility which was related to pain. Patients showed reduced lower limb ROM, stride length and gait velocity. These gait patterns are similar to others studies which have analyzed the influence of muscle pain induced by training in healthy elders. The reduced ROM, stride length and gait velocity are associated with pronounced risk of falls.

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2943 Board #90 May 30 8:00 AM - 9:30 AM

**Axial Rotation Of Lumbar Spine During Treadmill Walking At Three Constant Velocities**

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Forward progression of the body during walking involves both displacement of the legs in a frontal plane and rotation of the trunk about a longitudinal axis.

**PURPOSE:** To determine the range of motion and the relative timing of displacement in transverse planes for the shoulders, lumbar spine, and pelvis during treadmill walking at three constant velocities.

**METHODS:** Three healthy young women ( $24.7 \pm 1.5$  yrs,  $1.61 \pm 0.04$  m,  $47.3 \pm 5.5$  kg) with no history of neurological or musculoskeletal disorders participated in the study. The participants were asked to walk on a treadmill (L7, LANDICE, USA) at three constant velocities (A = 0.9 m/s, B = 1.2 m/s, C = 1.5 m/s). All participants performed 2-minute walk at each velocity with a 1-minute rest in between trials. All trials were captured by an eight-camera motion capture system (MAC3D, Motion Analysis Corporation, USA), operated at 200 Hz. Ten reflective markers were placed on the bony landmarks of the shoulder, lumbar spine, and pelvis.

**RESULTS:** Stride length increased significantly (A =  $1.17 \pm 0.03$  m; B =  $1.30 \pm 0.07$  m; C =  $1.45 \pm 0.11$  m,  $p < 0.05$ ) with walking velocity. At initial contact of the right foot, the right side of the pelvis rotated forward to facilitate the placement of the foot. The angular displacement of the pelvis increased significantly with walking speed (A =  $12.1 \pm 3.6$  deg; B =  $15.6 \pm 2.4$  deg; C =  $19.8 \pm 4.0$  deg,  $p < 0.05$ ), and the timing of the peak forward rotation occurred earlier relative to foot contact as speed increased. The shoulder displacement was  $180^\circ$  out of phase with that of the pelvis. Shoulder displacement, however, did not change significantly with walking speed (A =  $10.5 \pm 2.6$  deg; B =  $7.7 \pm 1.6$  deg; C =  $10.1 \pm 2.7$  deg). Similarly, the angular displacement of the lumbar spine did not change significantly with walking speed (A =  $8.5 \pm 2.1$  deg, B =  $7.3 \pm 2.1$  deg, C =  $9.2 \pm 3.0$  deg), and the intermediate position (0 deg) occurred when both the pelvis and shoulder were at maximum angles.

**CONCLUSION:** The results indicate that only the rotation of the pelvis and not that of the shoulders or lumbar spine changed across walking speed.

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**2944 Board #91 May 30 8:00 AM - 9:30 AM**  
**A Cross-sectional Study Of Age Related Changes In Gait In Females Aged 20-59**

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(No relationships reported)

Knee osteoarthritis (OA) is a leading cause of pain and disability among the elderly. Women are 2-3 times more likely than men to develop knee OA. It has been suggested that this may be associated with the finding that females with knee OA exhibit altered frontal plane gait mechanics compared to males with knee OA, who demonstrate gait mechanics closer to the asymptomatic population. However, the mechanism behind the differential disease progression in females is not well understood.

**PURPOSE:** To examine gait mechanics in females without degenerative knee OA from 20-59 years to assess potential differences in biomechanical risk factors in gait for knee OA development.

**METHODS:** Forty females between the ages of 20-59 years with no history of connective tissue knee injury volunteered to participate in the study and were divided into four age groups: 20-29, 30-39, 40-49 and 50-59. All participants completed a gait analysis at a self-selected intentional walking speed that allowed for calculation of frontal plane knee and hip joint angles and internal joint moments. The average of five trials was used to analyze the relevant variables. One way ANOVAs were performed to examine potential differences in the variables of interest ( $p < 0.05$ ).

**RESULTS:** No differences in BMI or gait velocity were observed between the age groups. Younger females exhibited higher activity levels compared to the older females as measured by the Tegner scale. No significant differences existed between the groups in peak frontal plane knee and hip abduction moments, peak knee and hip adduction angles, and peak knee and hip adduction excursion.

**CONCLUSION:** In a female population without previous knee injury and with similar BMIs, age alone is not associated with differences in gait that have been related to the development of knee OA progression. These preliminary results suggest that there is not a specific time at which to intervene with females in order to reduce their risk for knee OA progression. Other factors that occur throughout the female lifespan need to be analyzed to identify women most at risk for knee OA development.

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**2945 Board #92 May 30 8:00 AM - 9:30 AM**  
**The Influence Of Running With Pain On Lower Extremity Kinematics In Runners With Patellofemoral Pain**

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(No relationships reported)

Patellofemoral pain (PFP) is one of the most prevalent running overuse injuries. Abnormal kinematics, such as excessive eversion, hip internal rotation, and knee abduction (valgus) have been implicated. In most studies, the runner is in a fresh, non-exerted and pain-free state. These mechanics may not be associated with the development of pain during the run.

**PURPOSE:** To investigate the mechanics of runners with PFP as they develop knee pain over the course of a run.

**METHODS:** Twenty runners with PFP and 20 healthy controls (CON) ran on a treadmill at an average speed of 2.6 m/s ( $\pm 0.3$ ). Kinematic data were collected at 5 minute intervals. Knee pain was recorded in the PFP group at each interval using a visual analog scale (VAS). Pain onset was identified as a VAS of 3/10 (VAS3) and kinematic data were collected at this time. Peak joint angles during stance at the beginning of the run and at the time of VAS3 were compared to controls at equivalent time periods using a 2-way repeated measures ANOVA.

**RESULTS:** At the beginning, 16 of 20 runners with PFP reported a VAS of 0/10, with the rest between 0.3 and 1. The pain onset occurred at an average time of 16.5 minutes ( $\pm 8.1$ ). Overall, the PFP group displayed lower peak angles than the CON group, with only knee flexion being statistically different (Table 1). This pattern of reduction may have been a compensatory mechanism to avoid the oncoming knee pain. No interactions were observed as peak angles tended to increase in both groups over time.

**CONCLUSION:** The PFP group exhibited an overall reduction in peak angles, while both groups tended to increase peaks over time. Thus, pain onset did not appear to differentially influence the peaks in the PFP group. Greater levels of knee pain (VAS > 3/10) may be needed to elicit these changes.

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**2946 Board #93 May 30 8:00 AM - 9:30 AM**  
**Comparison Of The Metabolic Cost Of Walking At Different Speeds With Stride Length In Obese And Normal Weight Adults**

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(No relationships reported)

Comparing normal and obese energetic costs with stride length while walking at different speeds is important. We hypothesize possible coordinative shifts in gait, as revealed by changes in stride length, may occur in obese individuals while walking at non-preferred gait speeds.

**PURPOSE:** The purpose of this study was to compare stride lengths (mean and standard deviation) with metabolic costs of walking at preferred and non-preferred walking speeds in obese (O) and normal weight (NW) adults.

**METHODS:** Thirty-two adults volunteered for the study. Participants walked on the treadmill for five minutes each at preferred speed, 25% above and 25% below preferred speed. Metabolic rate (indirect caloric expenditure) was measured and the last two minutes of each condition were averaged. Net (N) values were obtained by subtracting standing ambulatory rest from gross (G) values. Body composition was determined via DXA. Stride length was determined using Vicon motion analysis. Stride length was determined over the last 30 seconds of each speed trial. Statistical analysis included a three way ANOVA (group x condition) and significance was defined as  $p < 0.05$ .

**RESULTS:** Significantly greater body composition (mass, % fat and BMI), defining subjects as Obese class I (N=14), was found for overweight subjects. No group differences were noted in preferred walking speed and net metabolic rate (W per kg). However, net  $\dot{V}O_2$  (L/min) was significantly greater for O individuals than NW individuals. There were no

significant differences in stride length regardless of weight cohort.

**CONCLUSION:** Adult stride lengths may be the same for obese and NW individuals at both preferred and non-preferred walking speeds. Treadmill walking as well as including subjects who were only mildly to moderately obese may have influenced outcome measures.

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**2947      Board #94      May 30      8:00 AM - 9:30 AM**  
**Gait Adaptations To 37-kg Weight Loss Produced By Bariatric Surgery**

Patrick Rider, Cortney Herring, Jonathan Patterson, Benjamin Long, Patrick Sams, Kelly Jernigan, Walter Pories, Walter Pories, Paul DeVita, FACSM, Tibor Hortobagyi, FACSM. *East Carolina University, Greenville, NC.*  
(No relationships reported)

Many clinical conditions evoke adaptations in gait. Obese vs lean adults walk more slowly and with a more erect posture. It is unknown if such adaptations become hard-wired with obesity or there is a rapid re-adaptation of obese gait to lean gait after weight loss.

**PURPOSE:** Examine the effects of extreme weight loss on human locomotion 6 months following bariatric surgery.

**METHODS:** 3D lower limb kinematics and kinetics were assessed prior to ( $n = 5$ , BMI = 46.8) and six months after ( $n = 5$ , BMI = 32.7) bariatric surgery. Subjects walked at their self selected pace and the results of five acceptable trials were averaged.

**RESULTS:** Following surgery, subjects had significantly longer stride lengths (1.42m to 1.49m,  $p < 0.05$ ). There were also large reductions in vertical ground reaction forces (1032N to 736N,  $p < 0.05$ ), and frontal plane average knee torques (-27.3Nm to -20.9Nm,  $p < 0.05$ ). Increases in normalized (body weight x height) sagittal plane maximal ankle plantar flexor torque (7.7Nm/kg\*m to 8.5 Nm/kg\*m,  $p < 0.05$ ) and normalized (body weight) sagittal plane ankle work (0.003 J/kg to 0.049 J/kg,  $p < 0.05$ ) were observed.

**CONCLUSIONS:** The longer stride length appeared to be driven by the increased torque and work production at the ankle joint. The extreme amount of weight loss contributed to a large reduction in overall external loads placed on each individual. This resulted in large reductions in frontal plane torques at the knee joint to overcome the reduced external loads. The frontal plane knee torque result was especially significant since it is well documented that increased knee adduction torque is a predictor of knee osteoarthritis (OA), which may suggest that due to the significant weight loss, these individuals are less likely to develop knee OA. These data suggest a partial restoration of lean gait after surgery-induced large weight loss in obese adults, with disproportionately large changes in some variables.

Supported by NIH R01AG024161.

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**2948      Board #95      May 30      8:00 AM - 9:30 AM**  
**Metabolic Cost Of Altering Foot Strike Patterns In Running**

Allison H. Gruber, Elizabeth M. Russell, Joseph Hamill, FACSM. *University of Massachusetts, Amherst, MA.*  
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(No relationships reported)

Differences in kinematics of the lower extremity between a forefoot (FF) and rearfoot (RF) strike pattern may alter the metabolic demands of running. The FF strike pattern has been characterized by increased plantarflexion and inversion at touch down, greater rearfoot motion, increased knee internal rotation velocity and decreased ground contact time. It has been suggested that the kinematic profile of a FF strike pattern may reduce the metabolic cost of running as well as decrease the risk for injury. However, any deviation from preferred kinematics of gait has been shown to increase the metabolic demands of the task.

**PURPOSE:** The purpose of this study was to examine the effect of altering running strike pattern on kinematic and metabolic parameters in healthy RF strike runners.

**METHODS:** Ten natural RF strike runners (5 males, 5 females, age =  $25 \pm 5$  yrs, mass =  $64.74 \pm 9.55$  kg) participated in this study. All subjects ran  $27.2 \pm 7.1$  km per week and were free of injury for at least 1 year. Subjects were asked to run on a treadmill at their preferred running speed ( $3.01 \pm 0.50$  m/s) under two conditions: RF strike pattern and FF strike pattern. The order of conditions was counterbalanced. Oxygen consumption was measured with indirect calorimetry. Temporal-spatial parameters were collected for 60 s when the subject reached steady-state oxygen consumption. Differences between means were assessed by independent t-tests ( $\alpha = 0.05$ ).

**RESULTS:** Switching to the non-preferred gait pattern did not significantly increase the steady state oxygen consumption during running. There was no difference in stride frequency within subjects.

**CONCLUSIONS:** There was no difference in steady state oxygen consumption when switching from a preferred to a non-preferred gait pattern in running. Therefore, recommending a runner to switch strike patterns may not provide a benefit in metabolic cost.

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**2949      Board #96      May 30      8:00 AM - 9:30 AM**  
**Long Range Correlations In Stride Time During Running To Volitional Fatigue**

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(No relationships reported)

Detrended fluctuation analysis (DFA) has been used to study long range correlations in running. Reduced strength of long range correlations implies a less patterned and more adaptable system. Understanding system adaptability may be important to performance enhancement and injury prevention. The effect of volitional fatigue on strength of long range correlations is unknown.

**PURPOSE:** To examine the strength of long range correlations over a prolonged run.

**METHODS:** A uni-axial low mass accelerometer was mounted to the distal anterior medial tibia of 9 runners (5 female, 4 male,  $64.3 \pm 11.1$  kg,  $171.9 \pm 14.1$  cm) to quantify impacts (1000 Hz). After warm up, subjects ran at their preferred 5K pace  $\pm 5\%$  on an indoor track to volitional fatigue. Biomechanical parameters were processed separately for three phases of the run to examine the effect of an exhaustive run; data from the first lap was omitted from analysis. The mean, standard deviation (SD), coefficient of variation (CV) and strength of long range correlations (alpha) using DFA were calculated for stride times in each phase. Cohen's d effect sizes (ES) were calculated on all variables.

**RESULTS:** Subjects ran an average of  $24.88 \pm 4.51$  min at  $3.65 \pm 0.35$  m/s. The average number of strides analyzed per phase was  $646 \pm 145$ . The mean alpha across all subjects and phases was  $.94 \pm .30$ . When compared to the beginning, alpha levels dropped in the mid portion of the run; they slightly increased at the end when compared to the middle (beginning =  $1.13 \pm .20$ , mid =  $.79 \pm .36$ , and end =  $.88 \pm .26$ ; ES beginning/mid = 1.20, ES mid/end = 1.12). Mean stride time remained consistent throughout the run ( $.70 \pm .06$ ,  $.69 \pm .06$ , and  $.69 \pm .05$ s). A small decrease in SD and CV was observed over time ( $.012 \pm .004$ ,  $.011 \pm .003$ ,  $.010 \pm .003$ s and  $1.71 \pm .61$ ,  $1.53 \pm .53$ ,  $1.48 \pm .49\%$ ).

**CONCLUSION:** A large effect of running to volitional fatigue was observed for alpha. Runners initially demonstrated persistent long range correlations consistent with a search strategy for correct running velocity and optimal stride characteristics. During the middle portion of the run, strength of long range correlations was reduced as a more adaptable running style emerged. Near the end of the run, more persistent long range correlations started to reappear as the runners' movement system became less adaptable reflecting a reduction in degrees of freedom.

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**2950      Board #97      May 30      8:00 AM - 9:30 AM**



## Stride Length Influences Metabolic Cost During Walking In Obese Women

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(No relationships reported)

At a given speed, humans habitually walk at the stride length (SL) and stride frequency (SF) combination that is the most economical. As the SL, and thus SF, deviates farther from the preferred, metabolic cost increases in a curvilinear fashion. However, this has only been tested across a wide range of SL's in a running gait, not walking, and in healthy populations, not obese. Biomechanical gait properties in obese persons differ from those in healthy persons and may cause a different metabolic cost profile across a range of SL's.

**PURPOSE:** To investigate how a wide range SL's, at a constant speed, influences the metabolic cost of walking in obese women.

**METHODS:** 10 obese and 10 healthy-weight women participated. Metabolic measures were recorded as subjects walked on a treadmill at a preferred pace until steady state  $\text{VO}_2$  was reached. Speed was controlled and a metronome paced SF such that subjects walked at SL's of 0%,  $\pm 5\%$ ,  $\pm 10\%$ ,  $\pm 15\%$  and  $\pm 20\%$  of their preferred length. Metabolic cost was measured as the average  $\text{VO}_2/\text{kg}$  value during the final two minutes of steady state. A mixed repeated measures ANOVA design ( $\alpha = 0.05$ ) was used to assess differences between groups and conditions.

**RESULTS:** Obese women walked slower and with shorter preferred SL's than healthy-weight women. Metabolic cost was minimized at or just above the preferred SL in healthy women and increased as SL deviated farther from the preferred. This U-shaped profile from -20% to +20% of the preferred SL was wider in the obese group. In obese women, metabolic cost was minimized across a wide range of SL's and only increased when SL deviated far from the preferred. Overall, an increase in SL from the preferred increased metabolic cost more than the same percent decrease in SL.

**CONCLUSIONS:** At a given speed, as SL deviates from the preferred SL metabolic cost increases because the limb oscillations are not operating at their natural pendular frequency, where energy inputs to the system are minimal. It is possible that the obese women did not show the same increases in metabolic cost as SL deviated from the preferred because, in an effort to control the greater inertial properties and lateral excursions of the lower limbs, the preferred SL did not match the pendular frequency of the limb.

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### 2951 Board #98 May 30 8:00 AM - 9:30 AM Muscle Activity During Running At Reduced Body Weight.

Dana M. Forrest<sup>1</sup>, Janet S. Dufek, FACSM<sup>1</sup>, Kenji Masumoto<sup>2</sup>, John A. Mercer, FACSM<sup>1</sup>. <sup>1</sup>University of Nevada Las Vegas, Las Vegas, NV. <sup>2</sup>Kyushu University, Fukuoka, Japan.

(No relationships reported)

Running at reduced body weight (BW) may have rehabilitation advantages in that it may be possible to modulate the stress applied to the lower extremity. A unique treadmill has been designed to apply an upward directed force on the runner such that effective BW can be reduced. For example, the treadmill can be set to have the runner run at 60% of his/her BW. Recently, it has been reported that ground reaction forces (GRFs) are influenced by the variation of BW (Grabowski and Kram, JAB, 2008). The change in GRFs may be an indication that running style changes as BW is varied and we sought to understand the activity of lower extremity muscles as BW is manipulated.

**PURPOSE:** To determine if knee flexor and extensor muscle activity is influenced by 1) magnitude of effective BW and 2) intensity of exercise across BW conditions.

**METHODS:** Subjects ( $n=5$ ,  $26.4 \pm 10.6$  yrs;  $71 \pm 14.2$  kg,  $176 \pm 15.4$  cm) completed two minutes of running at 100, 90, 75 and 60% of BW at Rating of Perceived Exertion (RPE) levels of 11 (fairly light), 13 (somewhat hard) and 15 (hard). Order of conditions was RPE 11, 13 and 15 from highest (100%) to lowest (60%) BW. Prior to testing, subjects completed a familiarization period where they ran at different speeds and effective BWs. Measurement began by placing electromyography (EMG) electrodes on the belly of the rectus femoris (RF) and biceps femoris (BF). Data were collected (1000 Hz) during the final 30 seconds of each 2 minute run. EMG data were reduced by removing any zero offset, full wave rectifying, and then averaging muscle activity across 30 seconds. Dependent variables (average RF and BF muscle activity) were analyzed using a 3 (RPE: 11, 13, 15) x 4 (BW: 100, 90, 75, 60%) repeated measures analysis of variance.

**RESULTS:** Neither muscle was influenced by the interaction of BW and RPE ( $p > 0.05$ ). RF and BF muscle activity increased across RPE levels ( $p < 0.05$ ).

**CONCLUSIONS:** Muscle activity was not influenced by changes in BW when subjects were allowed to adjust treadmill speed to select a specific RPE. In general, subjects selected a faster running speed as BW was reduced and/or RPE increased. The faster running speed per reduction in effective BW offset any potential reduction of muscle demand. The treadmill used in the study was provided by Alter-G, Inc.

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### 2952 Board #99 May 30 8:00 AM - 9:30 AM Foot Arch Kinematics; Differences Between Barefoot And With Footwear

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(No relationships reported)

**INTRODUCTION:** The relationship of athletes and footwear is important to sports performance. However, there is little information the effects of footwear on the foot arch kinematics which acts as a shock attenuator. The reasons include the foot is covered by sock or footwear; we cannot observe the foot motion from the outside.

**PURPOSE:** The purpose of this study was to demonstrate the footwear effects on the sagittal plane kinematics of the medial and lateral longitudinal arch during single leg landing using cineangiography.

**METHODS:** Ten healthy male and seven healthy female subjects participated in this study (males; age:  $21.7 \pm 3.4$  y.o., height:  $172.6 \pm 6.8$  cm, weight:  $61.9 \pm 6.0$  kg, females; age:  $22.3 \pm 3.8$  y.o., height:  $167.8 \pm 11.3$  cm, weight:  $58.3 \pm 14.8$  kg). IRB approved informed consent was obtained from all subjects. All subjects performed single leg landing from a height of 10cm with the knee extended under two conditions; barefoot and shod. Subjects were asked to stop and balanced after landing. All trials were recorded using cineangiography. Images were obtained at rate of 60Hz. Simultaneous vertical ground reaction force was measured using a force plate. Data were analyzed using graphic software. The sagittal plane motion of the foot arch was defined as the angular change and translational motion observed after landing. A paired t-test was performed to determine differences between barefoot and shod conditions. Significance was set at  $p < 0.05$ .

**RESULTS:** The angle variation of the lateral arch in shod condition was significantly smaller than that of barefoot (males;  $5.1 \pm 2.0^\circ$  (shod),  $7.9 \pm 3.2^\circ$  (barefoot), females;  $5.7 \pm 1.6^\circ$  (shod),  $11.5 \pm 1.9^\circ$  (barefoot)). On the other hand, the medial angle change did not have a significant difference (males;  $2.4 \pm 1.6^\circ$  (shod),  $3.5 \pm 3.3^\circ$  (barefoot), females;  $5.3 \pm 1.7^\circ$  (shod),  $7.8 \pm 2.1^\circ$  (barefoot)). The maximum vertical ground reaction force was reduced in shod condition.

**CONCLUSIONS:** This study suggests that footwear effects a change in the kinematics of the longitudinal arches during landing.

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## G-19 Free Communication/Poster - Genetics

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

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**2953 Board #100 May 30 9:30 AM - 11:00 AM**  
**Identification Of A Possible Genetic Risk Factor For The Fibromyalgia Syndrome**

Jonathan C. Reeser, FACSM, Catherine A. McCarty, Terrie Kitchner. *Marshfield Clinic, Marshfield, WI.*  
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(No relationships reported)

The fibromyalgia syndrome (FMS) is an incompletely understood musculoskeletal pain condition that affects 2-6% of the population. Patients with FMS complain of widespread muscular pain and tenderness, in addition to fatigue, disordered sleep, headache, depression, irritable bowel and bladder, and temporomandibular joint discomfort. Clinically, FMS shares many phenotypic traits with post-concussive syndrome. FMS has been shown to have a genetic component, but does not follow simple Mendelian inheritance patterns.

**PURPOSE:** To determine whether the Apolipoprotein E4 allele may be a genetic risk factor for FMS.

**METHODS:** 150 cases of fibromyalgia were identified according to a strict phenotypic definition from among the nearly 20,000 subjects enrolled in the Marshfield Clinic Research Foundation's Personalized Medicine Research Project (PMRP) - the largest population-based biobank in the United States. Age and gender matched controls were identified from the PMRP in a 2:1 control:case ratio. The ApoE genotype for cases and controls was determined by single nucleotide polymorphism (SNP) analysis using SNPs rs7412 and rs429358. Relevant historical data were abstracted from the Clinic's electronic medical record.

**RESULTS:** Approximately one quarter of the cases and controls were found to carry at least one ApoE4 allele. However, the prevalence of the ApoE4 allele was significantly greater among those cases who had ever been in a motor vehicle accident (MVA) (28% vs 14% of controls,  $p < 0.001$ ), and among those cases who had ever smoked (41% vs 25% of controls,  $p < 0.001$ ).

**CONCLUSION:** These data strongly suggest that specific interactions between genetically susceptible individuals (e.g. those with at least one copy of the ApoE4 allele) and the environment (e.g. a history of MVA, or of ever smoking) may contribute to the risk of developing FMS.

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**2954 Board #101 May 30 9:30 AM - 11:00 AM**  
**Effect Of Long-term Physical Activity On Health In Twins: A 30-year Longitudinal Study**

Katja Waller<sup>1</sup>, Urho M. Kujala<sup>1</sup>, Jaakko Kaprio<sup>2</sup>, Markku Koskenvuo<sup>2</sup>, Taina Rantanen<sup>1</sup>. <sup>1</sup>*University of Jyväskylä, Jyväskylä, Finland.* <sup>2</sup>*University of Helsinki, Helsinki, Finland.*  
(No relationships reported)

**PURPOSE:** Physical activity has many positive and some negative effects on health. The main aim of this study was to find out whether persistent leisure time physical activity, adjusted for genetic liability and childhood experiences, protects against chronic diseases, early signs of disability and loss of life satisfaction.

**METHODS:** From 5663 healthy adult twin pairs 146 pairs were identified who were discordant for both intensity and volume of leisure physical activity in 1975 and 1981. Of them, both members of 95 pairs were alive and participated in our follow-up study in 2005 when different chronic diseases, life-satisfaction, disability and physical activity level were assessed by a structured telephone interview. Mean age of the participants was 58 years (range from 47 to 79 years) in 2005. Paired tests were used in statistical analyses.

**RESULTS:** Active co-twins had decreased risk of different chronic diseases with active MZ twins having significantly less often two or more chronic diseases than their inactive cotwins (OR=0.14,  $p=0.031$ ). Overall, the risk of type 2 diabetes or glucose intolerance (OR= 0.09,  $p=0.022$ ) and incident elevated blood pressure (OR=0.46,  $p=0.039$ ) was decreased among active cotwins. Active cotwins were more satisfied with their life at follow-up ( $p=0.047$ ), and tended to need less hospital care during the last three years of the follow-up ( $p=0.065$ ). In contrast, active co-twins showed a tendency of having more sports-related injuries (OR=1.9,  $p=0.051$ ), but signs of disability did not differ according to activity.

**CONCLUSIONS:** Physical activity may help in maintaining health and life satisfaction. However, genetic factors may play a role in explaining some of the association between disease occurrence and physical activity as some of the findings were more clear among physical activity discordant dizygotic than monozygotic twins.

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**2955 Board #102 May 30 9:30 AM - 11:00 AM**  
**Leisure Time Physical Activity And Body Fat: A Twin Study**

Tuija Leskinen<sup>1</sup>, Sarianna Sipilä<sup>1</sup>, Markku Alen<sup>2</sup>, Sulin Cheng<sup>1</sup>, Kirsi H. Pietiläinen<sup>3</sup>, Jussi-Pekka Usenius<sup>4</sup>, Harri Suominen<sup>1</sup>, Vuokko Kovanen<sup>1</sup>, Heikki Kainulainen<sup>1</sup>, Jaakko Kaprio<sup>3</sup>, Urho M. Kujala<sup>1</sup>. <sup>1</sup>*University of Jyväskylä, Jyväskylä, Finland.* <sup>2</sup>*University of Oulu, Oulu, Finland.* <sup>3</sup>*University of Helsinki, Helsinki, Finland.* <sup>4</sup>*Suomen Terveystalo Oyj, Jyväskylä, Finland.*  
(No relationships reported)

Exercise is thought to reduce body fat, but intervention studies are frequently limited by short follow-ups and observational studies by genetic selection. To tackle these problems, we carried out within-pair analyses in twin pairs identified on the basis of their long-term physical activity discordance. By studying both monozygotic and dizygotic twin pairs, we were able to control for childhood environment and partially for genetic liability as monozygotic co-twins share all and dizygotic co-twins on average half of their segregating genes.

**PURPOSE:** To study the effects of a physically inactive vs. active lifestyle on body fat in twin pairs discordant for physical activity for 32 years.

**METHODS:** Sixteen middle-aged (50-74 yrs) same-sex twin pairs (seven monozygotic, nine dizygotic) discordant for physical activity habits were comprehensively identified from the Finnish Twin Cohort ( $N=5663$  baseline healthy pairs). Discordance was initially defined in 1975 and the same co-twin remained significantly more active during most of the follow-up. At the end of the follow-up in 2007 a series of body composition measurements, including bioimpedance measurement of whole body fat and specific MR imaging, was carried out.

**RESULTS:** At the end of the follow-up the inactive co-twins weighed 6.5 kg more ( $P=0.12$ ) and had 6.0 kg more fat mass ( $P=0.015$ ) than their active co-twins, but no differences in fat-free masses were found. Visceral fat area was 50 % ( $P=0.010$ ), liver fat score 170 % ( $P=0.030$ ) and midhigh intramuscular fat area 48 % ( $P=0.034$ ) greater among the inactive co-twins. Similar trends were seen among both monozygotic and dizygotic pairs. The intrapair difference correlation between visceral and intramuscular fat was high ( $r=0.648$ ,  $P=0.009$ ).

**CONCLUSION:** Long-term habitual physical activity seems to protect from the accumulation of total, visceral and ectopic fat, even after partly controlling for genetic liability and childhood environment. Therefore the prevention of obesity should emphasize the role of regular leisure time activity.

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**2956 Board #103 May 30 9:30 AM - 11:00 AM**  
**Interaction Of Body Mass Index And Adiposity-related Gene Polymorphisms Influences Risk For Metabolic Syndrome**

Paul M. Gordon, FACSM<sup>1</sup>, Dongmei Liu<sup>1</sup>, Heather Gordish-Dressman<sup>2</sup>, Joseph M. Devaney<sup>2</sup>, Emilio Pistilli<sup>2</sup>, Theodore J. Angelopoulos<sup>3</sup>, Priscilla M. Clarkson<sup>4</sup>, Niall M. Moyna<sup>5</sup>, Linda S. Pescatello<sup>6</sup>, Richard L. Seip<sup>7</sup>, Paul S. Visich<sup>8</sup>, Robert F. Zoeller<sup>9</sup>, Paul D. Thompson<sup>7</sup>, Eric P. Hoffman<sup>2</sup>.  
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(No relationships reported)

Little is known of the interactions between genetic and environmental factors that may contribute to elevate one's risk of metabolic syndrome.

**PURPOSE:** To investigate the interactive effect of adiposity-related genotypes and Body Mass Index (BMI) on markers for metabolic syndrome.

**METHODS:** Young adult Caucasians from the FMS cohort (n= 370) were measured on the following metabolic phenotypes: fasting glucose (GLU), fasting insulin (INS) and HOMA-IR, and were genotyped for the following adiposity-related gene polymorphisms: TNFa (G308A), LEPR (A150124G), and RETN (C-179G, A-296G, C30T, A537C, G540A, C980G). Gender-specific ANCOVAs including age as a covariate and a genotype x BMI interaction term was performed on each metabolic phenotype. Significant interactions were evaluated by pairwise testing of the slopes for each genotype group.

**RESULTS:** A BMI x Genotype interaction for INS was found in males for RETN C-179G (G/G (n=18) vs. C/C (n=46), p=0.03 and C/G (n=56), p=0.005) and RETN A537C (A/A (n=108) vs. A/C (n=12), p=0.005). A BMI X Genotype interaction for GLU was found in males for LEPR (A/A (n=46) vs. GG (n=6), p=0.03 and A/G (n=33), p=0.03), RETN A-296C (A/A (n=108) vs. A/C (n=12), p=0.01) , RETN G540A (G/G(n=55) vs. G/A (n=53), p=0.02), and modestly in TNFA (G/G (n=83) vs. G/A (n=36), p=0.051). Only RETN C30T (C/C (n=242) vs. C/T (n=8), p=0.03) was identified in females. BMI X Genotype interactions for HOMA-IR were found only in males for RETN C-179G (G/G (n=18) vs. C/C (n=46), p=0.02 and C/G (n=56), p=0.003) and RETN A537C (A/A (n=108) vs. A/C (n=12), p=0.0006).

**CONCLUSIONS:** The interactive effects of BMI and adiposity-related gene polymorphisms on markers for metabolic syndrome suggest that the influence of excess body weight on risk of metabolic syndrome is not uniform in individuals with different genotypes. Additional research is needed to confirm these findings and further clarify those with heightened risk.

Supported by NIH-NINDS R01 NS40606-02

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**2957 Board #104 May 30 9:30 AM - 11:00 AM**  
**Vitamin D Receptor Genetic Variants And The Muscle Size And Strength Response To Resistance Training**

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**PURPOSE:** The present study examined associations among vitamin D receptor (VDR) polymorphisms and the muscle size and strength response to a unilateral, upper-arm resistance training (RT) program in healthy, young adults.

**METHODS:** Caucasian men (n=236) and women (n=356) were genotyped for three VDR single nucleotide polymorphisms: TAQI (rs7975232), BSMI (rs1544410), and FOKI (rs2228570). Subjects underwent a RT program of the non-dominant arm (trained, T) with the dominant arm (untrained, UT) as a comparison. Elbow flexor strength was measured with one repetition maximum (IRM) and maximum voluntary contraction (MVC), while cross-sectional area (CSA) was measured by magnetic resonance imaging in both arms pre- and post-RT. Phenotypes were analyzed using analysis of covariance with gender and genotype as fixed factors and body mass index and age as covariates.

**RESULTS:** CSA: In the T arm, men with the TAQI TT (22.4%) and CT (20.4%) genotypes had greater % CSA increases versus men with the CC genotype (15.0%) pre- to post-RT (p<0.05). IRM: In the T arm, women with the TAQI CC (76.1%) genotype experienced greater % IRM increases than women with the TAQI CT (61.1%) and TAQI TT (63.0%) genotypes pre- to post-RT (p<0.05). Pre-RT IRM of the T arm was lower among women with the FOKI AA genotype compared to women with the FOKI GG genotype (13.1 ± 0.5 vs 14.4 ± 0.3 kg, respectively) (p<0.05). However, women with the FOKI AA genotype gained more IRM strength (74.7%) in the T arm post-RT versus women with the FOKI GG (60.5%) genotype (p<0.05). MVC: Pre-RT MVC of the T arm was lower in men with the FOKI GG genotype than men with the FOKI GA and AA genotypes (129.4 ± 5.4 vs 146.1 ± 3.9 vs 141.4 ± 7.6 kg, respectively) (p<0.05). However, men with the FOKI GG (20.8%) genotype gained more MVC strength than men with the FOKI AA (11.1%) genotype in the T arm post-RT (p<0.05).

**CONCLUSIONS:** VDR SNPs contribute to gender-specific, individual variation in baseline muscle strength and gains in muscle strength and size resulting from RT. Potential mechanisms may be linked to differences in VDR genotype influencing skeletal muscle calcium uptake, cell proliferation, and/or differentiation.

Supported by a grant from the NIH (NINDS/NIA/NIAAMS/NS40606).

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**2958 Board #105 May 30 9:30 AM - 11:00 AM**  
**Body Fatness And Fitness Modulate The Associations Between The Gnb3 Genotype And Resting Blood Pressures In Korean Women**

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Unlike in Caucasians and black Africans, the relationships between the C825T allele variant in exon 10 of the G protein b3 gene (GNB3) and blood pressures are inconsistent in Asians.

**PURPOSE:** To investigate whether or not the GNB3 genotype is differently associated with resting blood pressures and body fatness across cardio/respiratory fitness (CRF) levels. **METHODS:** A total of 727 Korean women aged 31-60 years (mean age, 47.8±5.4 yrs old) voluntarily participated in the study. Body fatness and fitness and resting blood pressure were measured by using standardized protocols. The GNB3 genotype (C825T) was determined by using polymerase chain reaction-restriction fragment length polymorphism.

**RESULTS:** For the obese group with body mass index of ≥25 kg/m<sup>2</sup>, subgroup analyses showed that TT individuals were younger (P =0.049 & P=0.002, respectively) and had significantly higher values in body weight (P=0.006 & P=0.006, respectively) and BMI (P=0.002 & P=0.011, respectively) than CC and CT individuals. Further, TT and CT individuals tended to have higher values in CRF than CC individuals. Regression analyses showed that the relationships between the GNB3 genotype and resting blood pressures remained significant even after adjustments for age and menopause, but the relationships were no longer significant when additionally controlling for body fatness.

**CONCLUSION:** The findings of this study suggest that both body fatness and CRF might differently influence the genetic susceptibility of the GNB3 genotype to elevated resting blood pressures in middle-aged Korean women.

Supported by the Korean Research Foundation funded by the Korean Government (KRF-2005-042-G00025)

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**2959 Board #106 May 30 9:30 AM - 11:00 AM**  
**Actn3 Genotype Is Not Associated With Muscle Fatigue Performance**

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(No relationships reported)

The R577X polymorphism within the alpha-actinin-3 gene (*ACTN3*) has been associated with elite athletic performance, and more recently with muscle strength, muscle power, fat free mass, and adaptations to strength training, though inconsistencies exist in the literature. The specific skeletal muscle phenotypes most influenced by the polymorphism are uncertain.

**PURPOSE:** To examine the association between *ACTN3* R577X genotype and muscle fatigue performance phenotypes in young men and women.

**METHODS:** Forty-one healthy and recreationally active (less than 60 minutes of aerobic exercise per week, no lower body strength training) individuals (n=15 men; n=26 women), aged 18-30 yr. (mean: 22 yr.) participated in this study. Muscle fatigue performance was assessed using two **METHODS:** 1) a 30 repetition knee extension (KE) and knee flexion fatigue protocol on an isokinetic dynamometer at testing speeds of 180 deg/sec and 250 deg/sec, and 2) a 30 second Wingate Anaerobic Cycling Test (WAnT). Differences in absolute and relative peak power, peak torque, total work, and fatigue index were compared among *ACTN3* genotype groups.

**RESULTS:** Sample sizes for each genotype group were as follows: RR = 18; RX = 17; XX = 6. Isokinetic torque and WAnT cycling power values significantly decreased over the duration of each test (both  $P < 0.05$ ), but no significant differences were observed among *ACTN3* genotype groups. Similarly, no significant genotype differences (RR vs. RX vs. XX, respectively) were observed for: KE peak torque (180 deg/sec  $51.2 \pm 5.3$  vs.  $48.4 \pm 4.6$  vs.  $52.4 \pm 6.7$  Nm; 250 deg/sec  $29.3 \pm 2.8$  vs.  $30.7 \pm 3.8$  vs.  $33.2 \pm 8.4$  Nm); WAnT absolute peak power ( $613.8 \pm 53.7$  vs.  $598.5 \pm 61.0$  vs.  $677.6 \pm 103.9$  W); relative peak power ( $9.1 \pm 0.4$  vs.  $8.7 \pm 0.5$  vs.  $8.8 \pm 0.9$  W/kg); total work ( $11.1 \pm 1.1$  vs.  $9.9 \pm 1.2$  vs.  $12.0 \pm 1.4$  kJ); or fatigue index (WAnT  $62.3 \pm 1.5$  vs.  $63.9 \pm 2.2$  vs.  $58.9 \pm 4.2\%$ ).

**CONCLUSIONS:** The present results indicate that in recreationally active individuals the *ACTN3* R577X polymorphism is not associated with muscle fatigue performance phenotypes.

*This study was Supported by NIH grants AG022791 and AG00268.*

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**2960 Board #107 May 30 9:30 AM - 11:00 AM**  
**Visfatin Genotypes Influence Glucose And Obesity-related Variables And Their Aerobic Exercise Training Responses**

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(No relationships reported)

Previous research has linked the proposed adipokine visfatin and its gene (PBEF1) polymorphisms with glucose and obesity-related conditions; however, no one has examined them in connection with aerobic exercise training in generally healthy older individuals.

**PURPOSE:** To determine whether PBEF1 polymorphisms are associated with the response of glucose and obesity-related variables to aerobic exercise training.

**METHODS:** Following the completion of 6 wks of dietary stabilization, 116 healthy, sedentary, middle-aged, Caucasian men and women underwent 24 wks of aerobic exercise training. DEXA was used to assess body composition, and oral glucose tolerance testing was used to determine glucose and insulin response variables, including total area under the curve (AUC) and insulin sensitivity (IS), before and after 6 months of aerobic exercise training. TaqMan and RFLP assays were used to determine PBEF1 genotypes, and ANCOVA was used to test for differences between genotype groups.

**RESULTS:** There were several associations at baseline between glucose and obesity-related variables and the PBEF1 polymorphisms. The -4689 (rs2110385) TT genotype group had lower insulin AUC ( $p < 0.01$ ) and higher IS ( $p < 0.02$ ) values than the GG genotype group, whereas PBEF1 -1001 (rs9770242) G allele carriers had lower fasting insulin ( $p < 0.03$ ), lower body mass index (BMI;  $p < 0.02$ ), and higher IS values than the TT genotype group ( $p = 0.04$ ). Additionally, the -948 T allele carriers group had lower glucose AUC ( $p = 0.03$ ), lower insulin AUC ( $p < 0.02$ ), and higher IS values than the GG genotype group ( $p < 0.02$ ). Finally, the SER301SER (rs2302559) TT genotype group had lower fasting insulin ( $p < 0.02$ ), lower insulin AUC ( $p < 0.01$ ), and higher IS ( $p < 0.01$ ) values than the CC genotype group. The SER301SER polymorphism also influenced aerobic exercise training-induced changes in percent body fat ( $p < 0.02$ ) and BMI ( $p = 0.03$ ).

**CONCLUSIONS:** Our results suggest that variation at the PBEF1 locus is associated with baseline and aerobic exercise training-induced changes in glucose and obesity-related variables. Future studies need to address the physiological mechanisms and functional significance of visfatin polymorphic variation.

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**2961 Board #108 May 30 9:30 AM - 11:00 AM**  
**The Ace Gene I / D Polymorphism And Elite Swimmers**

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The influence of ACE gene on athletic performance has been widely explored. Most published data concern to a polymorphism in the presence (insertion, I allele) or absence (deletion, D allele) of a 287-bp in intron 16 that determines ACE levels in serum and tissues, heart cells included. A higher I allele frequency has been reported amongst elite endurance athletes and a higher D allele frequency amongst those engaged in more power-orientated sports. However, such associations has not been well clarified in swimming, particularly in pool competitions events, ranged between 50m to 1500m, or in longer duration trials, such in triathlon.

**PURPOSE:** To examine the role of ACE I/D amongst Portuguese elite swimmers and triathletes with diverse competitive distance specialization and compared to healthy control subjects.

**METHODS:** The study groups included 39 swimmers (22 male and 17 female,  $18.84 \pm 2.97$  years) and 25 triathletes (16 male and 9 female  $18.491 \pm 3.086$  years), both groups representing over than 75% of the elite Portuguese swimmers and triathletes (Olympic candidates). The athletes were stratified into 3 homogeneous groups based on sporting discipline and actual duration of their event: short duration athletes - SDA (between 50m and 200m swim events, predominantly anaerobic, swimmers, n=25); medium duration athletes - MDA (over 400m to 1500m swim events, mixed: anaerobic/aerobic, swimmers, n=14); long duration athletes - LDA (1500m and above swim events, predominantly aerobic, triathletes, n=25). A control group (n=100) was selected from the Portuguese population. Chelex 100® was used for DNA extraction and PCR-RFLP methods determined the genotype.

**RESULTS:** Significant differences were found between elite SDA and controls among DD genotype groups ( $P = 0.029$ ) and alleles (I/D) frequencies ( $P = 0.021$ ). In addition, there was a significant decrease in the frequency of the D allele with swimming distance increase: between SDA and MDA ( $P < 0.001$ ) and between SDA and LDA ( $P < 0.001$ ).

**CONCLUSIONS:** These data are consistent with an association between the D allele and short mainly anaerobic swimming events.

*Supported by the Portuguese Science and Technology Foundation (SFRH/BD/40243/2007).*

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**2962 Board #109 May 30 9:30 AM - 11:00 AM**  
**Angiotensin-I Converting Enzyme Genotype Does Not Strongly Correlate With Elite Endurance Athlete Status In Ethiopians**



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(No relationships reported)

There has been considerable interest over recent years in the use of the Angiotensin-I Converting Enzyme (ACE) gene as a marker of athletic performance. A previous study found no difference in ACE polymorphism between elite Kenyan endurance runners and demographically-matched controls (Scott et al. Comp Biochem Physiol A Mol Integr Physiol 141(2):169-175, 2005), a result that was somewhat surprising in view of contrasting findings in Caucasian populations.

**PURPOSE:** To investigate the association between ACE polymorphisms and elite endurance athlete status in Ethiopians.

**METHODS:** DNA was extracted from buccal swabs collected from 114 members of the Ethiopian national athletics team (E), 315 individuals representative of the general Ethiopian population (C), and 93 individuals from the Arsi region (A), where the majority of elite Ethiopian distance runners originate.

**RESULTS:** There were no significant deviations from Hardy-Weinberg equilibrium in athletes or controls. Ethiopian athletes did not differ significantly from general controls ( $P = 0.076$ ) or Arsi ( $P = 0.87$ ) in their ACE ID genotype frequencies (E: 16% II, C: 8% II, A: 13% II). The tendency towards significance in ID genotype frequency between athletes and general controls was not replicated in ACE 22982 genotype (E: 13% AA, C: 12% AA, A: 13% AA), where no significant differences were found (E vs C:  $P = 0.95$ , E vs A:  $P = 0.73$ ).

**CONCLUSIONS:** As previously shown in elite Kenyan athletes, the ACE genotype is not directly associated with elite endurance status in Ethiopians. The tendency towards significance in ID genotype frequency between athletes and general controls may be a reflection of the region of Arsi where the majority of Ethiopian athletes originate.

Research part-funded by The Royal Society, The Carnegie Trust for the Universities of Scotland, and The Wellcome Trust

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**2963 Board #110 May 30 9:30 AM - 11:00 AM**

**Physical Activity Ancestry Affects Body Composition Phenotypes And Gene Expression In Mice Offspring**

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(No relationships reported)

**PURPOSE:** To investigate the possible role of physical activity ancestry on body composition phenotypes and gene expression in multiple tissues (e.g., skeletal muscle, brain).

**METHODS:** We initiated a breeding program in Balb/C mice in which half of the first generation (F0) was subjected to voluntary wheel running for 12 weeks prior to breeding, with the second half of animals housed in sedentary conditions. The breeding pairs and pregnant females continued to have access to the running wheel. The resulting F1 pups of both groups were sacrificed at 10 wks without having an exercise exposure. A number of tissues were removed including gastrocnemius muscle and hippocampus.

**RESULTS:** The physically active animals successfully performed the intervention, running an average of 7 km/day (males) and 10 km/day (females) during the period leading up to breeding. The 10 wk-old F1 offspring with physical activity ancestry ( $n=6$ ) exhibited lower values for body weight (males:  $18.6 \pm 0.1$  vs.  $20.1 \pm 0.5$  g; females:  $23.6 \pm 0.3$  vs.  $25.8 \pm 0.4$  g), visceral fat pad mass (males:  $0.26 \pm 0.04$  vs.  $0.37 \pm 0.03$  g; females:  $0.30 \pm 0.08$  vs.  $0.58 \pm 0.18$  g), and gastrocnemius muscle mass (males:  $0.07 \pm 0.01$  vs.  $0.14 \pm 0.03$  g; females:  $0.11 \pm 0.02$  vs.  $0.16 \pm 0.01$  g) compared to F1 offspring with sedentary ancestry ( $n=7$ ). Higher levels of gastrocnemius muscle mRNA were observed for the *Ppargc1a* (PGC-1 $\alpha$ ) gene in the F1 offspring with exercise ancestry compared to F1 sedentary ancestry offspring. Similarly, higher levels of hippocampus mRNA were observed for the *Bdnf* gene in the F1 offspring with exercise ancestry compared to F1 sedentary ancestry offspring.

**CONCLUSION:** These preliminary data support the hypothesis that physical activity ancestry can affect both body composition and gene expression in mice offspring, with elevated expression of metabolic and neurotrophic genes compared to offspring of sedentary animals.

Funding was provided by the SPH Seed Grant Program and NIH AG00268.

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**2964 Board #111 May 30 9:30 AM - 11:00 AM**

**Gene Expression Analysis Of Peripheral Blood Following Resistance Exercise**

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**PURPOSE:** Phenotypic studies suggest a strong correlation between exhaustive resistance exercise and effects on the immune system. The goal of this study was to characterize the gene expression changes using Affymetrix microarrays during these exercise regimens and determine whether these expression changes correlate to standard differential blood counts or other immunophenotyping data.

**METHODS:** Ten resistance-trained male collegiate athletes between 20-24 yr of age ( $22.30 \pm 1.25$  yr) with at least 2 yr resistance training experience ( $5.00 \pm 2.31$  yr) performed an acute bout of RE for 30.59 min ( $\pm 0.59$ ). The RE included the back parallel squat and the leg press each at 45% & 55% of 1-RM for first 2 sets, and 65% of 1-RM for the remaining 4 sets. All exercises were performed with a 2.2 cadence followed by 2 min rest periods. Following a 12 hr fast, blood samples were collected at baseline, immediately following exercise, and at 2 hr postexercise. RNA was prepared by combining 3.75 ml of TriReagent BD to 1 ml of whole blood containing EDTA immediately after sampling and frozen at  $-80^{\circ}\text{C}$ . RNA was extracted using the standard blood method outlined by the manufacturer, analyzed for quality, and prepared for hybridization to an Affymetrix U133a 2.0 GeneChip using the NuGEN Ovation WB system.

**RESULTS:** Initial results of our microarray data indicate that, with high statistical significance, gene expression features are highly correlated with blood counts. Differentially expressed genes were statistically significantly associated with immune system function.

**CONCLUSION:** These data suggest that an acute bout of RE induced substantial changes in immune system function that was reflected in differential gene expression.

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**2965 Board #112 May 30 9:30 AM - 11:00 AM**

**Association Of Atrogin-1 Genotypes With Baseline Muscle Phenotypes**

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Atrogin-1 is an important regulator of the atrophy response pathway. It directs the breakdown of muscle protein in response to various conditions (ex. disuse, cancer, starvation), and it is down-regulated during the hypertrophy response. Consequently, it has strong potential as a modifier of muscle size and strength.

**PURPOSE:** To examine the effects of single nucleotide polymorphisms (SNPs) in the human Atrogin-1 gene on muscle size and strength and the response of these variables to a strength training program in a young, college-age population.

**METHODS:** We genotyped five Atrogin-1 SNPs (rs4871385, rs6990663, rs3739287, rs22891779, rs16898553) in a Caucasian population (446 females; 312 males; age  $24 \pm 8$  y) that participated in a 12 wk supervised resistance training program. Baseline muscle size (via MRI) and strength (isometric and 1-RM) were measured for each subject at the start of the study and again after the completion of the training program. Genotyping for the Atrogin-1 SNPs was performed using the TaqMan (Applied Biosystems) allele discrimination assay. Associations between the SNP and each phenotype were tested using ANCOVA with Sidak post-hoc tests. Each model included baseline body weight and age as covariates.

**RESULTS:** We found significant associations between Atrogin-1 SNPs and several muscle phenotypes. The most significant results were found in females with the rs2891779 SNP, which is located in the putative promoter region of the Atrogin-1 gene. Specifically, when a dominant model was applied, females having 1 or 2 copies of the A allele had significantly higher baseline isometric strength, torque, and muscle quality than those who were homozygous for the G allele. These same associations were seen in both the dominant and non-dominant arms.

**CONCLUSIONS:** This data suggests that the Atrogin-1 rs2891779 SNP influences baseline muscle strength, torque, and muscle quality in females, which may indicate a sex-specific effect for this SNP. The location of this SNP in the promoter region of Atrogin-1 suggests that it may exert its influence through regulation of Atrogin-1 expression. This data contributes additional insight to the complex genetic milieu that affects muscle size and strength.

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**2966 Board #113 May 30 9:30 AM - 11:00 AM**  
**The Physical Fitness Is Associated With Pgc-1 Gene Gly482ser Polymorphism In Japanese Elderly.**

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(No relationships reported)

Mitochondria are predominant organ to provide ATP to working muscle during endurance exercise. The muscle mitochondrial content and function could be influence endurance performance. PGC-1 $\alpha$  plays as a stronger activator of mitochondrial biogenesis, thus, the activation of PGC-1 $\alpha$  expression could be key factor to improve a physical fitness. Muscle PGC-1 $\alpha$  and PGC-1 $\beta$  gene expression are affected by the Gly482Ser gene polymorphism. The PGC-1 gene Gly482Ser polymorphism could influence muscle mitochondrial content and function, the gene polymorphisms determine human physical fitness.

**PURPOSE:** To determine whether the PGC-1 gene Gly482Ser polymorphism affects physical fitness and trainability in Japanese elderly.

**METHODS:** Two hundreds forty six subjects (96 men and 150 women) were participated in cross sectional study. In 184 subjects (75 men and 109 women) carried out exercise training for 12 weeks at lactate threshold (LT) intensity. The LT intensity was evaluation as physical fitness. Values were compared by ANCOVA and Tukey-Kramer. Age, baseline of LT and training volume were adjusted.

**RESULTS:** The distributions of Gly482Ser polymorphism are in Hardy-Weinberg equilibrium (Gly/Gly: 62, Gly/Ser: 129, Ser/Ser: 55 in cross sectional study, Gly/Gly: 46, Gly/Ser: 94, Ser/Ser: 44 in training study). The age, men-women ratio, height, weight and training time were no significant difference among the genotypes. Physical fitness is significantly higher in Gly/Gly+Gly/Ser ( $4.7 \pm 0.9$  METs) than Ser/Ser ( $4.4 \pm 0.9$  METs) in cross sectional study and baseline of training study (Gly/Gly+Gly/Ser:  $4.8 \pm 0.9$  METs, Ser/Ser:  $4.4 \pm 0.9$  METs). However, the training effect of physical fitness is no significant difference among the genotypes.

**CONCLUSION:** The PGC-1 gene Gly482Ser polymorphism is weakly influence physical fitness in Japanese elderly.

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**2967 Board #114 May 30 9:30 AM - 11:00 AM**  
**Aquaporin-1 Gene Polymorphism Association With Acute Body Fluid Loss In Long Distance Runners**

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(No relationships reported)

Intrinsic body fluid regulation is critical for optimizing endurance performance. Aquaporins (AQPs) are a family of transmembrane proteins that transport water and glycerol across cellular membranes. A recent report (MSSE 37(5): S164, 2005) revealed an association between a single nucleotide polymorphisms (SNP) in the Aquaporin-1 (AQP1) gene and endurance performance.

**PURPOSE:** This study explored the association between the AQP1 SNP and acute body fluid loss in long distance runners.

**METHODS:** The subjects (N = 91, Age =  $26 \pm 3$  yrs; Ht =  $170 \pm 11$  cm; Wt =  $61 \pm 5$  kg) were biologically unrelated male long distance runners. Data were collected before and after an international 10km road race. Body fluid loss was determined by the difference between "naked weights" before and after the 10km run. The AQP1 (G  $\rightarrow$  C) gene variation was detected by the tetra-primer Amplification Refractory Mutation System Polymerase Chain Reaction (ARMS-PCR) procedure. Genotypes were determined by PCR product size.

**RESULTS:** The three expected genotypes for the AQP1 were observed and consistent with a Hardy-Weinberg equilibrium. Carriers of the AQP1 SNP had a significantly greater adjusted body fluid loss ( $3.7 \pm 0.9$  kg) than non-carriers ( $1.5 \pm 1.1$  kg) ( $P < 0.05$ ). No significant associations were observed between genotypes ( $P > 0.05$ ).

**CONCLUSION:** Our study supports the notion of an association between the AQP1 SNP and acute body fluid loss in long distance runners. :

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**2968 Board #115 May 30 9:30 AM - 11:00 AM**  
**Relationships Of Ace Gene Polymorphisms To Experience And Physiological Parameters In Cross Country Runners**

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(No relationships reported)

**PURPOSE:** To evaluate the relationships of angiotensin converting enzyme (ACE) gene polymorphisms to experience and physiological parameters in cross country runners. A diploid gene with two alleles located on chromosome 17 codes for ACE. The ACE I allele has an insertion of a 287 base pair fragment and the ACE D allele has an absence of this fragment. The enzyme coded by the ACE I allele has been shown to be slightly less efficient at converting angiotensin I into angiotensin II than the enzyme expressed by the ACE D allele.

**METHODS:** Thirty-nine males and 49 females participating in a cross country camp performed standard Wingate Anaerobic Tests to evaluate lower body anaerobic power (AnP-L), performed modified Wingate Anaerobic Tests to evaluate upper body anaerobic power (AnP-U), and performed graded exercise tests on a motor driven treadmill to determine maximal oxygen consumption (VO<sub>2</sub>MAX). The DNA sample was obtained from using a buccal swab, and the polymerase chain reaction was based on the technique

of Lindpaintner, Pfeffer, Kreutz and Stampfer.

**RESULTS:** The subjects ranged in age from 12 to 19 years (15.33±1.39 years). Thirteen subjects were I/I, 40 subjects were I/D and 33 subjects were D/D. Years of experience was highest for the I/I runners (3.50±2.78 yrs) followed by the I/D runners (2.71±1.68 yrs) and lowest for the D/D runner (1.94±1.61 yrs). No significant differences by ACE genotype were found for peak or average AnP-L or peak or average AnP-U (6.78±1.46 W/kg, 5.39±1.19 W/kg, 1.93±0.59 W/kg, 1.50±0.48). No significant differences by ACE genotype were found for VO<sub>2</sub>MAX (3.42±0.85 L/min, 60.12±9.99 ml/kg/min), duration of the graded exercise test (10.70±1.40 min), or maximal heart rate achieved during the graded exercise test (193.02±8.28 bpm) which was slightly lower than the maximal heart rate predicted by 200 - age (204.62±1.26).

**CONCLUSIONS:** The results for VO<sub>2</sub>MAX contrast with the results of other studies of endurance athletes, including a study of elite bicycle racers in this laboratory. High school cross country runners may not be properly challenged in training and/or competition to obtain the benefits of the I/I and I/D genotypes in contrast to collegiate and elite endurance athletes.

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**2969 Board #116 May 30 9:30 AM - 11:00 AM**

**Androgen Receptor Gene Repeat Polymorphism, Leptin And Fat Mass In Young Men And Women**

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(No relationships reported)

The exon-1 of the androgen receptor (AR) gene contains two length polymorphisms which modify either the amount of AR protein inside the cell (GGN<sub>n</sub>, polyglycine) or its transcriptional activity (CAG<sub>n</sub>, polyglutamine). Shorter CAG and/or GGN repeats provide stronger androgen signaling, and vice versa. On the other hand, androgen levels are inversely associated with fat mass.

**PURPOSE:** To test the hypothesis that CAG and GGN repeat AR polymorphism influences body fat and serum leptin concentrations.

**METHODS:** The length of CAG and GGN repeats was determined by PCR and fragment length analysis, serum leptin concentration by ELISA, and fat mass with DEXA in 282 men (28.6 ± 7.6 years) and 61 women (25.5 ± 6.7 years). All subjects were healthy and physically active. Individuals were grouped as CAG short (CAG<sub>s</sub>) if harboring repeat lengths of ≤21 in men and ≤22 in women, and CAG long (CAG<sub>L</sub>) if CAG >21 in men and >22 in women. GGN was considered short (GGN<sub>s</sub>) or long (GGN<sub>L</sub>) if GGN ≤23 or >23 in men and women.

**RESULTS:** There was no relationship between GGN and CAG repeat length and serum leptin concentration neither in women nor men. CAG<sub>s</sub> and CAG<sub>L</sub> groups had similar leptin concentrations, and GGN<sub>s</sub> and GGN<sub>L</sub> groups as well. There was no relationship between CAG repeat length and whole body fat mass, percentage of fat mass accumulated in the trunk region and percentage of body fat neither in men nor women. The GGN repeat length was not associated to fat mass or to the percentage of body fat in men. However, in women, there was a linear relationship between the length of GGN repeat microsatellite and the percentage of body fat (% fat=2.16xGGN -21.73, r=0.31, P<0.05) and a trend for a similar relationship between whole body fat mass and GGN repeat length (fat mass (kg) = 1.41xGGN - 14.97, r=0.22, P=0.09). No association between CAG or GGN repeat length and trunk fat accumulation was observed.

**CONCLUSIONS:** A long repeat GGN polymorphism is positively associated with increased percentage of body fat in physically active young women.

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**2970 Board #117 May 30 9:30 AM - 11:00 AM**

**The Heritability Of Consistent Leisure Time Physical Activity And Inactivity In The Finnish Twin Cohort**

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(No relationships reported)

Understanding the genetic regulation of physical activity/inactivity is important in tailoring effective ways to promote physical activity. Previous twin studies have shown that genes play an important role in explaining individual differences in exercise participation at a given moment in life. To the present there is little knowledge on possible genetic influences on sustained behaviors over time.

**PURPOSE:** To examine the role of genetic and environmental factors explaining individual differences in consistent leisure time physical activity and inactivity in both males and females.

**METHODS:** This investigation is part of the Finnish Twin Cohort study. Data was available from two occasions: years 1975 and 1981. We analyze the total leisure time physical activity in metabolic equivalent units (MET index) utilizing a 2 MET-hours/day threshold. Persons with a MET index ≥2M-hours/day in 1975 and 1981 were categorized as "consistently active" while those persons with a MET index <2M-hours/day were "consistently inactive". The total numbers of twins analyzed were 1840 MZ and 4366 DZ males, 2200 MZ and 4403 DZ females. We analyzed genetic and environmental influences on both consistent activity and inactivity by fitting structural equation models to raw dichotomous data utilizing biometric methods.

**RESULTS:** 36% of the males and 31% of the females were consistently active, while 30% of the males and 31% of the females were consistently inactive. The results from the model fitting analyses indicated that the heritability for consistent physical activity was 45% (95% CI 39 to 51%) for males and females, while the heritability for consistent inactivity was 53% (44 to 60%) for males and 38% (28 to 40%) for females.

**CONCLUSION:** The heritability estimates for consistent physical activity were moderate and in the range of those reported earlier for physical activity at a given occasion. Interestingly, estimates of genetic influences for consistent inactivity for males and females differed being higher for males than for females. Environmental influences, such as social factors, seemed to be more important for women to remain sedentary. These findings can be used by public health promoters to understand the gender differences to promote physical activity habits within sedentary populations.

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**G-20 Free Communication/Poster - Injury - Athletes**

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

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**2971 Board #118 May 30 8:00 AM - 9:30 AM**

**Exercise Associated Hyponatremia And Weight Change: When Should The Athletes Be Weighed?**

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(No relationships reported)

Exercise associated hyponatremia (EAH) is a potentially fatal complication of endurance event participation and is difficult to diagnose. Most participants with EAH present with a weight gain after the event. Weighing athletes before and after a race would provide objective data as part of a screening program. Logistically, weighing athletes immediately before a morning race is difficult.

**PURPOSE:** To determine if the timing of weight measurement before a marathon affects the performance of using weight change as a screening test.

**METHODS:** As part of the 2008 Houston Marathon Hydration Initiative, all registered marathon runners were encouraged to be weighed at packet pick up, which was held 1-2 days before the race (EXPO). Weights were measured on 92% of the runners (5358/5824 starters) in regular clothes with empty pockets. One pound was subtracted from the registered weight to account for differences from standard running attire. Digital scales were used for all weight measurements and were calibrated on the morning prior to use. 90 participants were weighed on the morning of the race (PRE) and 1757 athletes (30% of finishers) were weighed after the race (POST). 37 contestants had all three measurements. Athletes were considered at risk for EAH if they did not lose weight during the marathon. The weight change from the PRE to POST was considered the gold standard with the EXPO to POST as the experimental test. Bland Altman analysis was used to evaluate the correlation between weight difference measurement techniques. Tolerable limits of agreement were set at 4.4 pounds based on previous EAH studies.

**RESULTS:** The sensitivity was 100% and specificity was 94% when determining weight gain or weight loss of the participants. The Positive Predictive Value was 50% and Negative Predictive Value was 100%. The average difference of weight loss from the EXPO and PRE subtracted from the POST was -0.16 pounds + 2.67. Analysis of plot demonstrated that approximately 95% were within tolerable limits.

**CONCLUSION:** Determining weight change from the difference between a post-race weight and a weight taken 1-2 days prior to the marathon is adequate as a screening test for weight gain during a marathon. This may be useful as part of a screening process for EAH.

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**2972 Board #119 May 30 8:00 AM - 9:30 AM**  
**Relation Between Lower Limb Alignment And Injury In Runners With Achilles Tendinopathy**

Liane B. Azevedo<sup>1</sup>, Mike I. Lambert<sup>2</sup>, Christopher L. Vaughan<sup>2</sup>, Martin P. Schwellnus, FACSM<sup>2</sup>. <sup>1</sup>*University Worcester, Worcester, United Kingdom.*  
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(No relationships reported)

Although there is limited support from the literature, static lower limb alignment has been proposed as an intrinsic risk factor to running injuries. However, most of the studies have investigated a group of injuries and there is limited evidence on specific injuries.

**PURPOSE:** The aim of this study was to examine the relation between lower limb static measurements and Achilles Tendinopathy injury.

**METHODS:** Thirty four injury free runners (CON) (19 males:15 females; weight: 67.8±10.5 kg; height: 1.71±0.09 m; age: 37.0±9.2 years) and twenty one runners with Achilles tendinopathy (AT) (18 males:7 females; weight: 77.6±12.6 kg; height: 1.78±0.07 m; age: 41.8± 9.7 years) were selected for this study. The following lower limb static measurements were performed on both legs: rearfoot alignment, pronation angle at 45 degrees, Q angle, standing foot angle, navicular drop, forefoot alignment, subtalar joint passive range of motion for eversion and inversion, knee range of motion, functional foot type, knee alignment and leg length. The data of the left and right side were compared between groups and the afflicted side was compared to a random side of the uninjured group, matched with the percentage of left and right foot equal to the injured group. The relationship between lower limb alignment and the incidence of injury was evaluated by calculating 95% confidence interval (95% CI) for the difference between the mean measures in the injured and non-injured runners.

**RESULTS:** None of the anthropometrical variables of the right leg and injured limb versus the matched limb from uninjured group were considered significant discriminator between injured and uninjured runners. However, on the left side subtalar joint passive range of motion for eversion (STJE) and knee range of motion (KROM) were considered significant discriminators between the two groups (CON: 8.73±5.51; AT: 6.00±3.65, 95% CI -0.49 to 0.00; CON: 140.1±8.1; AT: 135.6±5.8, 95% CI -0.51 to -0.04).

**CONCLUSIONS:** Although subtalar joint passive range of motion for eversion and knee range of motion were significantly lower in runners with Achilles injury, this result was not replicated for the right leg and on the injured versus matched leg. We can therefore conclude that static lower limb alignment is not associated with Achilles Tendinopathy.

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**2973 Board #120 May 30 8:00 AM - 9:30 AM**  
**The Landing Error Scoring System Predicts Non-contact Injury In Youth Soccer Players**

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(No relationships reported)

Non-contact lower extremity injuries, such as anterior cruciate ligament (ACL) sprains, are common and costly. Understanding the risk factors associated with these injuries is critical for developing prevention strategies.

**PURPOSE:** To prospectively compare movement measured by a clinical movement analysis tool between youth subjects who sustain an ACL or other non-contact movement injury and those who do not become injured.

**METHODS:** Subjects (males: n=138, age=14±2 years, height=163±14 cm, mass=51±15 kg; females: n=160, age=14±2 years, height=162±9 cm, mass=51±10 kg) were recorded with videography while they performed three trials of a jump landing task prior to three consecutive soccer seasons. The videography was assessed using the Landing Error Scoring System, which uses a binary system based on landing characteristics including knee flexion and valgus, trunk flexion, and stance width. A higher LESS score indicates a greater number of errors committed. The average LESS score across the three trials was used for the analyses. Subjects were monitored for injury during each season. A non-contact lower extremity injury was defined as an injury if it occurred during physical activity, resulted in time lost from soccer, and did not involve direct contact between the injured body part and another player or object. Separate linear regression models evaluated the relationships between LESS score and ACL or other injury status (injured or uninjured) after controlling for age group (high school or pre-high school) and sex.

**RESULTS:** Six subjects sustained an ACL injury and 45 subjects sustained other non-contact injuries. There was a significant association between LESS score and ACL injury status ( $F_{(3, 252)}=5.19$ ,  $p=0.002$ ,  $R^2=0.06$ ) and between LESS score and other injury status ( $F_{(3, 297)}=3.87$ ,  $p=0.01$ ,  $R^2=0.04$ ). Individuals with an ACL injury (LESS: 5.4±2.1) and other injuries (LESS: 4.5±2.0) scored higher on the LESS, indicating worse landing technique, compared to those who did not sustain an injury (LESS: 4.0±1.7).

**CONCLUSION:** The LESS is a clinical movement analysis tool that appears to identify individuals with a higher risk of injury, which may enhance the ability to screen large numbers of subjects and target them for injury prevention movement training.

*Supported by the National Academy of Sports Medicine*

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**2974 Board #121 May 30 8:00 AM - 9:30 AM**  
**Injury Rates On Fieldturf And Natural Grass For High School Football And Soccer.**

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**PURPOSE:** Few studies have compared injury rates on natural grass and FieldTurf surfaces, especially in interscholastic sport populations. Prior studies have not reported differences in injury rates between FieldTurf and natural grass during practice and games in football and soccer. The purpose of our study was to compare the incidence of injury in high school football and soccer on natural grass and FieldTurf surfaces.

**METHODS:** A total of 539 athletes who participated on eight boys' football (283 boys) and sixteen soccer (131 boys, 125 girls) teams in Western Washington were followed between the 1998 to 2001 interscholastic seasons for injury occurrence on FieldTurf and natural grass surfaces. All injuries were reported and verified by an athletic trainer/physical therapist. Injury rates were calculated per 1,000 athletic exposures.

**RESULTS:** Injury rates on natural grass were significantly higher on FieldTurf for football ( $p<0.0001$ ) and girls' soccer ( $p=0.0005$ ). Injury rates were significantly higher on natural grass than FieldTurf for practices and games for football ( $p<0.0001$ ) and girls' soccer ( $p=0.008$ ). No significant differences were found between natural grass and FieldTurf in head-related trauma for football players ( $p=0.55$ ). For other body locations, higher rates of knee injury for football ( $p=0.002$ ) and ankle injury for girls' soccer ( $p=0.01$ ) occurred on natural grass compared to FieldTurf. By injury type, higher rates of sprains for girls' soccer ( $p=0.03$ ) and strains for football ( $p=0.003$ ) occurred on natural grass compared to FieldTurf. By position, for football, higher rates of injury occurred on natural grass than FieldTurf for lineman ( $p<0.0001$ ) and defensive backs ( $p=0.03$ ). For girls' soccer, defenders had higher rates of injury on natural grass than FieldTurf ( $p=0.006$ ).

**CONCLUSION:** The results of this study suggest that a new generation of synthetic turf, FieldTurf, may lower the risk of injury in football and girls' soccer at the high school level. Further studies are needed to compare the risk of injury between the two surfaces in other high school sports like field hockey or lacrosse that also play on these field surfaces.

Keywords: FieldTurf, injuries, prospective, high school

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**2975    Board #122    May 30    8:00 AM - 9:30 AM**  
**Sex-by-weapon Variations In Type And Location Of Time-loss Injuries In Competitive Fencing**

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Recent research has indicated that the risk of time-loss injury in competitive fencers is low. However, little is known about sub-group differences in injury characteristics in this population.

**PURPOSE:** To examine the sex-by-weapon variation in type and location of time-loss injuries in national fencing competitions.

**METHODS:** Data from a prospective, 5-year study of the United States Fencing Association were analyzed. Information on the number, sex, and event distribution of participants was compiled from official entry lists for the 2001-2006 seasons. Injury details were obtained from the competition medical records. Exposure data were derived from official score sheets and calculated as the combined number of bouts in pool play and direct elimination for each event. Each bout represented two (2) athlete exposures (AE). Injury type and location data were standardized to #/1,000 AE across six sex-by-weapon sub-groups.

**RESULTS:** A total of 78,223 competitors were involved. One hundred eighty four (184) time-loss injuries were recorded (Men: foil=35, epee=29, sabre=34; Women: foil=33, epee=23, sabre=30). The patterns of injury type and location in each sex-by-weapon group reflected the overall characteristics of time-loss injuries (predominantly sprains and strains in the lower extremities) but sub-groups differences were evident: a) Type: Male sabre fencers had 2.0-2.5 times greater risk of sprain than foil or epee fencers; Female foil and sabre fencers had 2.0 greater risk for sprains than epee fencers; Female sabre fencers had 5.0 times greater risk for puncture wounds than foil or epee fencers, b) Location: Male sabre fencers had 1.8-3.2 greater risk for knee injury and 4.2-4.8 greater risk for foot injury than epee or foil fencers; Female sabre fencers had 8.1-10.0 greater risk for hand injury than those in epee or foil. Female foil fencers had 4.0-6.0 greater risk of knee injury compared to epee or sabre fencers.

**CONCLUSIONS:** The overall rate of time-loss injury in competitive fencing is low but there are important sex-by-weapon differences in the rates of specific injury types and locations. Identifying these variations is fundamental to understanding the mechanisms by which they occur and developing effective interventions to further reduce the risk of time-loss injuries in fencing.

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**2976    Board #123    May 30    8:00 AM - 9:30 AM**  
**Mechanisms And External Causes Of Injuries Among Patients At A Ski And Snowboard Resort Clinic**

Stuart E. Willick, Christina A. Porucznik, Dutch M. Plante, Matthew S. Thiese, Elizabeth A. Joy, FACSM. *University of Utah, Salt Lake City, UT.*  
(No relationships reported)

**BACKGROUND:** We are developing a multi-center, long-term injury surveillance system for ski and snowboard injuries and have collected two years of pilot-scale data at a single resort. We retrospectively reviewed all injuries seen at a single medical clinic located at the base of a mountain resort. An analysis of two aspects of these injuries \_ spine injuries and listening to music as an external cause \_ is presented here. Our longer term goal is to use surveillance data to identify mechanisms of injury and devise and test injury prevention interventions.

**PURPOSE:** To quantify and describe the injuries seen at one clinic during the 2007-2008 winter season, accounting for patron load with emphasis on spinal injuries and listening to music.

**METHODS:** Medical records and ski patrol report forms were analyzed for N=1,639 patients seen at a mountainside clinic between November 2007 and April 2008.

**RESULTS:** Median age of all patients was 22 years with males younger than females ( $p<0.05$ ) and helmet use more common among younger patients ( $p<0.001$ ). Injured snowboarders (mean=21 years) were younger than injured skiers (34 years) ( $p<0.001$ ) and had increased odds (OR=1.5) of spinal injury, but were more likely to be wearing a helmet (OR=1.4) ( $p<0.05$ ). Several mechanisms were associated with increased odds of spinal injury compared to the most common mechanism of 'catching an edge' including: out of control (OR=2.4), landing short (OR=2.8) or long (OR=6.9) off of a jump, and hit by a snowboarder (OR=6.3). Patients injured in a terrain park were younger (20 vs. 29 years), more likely to be male (OR=5.3), and listening to music (OR=4.8) than those injured elsewhere. ( $p<0.001$ ). Snowboarders comprised 70% of patients injured in a terrain park. Patients listening to music when injured were younger (23 vs. 28 years) and more likely to be snowboarding (OR=2.9) than those patients not listening to music ( $p<0.001$ ).

**CONCLUSIONS:** Reported results are limited to patients seen in clinic. Without denominator data, rates cannot be calculated. Demographics and behaviors can predict risk of some injuries. Modifiable factors such as skill level and concomitant distractions affect risk of injury. Surveillance is ongoing. We will begin data collection using an electronic medical record for the 2008/9 season.

**ACKNOWLEDGMENTS:** Utah Sports Research Network.

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**2977    Board #124    May 30    8:00 AM - 9:30 AM**  
**A Detailed Survey of Injuries Sustained in Short Track Speed Skating Competition.**

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(No relationships reported)

**PURPOSE:** The purpose of this study was to document injuries sustained by participants in Short Track speed skating competition. These data provide insight into the demographics of injured participants, the circumstances, conditions and mechanisms of injury associated with the sport, and the relative risk to competitors.

**METHODS:** Using a standardized report form, detailed injury data were obtained by medical personnel at nine State, National or International Short Track competitions. Data included competitor demographics, injury type, region and severity, relevant previous history, treatment and outcomes, as well as injury mechanisms, circumstances, ice conditions and track position.

**RESULTS:** Over the course of nine competitions, 53 participants sustained 59 injuries requiring medical evaluation or treatment, representing an injury risk of 3.2% per athlete per competition. Most injuries were classified as minor or moderate (each 39%) and 22 % were severe. By region, most injuries were to extremities (59%) followed by thoracic or lumbar spine (14%) and head/neck (27%). By type, the highest percentage injuries were lacerations (25%) followed by contusions (22%) cervical, thoracic or lumbar strain or sprain (17%) and extremity strain or sprain (17 %). Injuries were most likely to occur during passing maneuvers on a narrow track position.

**CONCLUSIONS:** Based on our findings, Short Track speed skating is a relatively safe sport at all levels. While severe injury is possible, most injuries are minor, with little time lost from participation. Appropriate rink padding and cut-resistant suits are critical in prevention of serious injury. To our knowledge, this study represents the first analysis of injuries sustained in Short Track speed skating competition.

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## G-21 Free Communication/Poster - **Metabolic Syndrome**

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

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### 2978 Board #125 May 30 8:00 AM - 9:30 AM

#### **Carotid Intima-media Thickness, Dietary Intake And Cardiovascular Phenotypes In Adolescents: Relation To Metabolic Syndrome**

Daniel M. Croymans, B.S.<sup>1</sup>, Jacques D. Barth, M.D. Ph.D.<sup>2</sup>, Albert Sanchez, M.D.<sup>3</sup>, Christian K. Roberts, Ph.D., FACSM<sup>1</sup>. <sup>1</sup>UCLA, Los Angeles, CA. <sup>2</sup>Vasstech Foundation, Santa Monica, CA. <sup>3</sup>Pacific Health Education Center, Bakersfield, CA.

(No relationships reported)

**PURPOSE:** We assessed the association of carotid intima-media thickness (cIMT) with metabolic syndrome (MS), dietary intake and other cardiovascular phenotypes in adolescents using nonparametric exploratory analysis.

**METHODS:** 249 adolescents from three high-schools in Central California, a predominately Hispanic (N=119, 16.1±0.9 yrs), a predominately Caucasian (N=94, 15.7±1.2 yrs), and a 7<sup>th</sup> Day Adventist (7DA) (N=33, 17.0±1.3 yrs) high-school were assessed for cIMT, total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglycerides, uric acid, blood glucose, systolic and diastolic blood pressure (SBP and DBP), body mass index (BMI), and food frequency questionnaire based dietary intake. Significance was set to  $\alpha < 0.01$ .

**RESULTS:** Compared to 7DA, the predominately Hispanic and Caucasian high-schools exhibited higher LDL and BMI percentile, while 7DA and the Caucasian high-school exhibited lower uric acid and fasting glucose levels than the Hispanic high-school. Both Hispanic and Caucasian high-schools consumed more protein, meat and dietary cholesterol and less dairy products; the Hispanic high-school consumed fewer fruit/vegetables than 7DA. In all subjects, BMI percentile was positively correlated with total cholesterol ( $\rho = 0.28$ ), LDL ( $\rho = 0.34$ ), uric acid ( $\rho = 0.31$ ), triglycerides ( $\rho = 0.37$ ), SBP percentile ( $\rho = 0.33$ ), DBP percentile ( $\rho = 0.30$ ) (all  $p < 0.0001$ ), and glucose ( $\rho = 0.18$ ,  $p < 0.004$ ), and negatively correlated with HDL percentile ( $\rho = -0.31$ ,  $p < 0.0001$ ). Uric acid correlated with total fat intake ( $\rho = 0.25$ ), dietary cholesterol ( $\rho = 0.35$ ) and meat consumption ( $\rho = 0.33$ ) (all  $p < 0.001$ ). cIMT was only weakly correlated with SBP percentile ( $\rho = 0.20$ ,  $p < 0.01$ ) and uric acid ( $\rho = 0.20$ ,  $p < 0.003$ ). Despite no significant differences in the high-school frequency of MS risk factors, 58.6% of adolescents had 1 or more MS risk factor. Adolescents with MS exhibited higher uric acid levels compared to those without MS ( $p < 0.007$ ).

**CONCLUSION:** A majority of adolescents presented MS risk factors independent of ethnicity or a purportedly healthier lifestyle (7DA). Uric acid positively correlated with cIMT, BMI percentile, MS and dietary factors suggesting its potentially heightened importance for the assessment of adolescent cardiovascular health.

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### 2979 Board #126 May 30 8:00 AM - 9:30 AM

#### **Does Metabolic Syndrome Cause Arteriosclerosis In Japanese Children?**

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(No relationships reported)

Information on whether metabolic syndrome (MS) is involved in development of arteriosclerosis in children is sparse. Small, dense low-density lipoprotein (LDL) particle size and level of high sensitive C-reactive protein (hsCRP) are known to be novel markers characterizing the atherosclerotic process at an early stage.

**PURPOSE:** To examine the relationship between MS and early arteriosclerosis in childhood, we compared LDL size and hsCRP level among obese children with MS, normal and non-obese children without MS.

**METHODS:** The subjects were 67 Japanese children (32 non-obese, 35 obese) aged 7.0-12.6 yrs. Obesity was determined upon an obesity index score ((real weight - standard weight) / standard weight × 100) of more than +20%. Fasting levels of LDL size, hsCRP, glucose, insulin, lipid profile, and blood pressure were determined. Insulin resistance was quantified by the homeostatic model assessment (HOMA) index. Visceral fat area (cm<sup>2</sup>) was determined by magnetic resonance imaging. Obese children were grouped into with (n=5) and without (n=30) MS. MS was determined upon abdominal obesity (waist circumference: ≥75 cm) plus at least two other factors from elevated triglyceride (TG, ≥120 mg/dl), low high-density lipoprotein-cholesterol (HDL-C, <40 mg/dl), high systolic or diastolic blood pressure (≥125 or ≥70 mmHg), and fasting glucose (≥100 mg/dl) as per criteria newly established by a task force financed by the Ministry of Health, Labor and Welfare, Japan. Statistical treatment comprised ANOVA followed by Tukey's honestly significant difference adjustment for multiple comparisons.

**RESULTS:** Obese children with MS had significantly smaller LDL size and higher hsCRP level than normal and obese children without MS ( $p < 0.05$ ). No differences between normal and obese children without MS were observed for LDL size or hsCRP level. Obese children with MS showed higher TG, insulin, HOMA index, blood pressure, visceral fat area, and lower HDL-C than normal and obese children without MS ( $p < 0.05$ ).

**CONCLUSIONS:** Our findings suggest that metabolic syndrome more than obesity per se may be involved in early arteriosclerosis in children.

Supported by Grant-in-Aid for Young Scientists (B) (No.20700562) from Japan's Ministry of Education, Culture, Sports, Science and Technology.

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### 2980 Board #127 May 30 8:00 AM - 9:30 AM

## Exercise And The Metabolic Syndrome With Weight Regain

Tom R. Thomas, Shana O. Warner, Ying Liu, Melissa A. Linden, Pam S. Hinton, R Scott Rector, Kevin C. Dellsperger, Anand Chockalingam, Adam T. Whaley-Connell, John P. Thyfault, David R. Huyette. *University of Missouri, Columbia, MO.*

(No relationships reported)

**PURPOSE:** Metabolic syndrome (MetS) risk factors are improved with weight loss, but most individuals regain the weight. The primary aim was to determine if exercise training is effective in maintaining improvements in MetS risk factors during weight regain.

**METHODS:** Sixty-three overweight or obese (25.0-39.9 kg/m<sup>2</sup>) men and women (39±1y), with characteristics of the MetS, targeted 10% weight loss with individually prescribed and supervised walking/jogging exercise at 60% VO<sub>2</sub> max (-400 kcal/session), 5d/wk, and caloric restriction (-600 kcal/d) over a 4-6 mo period. Each subject met weekly with a study nutritionist and exercised daily under the supervision of a personal trainer in a dedicated fitness center. After weight loss, the 52 remaining subjects (dropout rate = 17%) were randomly assigned to two groups that underwent controlled partial weight regain (+50% of lost weight) over the subsequent 4-6 mo: Group 1- Continued supervised exercise, Group 2- No exercise. MetS parameters were assessed at Baseline, Post Weight Loss, and Post Weight Regain and groups compared by two-way repeated measures ANOVA. Forty-six subjects completed the entire study (total dropout rate = 27%). Exercise compliance for the entire study was 96%.

**RESULTS:** After weight loss (9.5±0.2%), significant (p<.05) improvements were observed in all metabolic parameters: VO<sub>2</sub>max, waist circumference, systolic and diastolic blood pressure (BP), total and subcutaneous and visceral abdominal fat and intermuscular fat (by computed tomography), insulin, glucose, insulin resistance (by homeostasis model assessment - HOMA), cholesterol, HDL-C, LDL-C, and oxidized LDL. With weight regain (54.4±1.6%), many of the outcome parameters were reversed in both groups. However, the exercise group did maintain the improvements in BP, insulin, HOMA, and oxidized LDL, but the non-exercise group did not maintain any parameters after partial weight regain.

**CONCLUSION:** Although aerobic exercise maintained improvements in some important MetS risk factors despite weight regain, the deleterious effects caused by weight regain on other parameters suggest that weight maintenance is important for metabolic health status.

Supported by NIH NIDDK RO1 DK067036

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### 2981 Board #128 May 30 8:00 AM - 9:30 AM

#### Maximal Rate Of Fat Oxidation Not Related To Lactate Threshold In Women With Metabolic Syndrome

Corey A. Rynders, Siddhartha S. Angadi, Nathan Y. Weltman, Glenn A. Gaesser, FACSM, Arthur Weltman, FACSM. *University of Virginia, Charlottesville, VA.*

(No relationships reported)

**PURPOSE:** To examine the relationship between VO<sub>2</sub> at lactate threshold (LT) and at the maximal rate of fat oxidation (FAT<sub>max</sub>) in abdominally obese women with and without the metabolic syndrome (MS).

**METHODS:** Three groups of females 1) MS (n=26; age, 47.8 ± 2.2 yrs; BMI, 34.5 ± 1.2 kg/m<sup>2</sup>; % body fat, 44.7 ± 0.9%; VO<sub>2</sub>peak, 21.1 ± 0.7 ml/kg/min); 2) obese % body fat matched controls without MS (O) (n=52; age, 37.2 ± 2.4 yrs; BMI, 34.1 ± 1.1 kg/m<sup>2</sup>; % body fat, 44.7 ± 0.8%; VO<sub>2</sub>peak, 17.6 ± 0.6 ml/kg/min); and 3) lean (L) (n=41; age, 28.9 ± 2.1 yrs; BMI, 21.8 ± 0.2 kg/m<sup>2</sup>; % body fat, 24.9 ± 1.0%, VO<sub>2</sub>peak, 33.1 ± 1.3 ml/kg/min) completed a continuous incremental (3 min stages) VO<sub>2</sub>peak/LT protocol. Fat oxidation rates were determined using indirect calorimetry and averaged over the last minute of each stage. The exercise intensity corresponding to the highest recorded fat oxidation rate was chosen as FAT<sub>max</sub> and LT was chosen as the breakpoint in the VO<sub>2</sub> blood lactate relationship.

**RESULTS:** LT occurred at a higher %VO<sub>2</sub> than FAT<sub>max</sub> in all groups (63% v. 52%, 57% v. 48%, and 53% v. 46% in MS, O, and L respectively, p<.05). Strong correlations between VO<sub>2</sub> at LT and FAT<sub>max</sub> were observed in O and L (r=.68, r=.69; p<.001) but not in the MS group (r=.39, p=.053) after controlling for age and when VO<sub>2</sub> was expressed as ml/kg/min. This relationship persisted when VO<sub>2</sub> was normalized to fat-free mass (ml/kgFFM/min; MS, r=.38, p=.058; O, r=.64, p<.001; L, r=.64, p<.001).

**CONCLUSION:** In abdominally obese females with MS, the VO<sub>2</sub> at FAT<sub>max</sub> and LT are not related even after accounting for differences in fat free mass.

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### 2982 Board #129 May 30 8:00 AM - 9:30 AM

#### Abdominally Obese Women With Metabolic Syndrome Have Higher Maximal Fat Oxidation Rates During Submaximal Treadmill Exercise.

Brian A. Irving, Corey A. Rynders, Siddhartha S. Angadi, Nathan Y. Weltman, Glenn A. Gaesser, FACSM, Arthur Weltman, FACSM. *University of Virginia, Charlottesville, VA.*

(No relationships reported)

**PURPOSE:** To compare absolute and relative fat oxidation rates between abdominally obese women who meet the International Diabetes Federation criteria for metabolic syndrome (MS) and lean without MS.

**METHODS:** Two groups of females 1) MS (n=26; age, 47.8 ± 2.2 yrs; BMI, 34.5 ± 1.2 kg/m<sup>2</sup>; % body fat, 44.7 ± 0.9%; VO<sub>2</sub>peak, 21.1 ± 0.7 ml·kg<sup>-1</sup>·min<sup>-1</sup>); 2) lean (L) without MS (n=21; age, 51.1 ± 3.9 yrs; BMI, 22.9 ± 0.5 kg/m<sup>2</sup>; % body fat, 32.7 ± 2.3%; VO<sub>2</sub>peak, 29.8 ± 2.0 ml·kg<sup>-1</sup>·min<sup>-1</sup>); completed a continuous incremental treadmill VO<sub>2</sub>peak/LT protocol. Fat oxidation rates were determined using indirect calorimetry and averaged over the last minute of each 3 min stage. LT was chosen as the breakpoint in the blood lactate - VO<sub>2</sub> relationship.

**RESULTS:** Although VO<sub>2</sub> at LT occurred at similar relative percentages of VO<sub>2</sub> peak (63 vs 58 % for MS and L respectively, p = 0.27) there was a dissociation between groups for maximal rate of fat oxidation (FAT<sub>max</sub>) (53 vs 43 % of VO<sub>2</sub> peak for MS and L respectively, p = 0.008). Absolute and relative FAT<sub>max</sub> were higher in MS compared to L (0.35 ± 0.03 g/min v. 0.21 ± 0.02 g/min, p<.001; 6.7 ± 0.4 mg/kgFFM/min v. 5.0 ± 0.4 mg/kgFFM/min, p=.005; respectively).

**CONCLUSIONS:** The present findings support previous research that indicates that obese subjects have higher rates of fat oxidation than lean subjects (in part due to higher rates non plasma fatty acid utilization) and extends these findings to abdominally obese subjects with MS.

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### 2983 Board #130 May 30 8:00 AM - 9:30 AM

#### Aerobic Exercise And Niacin Therapy Alter Lipoprotein Characteristics In Metabolic Syndrome

Peter W. Grandjean, FACSM<sup>1</sup>, Eric P. Plaisance<sup>1</sup>, A. Jack Mahurin<sup>2</sup>, Michael L. Mestek<sup>1</sup>, J. Kyle Taylor<sup>3</sup>, Jose Moncada-Jiminez<sup>1</sup>, Felipe Araya-Ramirez<sup>1</sup>, David M. Dean<sup>1</sup>. <sup>1</sup>Auburn University, Auburn, AL. <sup>2</sup>Baptist Family Medicine, Montgomery, AL. <sup>3</sup>Auburn University-Montgomery, Montgomery, AL.

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( P.W. Grandjean, Abbott Laboratories, Contracted Research.)

Changes in lipoprotein characteristics, such as particle size and number, may contribute to our understanding of the biochemical pathways that are influenced by exercise and niacin therapy to ameliorate secondary dyslipidemias.

**PURPOSE:** Our purpose was to characterize changes in lipoprotein characteristics after single episodes of aerobic exercise conducted before and after 6 wks of niacin therapy in men with metabolic syndrome.

**METHODS:** Thirteen men (44 ± 7 yrs; BMI = 34.5 ± 3.4 kg·m<sup>-2</sup>; % fat = 35 ± 5; VO<sub>2</sub>max = 27.7 ± 5.1 mL·min<sup>-1</sup>·kg<sup>-1</sup>; waist circumference = 108.8 ± 8.2 cm; HDL-C = 39 ± 8 and triglycerides = 287 ± 96 mg/dL; HOMA score = 4.4 ± 2.0) expended 500 kcals by treadmill walking at 65% of VO<sub>2</sub>max before and after a 6-wk regimen of prescription

niacin. Niacin doses were titrated by 500 mg/wk from 500 to 1500 mg/dy and maintained at 1500 mg/dy for the last 4 wks. Fasting blood samples were collected before and 24 hr after each exercise session for blood lipid and NMR analyses of lipoprotein characteristics (*Lipoprotein®*, *Liposcience Inc., Raleigh, NC*). Changes in lipid concentrations and lipoprotein particle size and number were determined by paired t-tests and multiple 1 (group) by 4 (condition) repeated-measures ANOVAs.

**RESULTS:** A 12% reduction in cholesterol, a 34% reduction in triglyceride and an 18% increase in HDL-cholesterol were observed after six weeks of niacin therapy ( $p < 0.018$  for all). Niacin, but not exercise, reduced total LDL particle number by 11% ( $p = 0.009$ ). The reduction in LDL particle number with niacin was observed across small LDL subclasses (16 to 23%,  $p < 0.0032$  for all) but not in the number of large LDL particles. The combination of exercise and niacin therapy reduced mean VLDL particle size 7% ( $p = 0.035$ ) and the increase in mean LDL particle size approached statistical significance ( $p = 0.081$ ). Participants' body weight and characteristics of VLDL, IDL, and HDL particles remained unchanged from baseline ( $p > 0.05$  for all).

**CONCLUSIONS:** The therapeutic effects of niacin include reducing LDL particle number - particularly in smaller, more atherogenic LDL subclasses. Moderate-intensity aerobic exercise in combination with niacin reduces mean VLDL particle size, an effect that may contribute to reductions in smaller LDL particles and triglyceride concentrations and to elevations in HDL-cholesterol.

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**2984 Board #131 May 30 8:00 AM - 9:30 AM**  
**Fetuin - A Responses To Exercise In Men With Metabolic Syndrome**

Robert L. Bowers<sup>1</sup>, Felipe Araya-Ramirez<sup>1</sup>, Teayoun Kim<sup>1</sup>, Rebecca A. Ludvigsen<sup>1</sup>, A. Jack Mahurin<sup>2</sup>, Jennifer D. Dennis<sup>1</sup>, David M. Dean<sup>1</sup>, Suresh T. Mathews<sup>1</sup>, Peter W. Grandjean, FACSM<sup>1</sup>. <sup>1</sup>Auburn University, Auburn, AL. <sup>2</sup>Baptist Family Medicine, Montgomery, AL

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(No relationships reported)

Fetuin-A, particularly the phosphorylated isoform, appears to attenuate insulin action by suppressing insulin receptor tyrosine kinase activity. In fact, fetuin-A is elevated in obesity, insulin resistance and Type 2 diabetes. Aerobic exercise is known to improve insulin action; however, the fetuin-A response to exercise in men with metabolic syndrome is unknown.

**PURPOSE:** Our purpose was to characterize the influence of a single episode of aerobic exercise on fetuin-A and markers of insulin action in obese men with metabolic syndrome.

**METHODS:** Ten men (39 + 8 yrs of age; BMI = 35.6 + 6.7 kg·m<sup>-2</sup>; % fat = 38 + 5; VO<sub>2</sub>max = 28.8 + 6.2 mL·min<sup>-1</sup>·kg<sup>-1</sup>; waist circumference = 45.9 + 6.3 in; HDL-C = 36 + 6 and triglycerides = 163 + 99 mg/dL; HOMA score = 5.3 + 4.4) expended 500 kcal by treadmill walking at 60-70% of VO<sub>2</sub>max. Fasting blood samples were collected prior to, immediately, and 24 hr post-exercise. Samples collected during a 2 hr oral glucose tolerance test (OGTT, 75g glucose load) were obtained prior to and 24 hr after exercise. Changes in serum glucose, insulin, non-esterified fatty acids, fetuin-A, phosphofetuin-A concentrations, HOMA, the glucose/insulin ratio, and OGTT areas under the curve (AUC) for glucose, insulin, fetuin-A and phosphofetuin-A were determined by multiple repeated-measures ANOVAs.

**RESULTS:** The glucose/insulin ratio increased 92% 24 hr after exercise ( $p = 0.0067$ ) and the insulin AUC was reduced 16% post-exercise ( $p = 0.049$ ). Serum phosphofetuin-A AUC was significantly lower ( $p < 0.006$ ) 24 hours after a single bout of exercise. HOMA ( $p = 0.062$ ) and fetuin-A concentrations remained unchanged with exercise.

**CONCLUSIONS:** The reduced phosphofetuin-A AUC observed after a single exercise session is consistent with improvements in surrogate markers of insulin sensitivity and may be a mechanism by which exercise improves insulin action.

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**2985 Board #132 May 30 8:00 AM - 9:30 AM**  
**Prevalence Of The Female Athlete Triad/Tetrad In Professional Ballet Dancers**

Anne Z. Hoch, FACSM<sup>1</sup>, Paula Papanek, FACSM<sup>2</sup>, Heather S. Havlik<sup>1</sup>, William G. Raasch<sup>1</sup>, Michael E. Widlansky<sup>1</sup>, Jane E. Schimke<sup>1</sup>, David D. Guterman<sup>1</sup>. <sup>1</sup>Medical College of Wisconsin, Milwaukee, WI. <sup>2</sup>Marquette University, Milwaukee, WI.

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(No relationships reported)

The prevalence of the female athlete triad in professional dancers is unknown. Furthermore, amenorrhea may increase the risk of endothelial dysfunction, a predictor of cardiovascular risk in this population.

**PURPOSE:** To determine the prevalence of disordered eating, menstrual dysfunction, reduced bone mineral density and endothelial dysfunction in professional ballet dancers.

**METHODS:** Twenty two professional ballet dancers volunteered for this study. Subjects completed a questionnaire in regards to disordered eating (EDE-Q). Whole serum blood was drawn to determine hormonal, TSH and prolactin levels. Subjects also completed a questionnaire about their menstrual history. Bone mineral density (BMD) and body composition were measured with a GE Lunar Prodigy DXA. Endothelial function was measured in the brachial artery by high resolution ultrasound employing standard methods for measuring brachial reactivity testing. An increase in brachial diameter < 5% to hyperemic flow stimulus was *a priori* defined as endothelial dysfunction.

**RESULTS:** Disordered eating. Thirty two percent had abnormal EDE-Q scores. Menstrual dysfunction. Eighteen percent reported a history primary amenorrhea, 27% currently had menstrual dysfunction and 9% were currently taking birth control. Bone mineral density. Thirty two percent had evidence of low bone density (Z score < 1.0). Cardiovascular. Sixty four percent of dancers had abnormal brachial artery flow mediated dilation (<5%).

**CONCLUSIONS:** Triad characteristics including endothelial dysfunction were common in this group. Eighteen percent had one component, 45% had two components, 18% had 3 components and 5% had all four components of the Triad (Tetrad).

**FUNDING:** This study was funded by a grant from the General Clinical Research Center, Grant #M01 RR00058, by the Clinical & Translational Science Institute Adult Translational Research Unit, Medical College of Wisconsin, and Recipient of Steve Cullen Healthy Heart Club Funding 2008.

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**2986 Board #133 May 30 8:00 AM - 9:30 AM**  
**Association Between Regular And Sugar-free Soda Consumption With Risk Of Metabolic Syndrome**

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(No relationships reported)

**PURPOSE:** The association between daily intake of sugar-free soda (SFS) and health consequences are not well understood. Recent findings suggest that SFS consumption is associated with an increased risk of metabolic syndrome (MetS). The purpose of this study was to examine the cross-sectional association between soda consumption and MetS.

**METHODS:** A sample of 3,320 participants (12.7% women, mean age 45.0 years) from the Aerobics Center Longitudinal Study who completed a series of health history questionnaires that included a dietary record and a treadmill fitness test were used for this cross-sectional analysis. MetS was defined according to NCEP-ATP III criteria. The sample was classified into seven groups of soda consumption (<1/wk SFS or regular; 1-6/wk SFS; ≥1/d SFS; 1-6/wk regular; ≥1/d regular; 1-6/wk SFS or regular; ≥1/d SFS or regular). Logistic regression analysis was used to compute odds ratios (ORs) and 95% confidence intervals (CIs).

**RESULTS:** Compared with <1/wk SFS or regular soda, age and sex adjusted ORs (95% CIs) were 1.63 (1.11-2.39) in 1-6/wk SFS, 2.85 (1.96-4.15) in ≥1/d SFS, 1.29 (0.96-1.74) in 1-6/wk regular, 1.54 (1.15-2.08) in ≥1/d regular, 1.22 (0.89-1.68) in 1-6/wk SFS or regular, and 1.85 (1.40-2.44) in ≥1/d SFS or regular. After adjustment for physical activity, smoking status, alcohol intake, dietary pattern, and total calorie intake, only ≥1/d SFS was significantly associated with higher risk of MetS. This OR remained significant after adjustment for



cardiorespiratory fitness (CRF). In analyses for individual the MetS components,  $\geq 1/d$  regular soda was positively associated with abdominal obesity ( $P=0.02$ ) whereas  $\geq 1/d$  SFS showed increased association with high triglycerides ( $P=0.04$ ) and impaired fasting glucose ( $P=0.03$ ) compared with  $<1/wk$  SFS or regular.

**CONCLUSIONS:** This cross-sectional analysis showed that drinking more than one SFS a day may be associated with increased prevalence of MetS. Additional studies are needed to further investigate the association between soda consumption and MetS.

Supported by NIH Grants AG06945 and HL62508

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## G-22 Free Communication/Poster - *Muscle and Bone Responses During Injury and Illness*

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

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### 2987 Board #134 May 30 9:30 AM - 11:00 AM

#### Effects Of Exercise On The Regeneration Of Injured Nerve And Soleus Muscle After Spinal Cord Contusion In Rats

Ilguy Jeong<sup>1</sup>, Myungjin Oho<sup>1</sup>, Moonnyeo Jang<sup>1</sup>, Donghee Kim<sup>2</sup>, Hayan Lee<sup>2</sup>, Jinhwan Yoon<sup>1</sup>. <sup>1</sup>Hannam University, Daejeon, Republic of Korea. <sup>2</sup>Chonnam National University, Gwangju, Republic of Korea.

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(No relationships reported)

It has been suggested that the functional recovery promoted by exercise training after spinal cord injury (SCI) might be associated with neurotrophic factors such as BDNF and GAP-43 in nerve tissue and insulin-like growth factor (IGF-1) in the inflicted muscle. However, it is needed to be elucidated more clearly how SCI and training followed by SCI affect the morphological changes as well as the neurotrophic and muscle growth factors.

**PURPOSE:** This study was designed to investigate the effects of treadmill training on the morphological change of injured spinal cord and the expression of BDNF, GAP-43 in injured nerve tissue and IGF-1 of soleus muscle in rats with SCI.

**METHODS:** Forty five male rats (7wk in age) were used and assigned into three groups: None-Contusion Group (NC, n=15), Contusion Control Group (CC, n=15) and Exercise after Contusion Group (EC, n=15). Every rat in CC and EC groups underwent laminectomy at T9 level and then contusion on the exposed spinal cord site in the anesthetized condition. After one week-recovery from contusion, every rat in EC group exercised on a motorized treadmill for 30 min/d, 5 d/wk for 7 wks. Immunofluorescence staining and microscopic observation was used in order to confirm the axon regeneration at the injured site and Western blot was used to analyze the nerve and muscle regeneration associated proteins. Functional recovery was also evaluated by BBB test (Basso, Brestti, Brenahan). The variables were analyzed using T test and repeated two-way ANOVA and Turkey post-hoc test.

**RESULTS:** The size of cavity formed in spinal cord remarkably decreased along with the significant axonal regrowth in EC compared to CC after 7 wks. BDNF and GAP-43 increased significantly 7 wks after SCI and treadmill exercise after SCI further up-regulated the proteins ( $p \leq .001$ ). The cross-sectional size of soleus muscle was decreased along with the reduction of IGF-1 protein after SCI and recovered with the increase of IGF-1 due to exercise training in EC ( $p \leq .001$ ). The higher score of functional test (BBB test) also appeared from 4 wks of training in EC group ( $p \leq .01 \sim .001$ ).

**CONCLUSIONS:** These results suggest that treadmill exercise after SCI might promote the functional recovery along with the axon regeneration and muscle regrowth through the up-regulation of BDNF, GAP-43 in nerve tissue and IGF-1 in muscle tissue.

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### 2988 Board #135 May 30 9:30 AM - 11:00 AM

#### Establishment Of Accurate Estimation Of Muscle Atrophy Based On Muscle Thickness In Knee Surgery Patients

Maya Hioki<sup>1</sup>, Takemitsu Furukawa<sup>2</sup>, Hiroshi Akima<sup>1</sup>. <sup>1</sup>Nagoya University, Nagoya, Japan. <sup>2</sup>Ogaki Orthopedic Surgery, Ogaki, Japan. (Sponsor:

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(No relationships reported)

Girth measurement has been widely used for estimation of change in muscle size following surgery-related disuse in clinical medicine. This method is simple and easy to use; however, the accuracy of estimation remains a matter of debate in the previous studies.

**PURPOSE:** The purpose of this study was to establish the accurate estimation of atrophy in quadriceps femoris (QF) muscles in patients who underwent knee surgery.

**METHODS:** A total of 32 individuals (men: 16, women: 16) (age,  $45.3 \pm 3.7$  yr; height,  $162.2 \pm 7.5$  cm; weight,  $62.5 \pm 11.5$  kg) who underwent arthroscopic knee surgery participated in the study. Their operated and non-operated thighs were scanned by magnetic resonance imaging to determine the volume and thickness of the QF muscles. Muscle volume was calculated using eleven axial images and muscle thickness was measured at the anterior, lateral and medial regions at the proximal (70% of length of the thigh; 70%Lt), middle (50%Lt) and distal (30%Lt) levels. To obtain the relationship between difference in muscle volume and difference in muscle thickness between operated and non-operated thighs, stepwise regression analysis was performed. The muscle volume difference between operated and non-operated limb was analyzed with a paired t-test.

**RESULTS:** The muscle volume of the QF muscles of the operated limb ( $789.9 \pm 226.0$  cm<sup>3</sup>) was significantly smaller than the non-operated limb ( $907.8 \pm 243.4$  cm<sup>3</sup>). As a result of stepwise regression analysis, the difference in muscle volume was significantly correlated with difference in muscle thickness in the anterior and lateral regions at the middle level and medial region at the distal level ( $R = 0.84$ ,  $R^2 = 0.71$ ) ( $p < 0.001$ ).

**CONCLUSIONS:** It is concluded that the difference in muscle volume of the QF muscles between operated and non-operated could be estimated by muscle thickness at three different regions, i.e. anterior and lateral regions at 50%Lt and medial region at 30%Lt, which can be measured using costless imaging technique such as ultrasonography. It would be useful for accurate estimation of muscle atrophy induced by disuse due to injury and/or bed rest in clinical medicine.

Supported by Grants-in-Aid for Scientific Research from the Minister of Education, Culture, Sports, Science and Technology Grant (#15700414) and the Casio Science Promotion Foundation.

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### 2989 Board #136 May 30 9:30 AM - 11:00 AM

#### Attenuation Of Muscle Impairments Relates To Functional Improvements During Rehabilitation Following Immobilization.

Chris Gregory, Sunita Mathur, Robyn Hinds, Jessica Ball, Trevor Lentz, Glenn Walter, Krista Vandenberg. University of Florida, Gainesville, FL

(No relationships reported)

**PURPOSE:** The purpose of this study was to 1) quantify the effects of immobilization and subsequent rehabilitation training on muscle size and strength about the ankle and 2) determine the extent to which improvements in physical function relate to gains in strength in ankle plantar- and dorsi-flexor muscles. We hypothesized that greater relative changes in both muscle strength and size would be seen in the plantar- versus the dorsi-flexor muscle group, reflective of the anti-gravity responsibilities of the plantar flexor muscles.

**METHODS:** Following immobilization, fourteen subjects enrolled in a standardized rehabilitation program involving progressive resistance exercises and treadmill walking. Plantar- and dorsi-flexor strength were determined via dynamometry and functional ability was assessed during stair climbing and over ground walking immediately prior to, during and following rehabilitation. In addition, maximum cross-sectional area (CSA) of the muscles that elicit ankle plantar- and dorsi flexion were determined via magnetic resonance imaging (MRI).

**RESULTS:** A greater degree of atrophy was noted in the plantar- compared to the dorsi-flexors following immobilization ( $25.5 \pm 6.4\%$  versus  $20.5 \pm 3.8\%$ , respectively). Similarly, plantar flexor strength was reduced  $73.3 \pm 12.4\%$  relative to the contralateral limb, while dorsi-flexor strength was reduced  $52.1 \pm 9.9\%$ . Following rehabilitation, increases in both plantar ( $55.1 \pm 14.9\%$ ) and dorsi-flexor ( $29.9 \pm 8.5\%$ ) strength were noted. Increased functional ability was also realized, with improvements in both stair climbing and over ground walking velocity following rehabilitation. Of note, recovery of function significantly correlated to the recovery of dorsi flexor ( $R^2 = 0.79$  and  $0.85$ ) and plantar flexor ( $R^2 = 0.86$  and  $0.88$ ) strength, respectively.

**CONCLUSIONS:** A discrepancy in the hierarchy of response was found between changes in muscle size and strength in the ankle plantar- versus dorsi-flexor muscles following immobilization. Rehabilitation induced improvements in muscle strength were realized in both the plantar and dorsi-flexion, with improvements significantly related to improved functional performance.

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**2990 Board #137 May 30 9:30 AM - 11:00 AM**  
**A Simple Prediction Model For Stress Fracture In New Recruits**

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**PURPOSE:** To develop a simple prediction model for stress fracture (SF) in new military recruits using an activity assessment questionnaire and anthropometry measurements.

**METHODS:** Data were collected from 63 young ( $18.5 \pm 0.5$  yrs) males prior to Special Forces Army basic training (ABT). A detailed history of physical activity included questions on the type and frequency of the activity, the age span during which the subject was involved in the activity, and the average number of minutes each activity was performed per week. The type of sport activities performed were further divided into four categories: high impact (i.e., running), multi-directional impact (i.e., court sports), and high and low magnitude. Anthropometric variables included weight, height, percent body fat, waist circumference, and BMI. Stress fractures were diagnosed during ABT by bone scintigraphy and/or MR imaging. All variables from the various categories were analyzed to evaluate the correlation with SF and to construct a new SF prediction model using logistic regression analysis.

**RESULTS:** Three variables were found to be significantly related to SF occurrence during ABT ( $p < 0.05$ ): aerobic training frequency (e.g., running), aerobic training duration, and waist circumference. The following model successfully predicted 78% of the soldiers with ( $n=23$ ) and without ( $n=28$ ) SF:

$PSF = 12.166 - 1.169ATn + 0.436ATt - 0.145Waist$

where: PSF= Stress fracture prediction according to the Log Odds(SF); Odds(SF)= Ratio between probability of SF existence and nonexistence; ATn= Aerobic training (times/week); ATt= Aerobic training (min/week); Waist = circumference (cm).

**CONCLUSIONS:** A simple, applicable prediction model for SF was developed. A young male soldier is at greater risk of developing SF if, before entering ABT, he trained aerobically <2 times a week, each training was >40 min, and his waist circumference was less than 75cm. This modeling effort identified candidate variables that may play a major role in SF occurrence. If validated through testing using a larger sample size, these findings may enable prevention of orthopedic injuries through the adjustment of the training program for at-risk individuals.

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**2991 Board #138 May 30 9:30 AM - 11:00 AM**  
**Effects Of Near-infrared Photobiomodulation On Body Weight Of Type 1 Diabetic Animals**

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**INTRODUCTION:** Diabetes mellitus can lead to the loss of muscle mass and an accumulation of fat mass. If these factors lead to a decrease in physical activity, the systemic health of the individual may deteriorate. Near-infrared light has already been shown to accelerate wound healing in diabetic animals. Near-infrared therapy has also been shown to increase energy production, attenuate oxidative stress, reduce toxic effects of mitochondrial poisoning and reduce pain.

**PURPOSE:** The purpose of this study was to determine the effect of a 670 LED non-thermal light on the body weight of a group of diabetic rats.

**METHODS:** Twenty-four male rats were randomly placed into 3 groups. All groups were given intraperitoneal injections; eight were given injections of a saline solution (CTR) and sixteen were given an injection of streptozotocin. The sixteen animals injected with streptozotocin were randomly assigned to two equal groups: one group received no treatment (STZ) and the other group received the near-infrared light treatment (NIP). Animal treatment and data collection began one week post-injections. Five days per week, all of the animals were placed in Plexiglas restrainers for five minutes. During this time, the NIP group received their light treatment. Animals were weighed midweek and harvested on day ninety-six.

**RESULTS:** Body weights were significantly different between CTR and STZ and between CTR and NIP at all time points. A trend of greater body weight by the NIP group as compared to the STZ group did exist, which may have physiological significance though it was not statistically significant. Cumulative muscle weight measures support this finding.

**DISCUSSION AND CONCLUSIONS:** A tendency to maintain or increase body weight, especially through muscle mass, may indicate an enhanced state of systemic health. Muscle mass is important to an individual with diabetes, as it may allow them the ability to be physically active. These results indicate that the dose of light treatment administered may lead to a persistent difference in bodyweight and greater muscle weights. Therefore, we hypothesize that the NIP group had the potential to deal with the hyperglycemic stress better and to function at a greater capacity.

This research was funded by a Research Growth Initiative grant from the University of Wisconsin - Milwaukee.

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**2992 Board #139 May 30 9:30 AM - 11:00 AM**  
**Voluntary Wheel Running Attenuates Muscle Mass And Myosin Isoform Changes In Cancer Cachexia**

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(No relationships reported)

**PURPOSE:** Cancer cachexia is characterized by significant decreases in skeletal muscle mass as well as alterations in skeletal muscle myosin heavy chain (MHC) isoform expression characterized by an increase in fast (type IIb) MHC expression. Increased muscle activity generally causes increases in both muscle mass and slow MHC isoform expression. As such, increased physical activity may be an attractive paradigm to attenuate the effects of cancer cachexia. Resistance activity has been shown to reduce tumor-induced muscle atrophy, but the effects of running activity on cancer cachexia are unknown.

**METHODS:** To determine the effect of running activity on muscle mass and MHC isoform expression during cancer, mice were injected with Lewis Lung carcinoma cells and were divided randomly into groups with access to running wheels (Exercise = EX) and groups without wheel access (No exercise = NE). The mice in the EX groups ran an

average of 4.5 km/day for 21 days. Upon sacrifice, hindlimb muscle mass was measured and MHC isoform content was determined by 1-D SDS-PAGE.

**RESULTS:** Mice injected with tumor cells developed tumors with an average mass of 1.75 g at 3 weeks post-injection. Exercise had no effect on tumor mass. The presence of the tumor had a significant effect on muscle mass in some muscles. In NE mice, cancer was shown to cause a 21% decrease in soleus mass and a 14% decrease in gastrocnemius mass. In addition, the tumor was associated with a significant slow-to-fast MHC isoform shift (-9.5% type I MHC, -8.5% type IIa MHC, +19% type IIb MHC) in the soleus muscle. The addition of voluntary wheel running had no effect on muscle mass or MHC isoform content in non-tumor-bearing mice. However, wheel running attenuated changes in muscle mass and MHC isoform expression in tumor bearing animals, such that there were no significant differences in either muscle mass or MHC content between the tumor bearing and the non-tumor-bearing groups.

**CONCLUSIONS:** Voluntary wheel running is not typically known to have significant effects on muscle mass in healthy animals, but these results suggest that both mass and MHC isoform content are sensitive to increases in muscle activity levels in tumor-bearing animals. These results further suggest that running activity may be an effective therapeutic strategy for cancer cachexia.

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**2993 Board #140 May 30 9:30 AM - 11:00 AM**  
**Determinants Of Bone Mineral Density In Persons With Multiple Sclerosis**

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Persons with multiple sclerosis (MS), including men and premenopausal women, have significantly increased risk of reduced bone mineral density (BMD). Therapeutic glucocorticoid use in MS does not appear to consistently result in this reduced BMD. There is evidence that low vitamin D (25(OH)D) and the suggestion that reduced physical activity negatively affects BMD in MS. In addition, depression and elevated cortisol are known to be associated with decreased BMD and are also common in MS.

**PURPOSE:** The overall aim of this study was to determine associations of 25(OH)D, physical activity, endogenous cortisol, and depression, to BMD in persons with MS.

**METHODS:** We tested 7 persons with MS (5 Female, 2 Male; Md EDSS = 2) and 11 control (C) subjects (10 Female, 1 Male). Depression (Beck Depression Inventory) and the Multiple Sclerosis Functional Composite score (MSFC) was obtained from all subjects as were the following measures: Bone mineral density (BMD) of the lumbar spine (L2-L4) and femoral neck (mean left and right) was measured with dual X-ray absorptiometry. Vitamin D (25(OH)D) was measured from serum and cortisol from a nighttime salivary sample (11:00PM, EIA). Physical activity was indicated by accelerometers worn for 7 days around the waist and recorded as raw acceleration units. Analysis was by unpaired t-tests and Pearson correlations. Data are Mean (SE). Significance was  $p \leq 0.05$ .

**RESULTS:** MS subjects compared to C reported greater depression (MS = 7(3), C = 3(0.5),  $p = 0.001$ ), and had lower MSFC (MS = 2.2, C = 2.8). There were no differences between groups in BMD, 25(OH)D, cortisol, or physical activity. Despite the lack of difference between groups, physical activity was strongly correlated to femoral neck BMD in the MS group ( $r = 0.77$ ,  $p = 0.04$ ) but not control ( $r = -0.07$ ,  $p = 0.87$ ). Neither 25(OH)D, cortisol, or depression was correlated to BMD in MS or C.

**CONCLUSIONS:** In MS subjects with normal BMD and replete 25(OH)D, physical activity but not cortisol or depression, contributes to BMD.

*This study was Supported by NMSS grant PP1509*

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**2994 Board #141 May 30 9:30 AM - 11:00 AM**  
**The Relationship Between Knowledge And Beliefs Of Osteoporosis And Bone Mineral Density**

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There are over 20 million individuals that currently have osteoporosis contributing to the 1.5 million fractures in the U.S. each year. It has been previously determined that one's knowledge of a disease or health condition is related to the health behaviors toward preventing that particular illness. However, this concept has not been studied sufficiently with osteoporosis.

**PURPOSE:** Therefore the aim of this proposed project is to determine if specific knowledge of osteoporosis and its prevention are related to bone density.

**METHODS:** Women from the surrounding community volunteered to participate in the present investigation. Each participant completed the previously approved informed consent, health history questionnaire, Osteoporosis Knowledge Test (OKT), and Osteoporosis Health Belief Scale (OHBS). Upon completion of all surveys, the participants had their bone density analyzed via dual-energy x-ray absorptiometry (iDXA, GE Lunar, Madison, WI). A total of three scans were completed; total-body, left hip, and lumbar spine. Multiple regression analyses were used to determine if the results of the surveys predicted bone density (total-body, left femur, and spine). Independent variables used were the OKT and OHBS surveys. Dependent variables were the participant's bone density values for total-body, left femur, and lumbar spine.

**RESULTS:** The sample consisted of 16 women ranging in age from 18 to 65 years (41.44 + 13.69). Analyses revealed that the OHBS and OKT are significant predictors of total-body BMD ( $F[2,13] = 4.23$ ,  $p = .04$ ) and left femoral neck BMD ( $F[2,13] = 6.35$ ,  $p = .01$ ). However, the two surveys did not significantly predict BMD of the lumbar ( $F[2,13] = 0.25$ ,  $p = .78$ ).

**CONCLUSIONS:** It has been previously stated that knowledge and/or health beliefs affect the personal habits of individuals. In the present investigation, this was affirmed with the femoral neck and total-body bone density; however, this was not the case with the lumbar spine. Further research should be implemented to determine if, in fact, beliefs and knowledge are actually related to this specific health outcome. With over 20 million Americans afflicted with this incurable disease, education is the key to prevention.

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**2995 Board #142 May 30 9:30 AM - 11:00 AM**  
**Influence Of Hormone Replacement Therapy With Maximal Eccentric Exercise On Estrogen Receptor Coregulators And Skeletal Muscle Damage In Postmenopausal Women**

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The use of hormone replacement therapy (HRT) is a potential treatment to relieve symptoms of menopause and prevent the onset of disease such as osteoporosis in postmenopausal women. Although estrogen has a possible protective effect against exercise-induced skeletal muscle damage, it is unclear if HRT therapy enhances estrogen receptor (ER) activity in skeletal muscle at rest and following resistance exercise.

**PURPOSE:** To evaluate changes in the mRNA gene expression of ER coregulators (SRC and SMRT) and markers of skeletal muscle damage (CK, LDH, and TNF- $\alpha$ ) in postmenopausal women following a high-intensity resistance exercise bout.

**METHODS:** Fourteen postmenopausal women were divided into two groups: Control, women not using HRT ( $n=6$ ,  $59 \pm 2$  yr,  $63 \pm 7$  kg), or HRT, women using traditional HRT ( $n=8$ ,  $59 \pm 1$  yr,  $89.5 \pm 8.4$  kg). Both groups performed 10 sets of 10 maximal eccentric repetitions of single-leg extension on the Cybex dynamometer at  $60^\circ/\text{s}$  with 20 second rest periods between sets. Two muscle biopsies of the vastus lateralis were obtained from the exercised leg at baseline and 4 hours after the exercise bout. mRNA gene expression was determined using RT-PCR for SRC, SMRT, and TNF- $\alpha$ . Blood draws were performed at baseline and 3 days post-exercise to measure CK and LDH. Independent t-tests were performed to test

group differences (Control vs HRT). A probability level of  $p \leq 0.05$  was used to determine statistical significance with Bonferroni adjustments.

**RESULTS:** We observed significantly greater changes in mRNA expression of SRC and SMRT ( $p \leq 0.01$ ) and significantly lower changes in mRNA expression of TNF- $\alpha$  ( $p \leq 0.01$ ) in the HRT group compared to controls following the exercise bout. mRNA expression of SRC significantly increased ( $p \leq 0.01$ ) and mRNA expression of SMRT significantly decreased ( $p \leq 0.01$ ) following the exercise bout in both groups. CK and LDH levels were significantly greater post-exercise ( $p \leq 0.01$ ) in the Control group.

**CONCLUSIONS:** These data suggest a single bout of maximal eccentric exercise significantly enhances ER activity with greater response present in postmenopausal women using HRT. Postmenopausal women not using HRT experienced greater muscle damage after exercise indicating a possible protective effect of HRT against exercise-induced skeletal muscle damage.

Keywords: SRC, SMRT, muscle damage

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**2996 Board #143 May 30 9:30 AM - 11:00 AM**  
**Intrinsic Muscle Properties Of The M. Quadriceps Femoris After Subacute Stroke**

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(No relationships reported)

For optimizing rehabilitation programs, a better understanding is needed of the nature of weakness and fatigability of muscles of patients with stroke.

**PURPOSE:** To characterize muscle properties of paretic (PL) and non paretic (NL) knee extensors in subacute stroke patients compared to able-bodied controls.

**METHODS:** Maximal rate of torque development (MRTD) was assessed as an indicator of speed using both voluntary and electrically evoked contractions of knee extensors in 14 patients with a hemi paresis of the lower extremity (56 $\pm$ 10 years, 3.5 $\pm$ 2 months after stroke) and in 12 age-matched able-bodied controls. In addition, changes in torque and half relaxation time (HRT) were measured during a fatigue protocol (35 electrically evoked intermittent contractions (1.5s on, 2 off)) and during electrically evoked 20Hz contractions. Force frequency relations (FFR) were established.

**RESULTS:** No differences among groups were found for normalized MRTD during electrically evoked contractions ( $p=0.117$ ). However, during voluntary contractions both PL (0.55  $\pm$  0.21%.ms<sup>-1</sup>) and NL (0.76  $\pm$  0.14%.ms<sup>-1</sup>) had significantly lower MRTD compared to control (1.04  $\pm$  0.31 %.ms<sup>-1</sup>) ( $p=0.022$  and  $p<0.001$  resp.). The course of torque decline showed that PL fatigued more and faster than control ( $p=0.011$ ). Furthermore, PL and NL relaxed more slowly than control as indicated by longer HRT in PL and NL during fatigue ( $p<0.001$ ) and during the 20Hz contractions (PL: 91.9  $\pm$  15.6ms, NL: 89.2  $\pm$  11.8ms, control: 80.5  $\pm$  8.2ms) ( $p=0.067$ ). Moreover, at the same stimulation frequencies, PL had a higher torque response than NL and control, but no differences in twitch torque were found among groups ( $p=0.125$ ).

**CONCLUSION:** Longer HRT in both PL and NL indicate muscle 'slowing' after stroke, although no differences were found in 'electrically evoked' MRTD. In addition, in PL this was accompanied by a left-shift of FFR and more rapid fatigue. These changes suggest adaptations in muscle properties towards slower, less fatigue resistant muscle which develop shortly after stroke. Moreover, the capacity to develop adequate torque rapidly (lower voluntary MRTD) is decreased after stroke. Thus, besides strengthening, also muscle endurance and speed should be addressed during rehabilitation to reverse adaptations in intrinsic muscle properties after stroke.

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**2997 Board #144 May 30 9:30 AM - 11:00 AM**  
**Malignant Hyperthermia Susceptible Mice Can Safely Perform Voluntary Endurance Training And Exhibit An Intrinsic Fatigue Resistance**

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(No relationships reported)

Malignant hyperthermia (MH) is a potentially lethal skeletal muscle disorder in which uncontrolled SR Ca<sup>++</sup> release is induced by halogenated anesthetics, heat, and potentially endurance exercise.

**PURPOSE:** To determine if MH susceptible mice (Y522S; heterozygous expression of ryanodine receptor 1 Y522S mutation) can perform 6 weeks of voluntary wheel running without inducing a fatal MH episode or excessive muscle damage and to assess the adaptive potential of Y522S anterior crural muscles [tibialis anterior (TA) and extensor digitorum longus (EDL) muscles].

**METHODS:** Wild type (WT) and Y522S mice were housed (~22°C) individually with a running wheel, while age-matched sedentary mice served as controls (n = 8/group). Trained and sedentary mice performed an *in vivo* anterior crural muscle fatigue test (360 concentric contractions in 30 minutes; 300 Hz, 38° angular movement at 400°/s). Citrate synthase activity and cytochrome C oxidase (COXIV subunit) protein content were determined in TA and EDL muscles respectively.

**RESULTS:** Y522S mice voluntarily ran without inducing a fatal MH episode, but ran 42% less distance per day than WT mice (4.0 $\pm$ 1.1 vs 6.9 $\pm$ 1.0 km/d). Neither Y522S nor WT trained mice exhibited exacerbated histological signs (H&E stain; right TA) of muscle damage. Sedentary Y522S mice exhibited a greater intrinsic fatigue resistance than WT mice (fatigue index: -13.4 $\pm$ 2.7 vs -28.9 $\pm$ 3.1%), as well as a ~67% greater EDL muscle COXIV protein content. Additionally, citrate synthase activity was greater in Y522S than WT TA muscle (28.1 $\pm$ 0.9 vs 26.0 $\pm$ 0.6  $\mu$ mol/min/g wet weight), regardless of training status. Wheel running improved fatigability (WT & Y522S fatigue index: -19.2 $\pm$ 1.6 & -12.0 $\pm$ 1.3%) and increased COXIV protein content (WT & Y522S: ~57 & ~17%) in WT but not Y522S mice. Trained Y522S mice remained more fatigue resistant than WT mice, although COXIV protein content was similar between groups after training.

**CONCLUSION:** Y522S mice can run voluntarily in an environment that is not thermally stressful (i.e., ~22°C) without inducing a MH episode and have an enhanced intrinsic resistance to fatigue, which may partially stem from a greater aerobic capacity.

-Supported by NIH grant AR41802

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**2998 Board #145 May 30 9:30 AM - 11:00 AM**  
**Determinants Of Peak Leg Extensor Muscle Power In Overweight And Obese Older Adults**

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(No relationships reported)

Peak muscle power (MP) has been shown to be a strong predictor of physical functioning in older adults. Additionally, although it has been reported that both fat and skeletal muscle need to be included in a sarcopenia definition, it has been recently suggested that a predictor of physical function should also be included. However, there is no consensus as to what measure of function should be included when assessing sarcopenic obesity.

**PURPOSE:** To assess the determinants of peak leg extensor MP in overweight and obese older adults.

**METHODS:** Thirty-one relatively healthy overweight and obese (BMI=31.8 $\pm$ 0.6) community-dwelling older (age = 66 $\pm$ 1 yrs) men (n=12) and women (n=19) were recruited for an ongoing dietary weight loss and exercise intervention trial. MP of the leg extensors was measured using a pneumatic leg extension power machine at 40%-80% of measured strength. Potential determinants of MP included age, sex, height, % body fat and fat-free mass (from air-displacement plethysmography), bi-lateral mid-thigh muscle and intermuscular fat cross-sectional areas (CSA) from computed tomography, and thigh muscle CSA/total body fat mass. Backward elimination regression was used to assess the contributions of these potential



determinants on MP ( $p < 0.10$  to remain in the final model).

**RESULTS:** In men, when adjusted for age, thigh muscle CSA was the only determinant of MP ( $p=0.065$ ). In women, the only significant determinant of MP was thigh muscle CSA/total body fat mass ( $p=0.010$ ).

**CONCLUSIONS:** These results indicate that thigh muscle CSA as a percentage of total body fat mass is a determinant of leg MP in older, overweight and obese women, suggesting that fat mass may play an important role in physical performance in women. However, thigh muscle CSA alone appears to be a better determinant of MP in men. Although results need to be validated with a larger sample size, these data provide support for the importance of both thigh muscle CSA and body mass fat when assessing function in a population at risk for obesity-related disability. These results also have implications for the development of a sarcopenia definition that includes peak MP.

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**2999 Board #146 May 30 9:30 AM - 11:00 AM**  
**Skeletal Muscle Alterations In Chronic Heart Failure (CHF): Differential Effects Of Left Ventricular Dysfunction On Catabolic Activation In The Quadriceps Muscle And The Diaphragm**

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**PURPOSE:** Muscle wasting is increasingly recognized as a cause of exercise intolerance in CHF. The catabolic process is in part mediated by the E3-Ligase Murf-1 via activation of the ubiquitin proteasome system. It is, however, unclear if respiratory muscles are equally affected by muscle catabolism as compared to peripheral skeletal muscles: Aim of this study was to examine the effects of CHF on expression of Murf-1 and the activity of manganese superoxide dismutase (Mn-SOD) in quadriceps muscle (Qua) and diaphragm (Dia) in LAD-ligated rats (MI).

**METHODS:** Left ventricular function was assessed in MI ( $n=12$ ) and sham operated (C,  $n=9$ ) rats using echocardiography and Millar-catheter 12 weeks after operation. Murf-1 protein expression and multi-ubiquitin content were quantified using Western Blot and Mn-SOD activity was measured in Qua and Dia.

**RESULTS:** Compared to C, MI resulted in CHF (EF:  $33.4 \pm 3.3$  vs.  $64.8 \pm 2.6$  %,  $p < 0.01$ ; LVEDD:  $9.6 \pm 0.3$  vs.  $6.8 \pm 0.2$  mm,  $p < 0.01$ , dp/dt max:  $4.4 \pm 0.3$  vs.  $5.8 \pm 0.5$ ,  $p = 0.02$ ). MI resulted in a 4.5-fold increase in Murf-1 expression in Qua ( $3.7 \pm 0.7$  vs.  $0.8 \pm 0.1$  arb. units,  $p < 0.001$ ). A negative correlation was observed with EF ( $r = -0.66$ ,  $p = 0.01$ ), a positive one with LVEDD ( $r = 0.59$ ,  $p = 0.03$ ). MI also resulted in an increase in the ubiquitin content in Qua ( $51.4 \pm 7.1$  vs.  $29.5 \pm 4.7$  arb. units,  $p = 0.05$ ). Mn-SOD activity decreased in MI ( $0.15 \pm 0.1$  vs.  $1.4 \pm 0.4$ ,  $p < 0.01$ ). This was negatively correlated with Murf-1 expression ( $r = -0.53$ ,  $p = 0.04$ ). MI also resulted in an increase of Murf-1 expression in Dia ( $2.2$  fold,  $2.8 \pm 0.4$  vs.  $1.3 \pm 0.3$  arb. units,  $p < 0.05$ ) but no difference in ubiquitin content was detectable ( $46.3 \pm 3.7$  vs.  $46.3 \pm 5.9$  arb. units,  $p = 0.99$ ). In contrast to Qua Mn-SOD activity increased with CHF in Dia ( $2.4 \pm 0.5$  vs.  $0.7 \pm 0.3$ ,  $p = 0.01$ ). All observed correlations in Qua could not be detected in Dia.

**CONCLUSIONS:** MI resulted in CHF accompanied by an increase of E3-Ligase Murf-1 and ubiquitinated proteins in peripheral muscle. This increase was significantly correlated with left ventricular dysfunction and decreased antioxidative capacity in quadriceps muscle. One reason for the attenuation of catabolic activation and the increase of Mn-SOD activity in Dia may be a dyspnea related training effect. These findings indicate differential effects of CHF on peripheral skeletal muscle and diaphragm.

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**3000 Board #147 May 30 9:30 AM - 11:00 AM**  
**Lack Of Myosin Light Chain Isoform Expression In The Mechanical Overloaded Obese Zucker Rat Plantaris**

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Myosin light chain (MLC) isoforms play an integral role in modulating maximal shortening velocity and power output in skeletal, cardiac, and smooth muscles. It is thought that the expression of MLCs is regulated, at least in part, by muscle contractile activity. Recent data has suggested that insulin resistance may affect the ability of skeletal muscle to adapt to an overload stimulus. How insulin resistance may affect the regulation of MLC expression following an overload stimulus is not well understood.

**PURPOSE:** The purpose of the study was to investigate the effect of mechanical overload (MOV) on MLC1S (Slow), MLC1F (Fast), and MLC3 expression in the insulin resistant Obese Zucker (OZ) (Lep<sup>fa</sup>) rat plantaris.

**METHODS:** Young (2 mo,  $n = 5$ ) male Lean Zucker (LZ) and young (2 mo,  $n = 5$ ) male OZ rats underwent unilateral surgical ablation of the gastrocnemius muscle to MOV the fast-twitch plantaris muscle for 8 weeks. A 20 mg proximal section from both the OZ and LZ MOV and Contralateral Control Plantaris (CCP) muscle was analyzed for changes in MLC expression using SDS-PAGE.

**RESULTS:** MOV increased MLC1S expression by 50.65% ( $p = 0.02$ ) in the LZ plantaris compared to the LZ CCP. There were no significant differences in MLC1F and MLC3 between the LZ MOV and LZ CCP. Obese Zucker MOV and OZ CCP muscle MLC1S, MLC1F, and MLC3 did not differ significantly. Furthermore, there were no significant differences observed between the OZ MOV, LZ MOV, OZ CCP, and LZ CCP muscle MLC1S, MLC1F, and MLC3 isoforms, respectively.

**CONCLUSION:** These results suggest that insulin resistance may affect the ability of skeletal muscle to alter MLC isoform expression in response to MOV.

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**3001 Board #148 May 30 9:30 AM - 11:00 AM**  
**Feet Alterations Prevalence In Elder Mexican Women.**

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(No relationships reported)

**PURPOSE:** to determine feet musculoskeletal alterations in elder Mexican women.

**METHODS:** We evaluated 182 women mean age  $71 \pm 11.26$  years old (range 51-106). The study consisted of two phases. First, a musculoskeletal evaluation, with emphasis in the morphological and pathological characteristics of the feet, was done. The plantar support was also evaluated. In a second session, feet were measured by means of a 3D digitizer. In addition, the participants' inner antero-posterior footwear length was measured. Data was processed using descriptive statistics. The difference between right and left feet's length, as well as that between feet and footwear's length was assessed by a Student's  $t$  test.

**RESULTS:** At least one musculoskeletal alteration was found in 73.3% of the participants. The most prevalent was *Hallux Valgus* (48.0%), followed by flat foot (37.9%) and cavus foot (28.5%). Statistically significant difference ( $p=0.028$ ) between length of the right and left feet was observed,  $233.25 \pm 11.05$  and  $232.01 \pm 10.13$  cm, respectively. The mean foot length, both sides included, was  $241.5663 \pm 9.17073$  cm. Also, a statistical difference between the footwear and the feet length, right side ( $p=0.001$ ), and left side ( $p=0.001$ ) was found.

**CONCLUSIONS:** The study displays a high prevalence of musculoskeletal alterations in the elder Mexican women feet. Differences between feet and footwear length suggest that inadequate footwear could be a cause for appearance and/or aggravation of these organ musculoskeletal alterations.

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**3002 Board #149 May 30 9:30 AM - 11:00 AM**  
**The Relationship Of Intramuscular Fat And Glucose Tolerance In Hispanic Women**

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Hispanic Americans are 1.5 times more likely to develop diabetes than non-Hispanic whites of similar age, and in almost every age group, the prevalence is higher in women than in men. Intramuscular fat (IMF) in the thigh has been related to impaired glucose tolerance (IGT) and physical inactivity which are risk factors for type 2 diabetes.

**PURPOSE:** The objective of this pilot study was to determine whether thigh IMF and aerobic fitness are related to glucose tolerance in Hispanic females.

**METHODS:** Participants were 18 Hispanic women (29.4 ± 8.3 years). T1-weighted magnetic resonance images of the right thigh were analyzed for IMF and muscle cross-sectional area (CSA). Peak oxygen uptake (VO<sub>2</sub>) during cycle ergometry was assessed, and fasting, 30, 60, and 120-minute glucose levels were measured. Differences between participants with (n=6) or without (n=12) IGT were assessed. Independent t-tests and simple linear regression were performed to assess relationships between IMF and the dependent variables.

**RESULTS:** Participants with IGT had 96 % more intramuscular fat CSA (5.7 ± 3.3 vs 2.9 ± 1.5 cm<sup>2</sup>, P = 0.028) and a higher percentage of IMF (6.8 ± 3.3 vs 3.2 ± 1.5 %, P = 0.005) than non-IGT participants. Peak VO<sub>2</sub> was 33% lower for participants with IGT (P = 0.003). Percent IMF was strongly associated with blood glucose levels for fasting (r<sup>2</sup> = .34), 30 (r<sup>2</sup> = .49), 60 (r<sup>2</sup> = .48), and 120- minutes (r<sup>2</sup> = .54) following glucose ingestion. Peak VO<sub>2</sub> was associated with percent IMF (P = 0.002) and blood glucose at 30, 60, and 120- minutes after glucose ingestion (P < 0.03).

**CONCLUSIONS:** It appears from these preliminary data that fat within the thigh muscle may be associated with impaired glucose tolerance and cardiorespiratory endurance in Hispanic women. Further work is needed to determine the underlying mechanisms behind these relationships.

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**3003 Board #150 May 30 9:30 AM - 11:00 AM**  
**Assessment Of Bone Density In Hispanic Women Living In Rural East Texas**

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(No relationships reported)

Most previous studies evaluating low bone density (BD), osteopenia, osteoporosis and non-traumatic fractures have involved Anglo women. Currently, bone research is being geared to other racial and ethnic groups. However research for bone density in Hispanic women lags behind that of African American and Asian women (Pothiwala, et al., 2006).

**PURPOSE:** To assess Bone Mineral Density (BMD) of the AP spine (APS), femoral Neck (FN), Total Hip (TH), Ultra Distal Forearm (UDF) and the Total Distal Forearm (TDF) in a group of Hispanic women who resided in rural East Texas.

**METHODS:** Subjects (Ss) consisted of 66 volunteer Hispanic women, referred by a private physician or by the Medical Director of the County Health Department. The criteria for Hispanic ethnicity were having a Hispanic surname and having a mother with a Hispanic surname. Anthropometric measures were: standing height, body weight, skinfolds, body circumferences, and skeletal widths. Body density was determined by the skinfold equation of Jackson et al., (1980) and converted to % body fat by the Siri equation (1961). Also, a survey of demographic, lifestyle and nutritional factors was obtained but only the demographic data will be reported here. Bone density was assessed on a Hologic Discovery (Model C) DEXA Bone Densitometer and all scans were obtained by the same technician. World Health Organization (WHO) Standards were used to determine Normal (Nm) Osteopenic (Pa) and Osteoporotic (Po) BMD status.

**RESULTS:** Ss birth places were: Mexico (n=55, 89%), other Central American countries (n=4, 6%), and US (n=3, 5%). Ss from Mexico had lived in the US for 14.1 ± 8.9 yrs, and from Central America for 12.5 ± 8.5 yrs. Means and SDs across all Ss for anthropometric data were: Age= 46.8 ± 5.3 yrs, Standing Ht=152.6 ± 7.1 cm, Body Wt=75.2 ± 14.3 kg, % Body Fat=35.4 ± 4.0 %, BMI=32.3 ± 6.1, and Waist Girth 96.6 ± 12.5 cm. Mean BMD (g/cm<sup>2</sup>) values evaluated by the number of Ss in WHO categories were: AP Spine=0.963 ± 0.098 (Nm=27 Pa=37 Po=2); FN=0.856 ± 0.111 (Nm=52, Pa=14); TH=1.015 ± 0.127, (Nm=61 Pa=5); UDF= 0.415 ± 0.043 (Nm=56 Pa=10); and TDF=0.548 ± 0.038 (Nm=50 Pa=16).

**CONCLUSIONS:** Although these Hispanic women in their mid 40s were overweight, their BMD values showed considerable osteopenia, especially in the spine. Thus, measures should be taken to prevent osteoporosis in this population.

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**G-23 Free Communication/Poster - Neuromuscular**

MAY 30, 2009 7:30 AM - 11:00 AM  
ROOM: Hall 4F

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**3004 Board #151 May 30 8:00 AM - 9:30 AM**  
**Physical Performance In Geriatrics: Affected By Rollator Use?**

Katrin Lucki<sup>1</sup>, Lutz Vogt<sup>1</sup>, Matthias Bach<sup>2</sup>, Bettina Schulze<sup>2</sup>, Winfried Banzer<sup>1</sup>. <sup>1</sup>Goethe-University Frankfurt, Frankfurt/Main, Germany. <sup>2</sup>St. Elisabethen-Krankenhaus Frankfurt, Frankfurt/Main, Germany.  
(No relationships reported)

Ambulation assistive devices are frequently prescribed to reduce fear of falling, increase stability and enhance mobility and independence. Nevertheless, authors have assumed that the regular use of walking aids will predict decline in ADL function and may be associated with hospitalization.

**PURPOSE:** The present study examined the effect of rollator use on gait and stair climbing rehabilitation outcome in geriatric patients.

**METHODS:** In a prospective randomized controlled trial, the admission ambulatory status of geriatric rehabilitation patients, was determined by the Performance-Oriented Mobility Assessment (POMA) and standardized judgements about stair climbing. After initial testing, 55 patients (47 women and 8 men; age range 67-97 years) with a high risk of falling (POMA-T<19) were randomly assigned to the experimental (wheeled walker, n=29) or the control group (no device, n=26). None of the subjects were using assistive devices in their every day lives. Measurements (balance, gait, stair ambulation) were repeated after the inpatient rehabilitation regimen (mean length of stay 28.7 (standard deviation 13.9) days) by a single experienced observer who was blinded to group randomization.

**RESULTS:** Mann-Whitney-U-test did not reveal significant group differences between the POMA-T admission and discharge scores. More than 70% of the patients in both groups (19 control; 21 verum) demonstrated individual functional ability improvements of at least 5 points during rehabilitation (POMA-T). However, at rehabilitation discharge 19 subjects of the control and 24 of the experimental group still demonstrated a increased fall risk. No significant staircase examination differences were observed for device users compared to the control subjects. At discharge less than 5% of both cohorts were able to negotiate stairs with slight or no limitations.

**CONCLUSION:** The present study evidenced that rollator assistance does not interfere with functional gains and rehabilitation outcome. Thus, patients with greater risk of

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**3005 Board #152 May 30 8:00 AM - 9:30 AM**

**Reference Values And Prediction Models Of Sarcopenia In Japanese Men And Women**

Kiyoshi Sanada<sup>1</sup>, Motohiko Miyachi<sup>2</sup>, Kenta Yamamoto<sup>1</sup>, Mitsuru Higuchi, FACSM<sup>1</sup>, Izumi Tabata, FACSM<sup>2</sup>. <sup>1</sup>Waseda University, Tokyo, Japan. <sup>2</sup>National Institute of Health and Nutrition, Tokyo, Japan.

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Sarcopenia is the loss of skeletal muscle mass resulting in a reduction of physical strength and ability to perform activities of daily living. However the reference values and prediction models of sarcopenia for Japanese adults still are not investigated.

**PURPOSE:** The purposes of this study were to investigate the reference values and prediction models of sarcopenia using dual-energy X-ray absorptiometry (DXA) and anthropometric measurements in Japanese men and women.

**METHODS:** Subjects were healthy Japanese men (n=529) and women (n=1239) aged 18-85 yrs. All subjects were randomly separated into 2 groups, a model development group (n=1374) and a validation group (n=394). Appendicular muscle mass was measured by DXA. Reference values for sarcopenia (skeletal muscle index, SMI; appendicular muscle mass/height<sup>2</sup>, kg/m<sup>2</sup>) in each sex were defined as values two standard deviations below the sex-specific means of this study reference data for young adults aged 18-40 years.

**RESULTS:** The subjects with sarcopenia were 2.1 % in men and 1.9% in women. The whole body bone mineral density in sarcopenia men and women ( $1.091 \pm 0.094$  and  $0.918 \pm 0.077$  g/cm<sup>2</sup>) were significantly lower than in normal subjects ( $1.161 \pm 0.103$  and  $1.041 \pm 0.121$  g/cm<sup>2</sup>,  $P < 0.05$ ), respectively. The handgrip strength in sarcopenia men and women ( $42.2 \pm 7.7$  and  $20.9 \pm 4.0$  kg) were significantly lower than in normal subjects ( $44.4 \pm 6.7$  and  $27.0 \pm 5.3$  kg,  $P < 0.05$ ). Stepwise regression analysis indicated that the handgrip strength, body mass, body height and age were independently associated with DXA-measured SMI both in men and women. The SMI prediction equations were applied to the validation group, and significant correlations were also observed between the DXA-measured and predicted SMI (n=386,  $r = 0.918$ ,  $P < 0.001$ ,  $SEE = 0.172$  kg/m<sup>2</sup>). The predicted SMI for the validation group was  $7.299 \pm 0.990$  kg/m<sup>2</sup>, which was very similar to the DXA-measured SMI of  $7.342 \pm 1.153$  kg/m<sup>2</sup>.

**CONCLUSION:** This study provides reference values of sarcopenia, and the prediction models of SMI using anthropometric measurement are valid for alternative DXA-measured SMI in Japanese men and women.

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**3006 Board #153 May 30 8:00 AM - 9:30 AM**

**Effects Of Pilates Mat Work On Pelvic Floor Muscles And Postpartum Depression In Puerperium Women**

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(No relationships reported)

**PURPOSE:** To investigate the effects of Pilates mat work on the pelvic floor muscles and postpartum depression of women in puerperium.

**METHODS:** Puerperium women at postpartum care center of a lying-in hospital located in B Metropolitan City participated in this study and divided into exercise and control group, consisting of 9 and 8 members respectively. Pilates mat work was applied to the exercise group for 7 weeks with 3 days a week, RPE 11-15 and 40-60 minutes per day. Independent t-test (between groups) and paired t-test (within group) were used for data analysis (SPSS ver. 12.0). The statistical significant level was  $p < .05$ . Based on results of the application compared pelvic floor muscles (maximal vaginal contraction pressure and maximal vaginal contraction duration) and postpartum depression (postpartum depression scale) were compared between two groups.

**RESULTS:** Both between-group and within-group comparisons showed that after the exercise, maximal vaginal contraction pressure ( $p < .001$ ) improved in the exercise group. The within-group comparison, it was found that after Pilates mat work, the exercise group showed improvements in maximal vaginal contraction duration ( $p < .05$ ) and postpartum depression scale ( $p < .05$ ). But control group was not statistically difference.

**CONCLUSIONS:** Pilates mat work is an exercise that is effective in improving the pelvic floor muscles and postpartum depression of puerperium women. This suggest that Pilates mat work can be positively used as a postpartum exercise program.

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**3007 Board #154 May 30 8:00 AM - 9:30 AM**

**Response To Prolonged Endurance Training and Detraining In Mitochondrial Myopathy**

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Patients with mitochondrial myopathies (MM) due to mtDNA mutations in skeletal muscle often suffer disabling exercise intolerance. Our previous studies suggest that short duration (14 weeks) endurance training improves exercise capacity and increases the activity of rate-limiting enzymes. The effect of a longer duration exercise training has not been studied.

**PURPOSE:** To assess the effect of 6 months of regular endurance training on exercise capacity and to determine if training adaptations are maintained after a prolonged period of self-selected activity in a patient with severe muscle oxidative impairment due to a mitochondrial myopathy.

**METHODS:** A 26-year male with a heteroplasmic single large-scale deletion of mtDNA underwent 26 weeks of cycle exercise training followed by a 52 week period of self-selected activity level. Peak work, oxygen uptake (VO<sub>2</sub>), and submaximal heart rate and blood lactate were determined at baseline, after training and following 52 weeks of self-determined activity.

**RESULTS:** Compared to baseline, training increased peak work from 110 to 130 watts and VO<sub>2</sub> from 1.527 to 1.837 L/min. During submaximal (50 watt) exercise, peak heart rate decreased from 153 to 120 bpm and venous lactate from 6.41 to 3.25 mM. After 52 weeks of self-selected activity following 6 months of endurance training, peak work and VO<sub>2</sub> fell to 110 watts and 1.684 L/min respectively. During submaximal exercise, after the self-selected activity period compared to post training, heart rate (133 vs. 120 bpm) and lactate levels (4.36 vs. 3.25 mM) were higher.

**CONCLUSION:** Endurance training in MM improved work and oxidative capacity supporting the efficacy of this therapy in patients with mitochondrial myopathy due to single large-scale mtDNA deletions. Despite the substantial benefits of exercise training, the patient did not choose to maintain regular exercise training and after the 52 week period of self-selected activity, exercise capacity declined to near pre-training levels indicating that deconditioning contributes to exercise limitations in these patients and that the applicability of exercise training as therapy is limited by patient motivation.

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**3008 Board #155 May 30 8:00 AM - 9:30 AM**

**Therapeutic Role Of Resistance Training With Vascular Occlusion In Inclusion Body Myositis: A Case Report**

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Inclusion body myositis (IBM) is a rare inflammatory idiopathic myopathy (4-9:1 million) that mainly affects middle-aged to older people. Little or no response to pharmacological treatment is the rule in this chronic, progressive and severe disease. Rehabilitation is indicated in those with stable disease activity but generally limited to mild exercises as intense physical training could possibly worsen muscle inflammation. As low-intensity resistance training with vascular occlusion can yield muscular adaptations comparable to those found in intensive training, we hypothesized that it could improve functional capacity in these patients.

**PURPOSE:** To assess the effects of low-intensity resistance training with vascular occlusion on muscle functional capacity, quality of life and disease activity in patients with IBM.

**METHODS:** A 65-year-old male with IBM (wt: 85 kg; ht: 180 cm;  $\text{VO}_{2\text{peak}}$ :  $10 \text{ ml}^{-1} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ) engaged a moderate resistance training program with vascular occlusion for 12 weeks. We assessed 1RM leg press strength, quadriceps cross-sectional area (by computerized tomography), balance and mobility function (timed up-and-go test), quality of life (SF-36 and HAQ), blood markers of inflammation (VHS, PCR) and muscle damage (CK, LDH, aldolase) at baseline (PRE) and after (POST) the 12-week program. Resistance training was performed twice a week and consisted of 3x15 RM (30 sec between sets) leg-press, knee extension and squat exercises performed with vascular occlusion at 50% of occlusion pressure (determined by doppler at each session).

**RESULTS:** The patient showed improvements in lower limbs strength (11.6%), quadriceps cross-sectional area (4.7%) and balance and mobility function (60%). The SF-36 subscale activities of daily life exhibited great improvements but HAQ scores were not different between PRE and POST. Exercise training did not increase levels of CK, LDH, aldolase VHS or PCR above normal range.

**CONCLUSION:** Low-intensity resistance training with vascular occlusion may improve strength, quadriceps cross-sectional area functional capacity and daily activities without worsening muscle inflammation or disease activity in an IBM patient. Prospective randomized studies should confirm these findings.

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**3009 Board #156 May 30 8:00 AM - 9:30 AM**  
**Active Warm Up On Isokinetic Peak Torque And Hamstring To Quadriceps Ratio**

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Warm up exercise has been practiced widely on the field by coaches and athletes because it is believed that the change in muscular performance play role in injury prevention. However, its effectiveness is still not well defined. Hamstring to quadriceps (HQ) ratio, which use to address the strength imbalance of lower limb, have been used as an index to predict knee injury. A low HQ ratio is proposed to have a higher risk of injury. Therefore, it is interested to see whether active warm up can influence the HQ ratio in order to lower the risk of injury.

**PURPOSE:** The objective of this study is to investigate the effect of active warm up exercises in isokinetic peak torque (PT) and HQ ratio for the sake of injury prevention.

**METHODS:** During four laboratory visits, 21 male subjects (mean age  $34.6 \pm 9.3$  yrs) randomly performed three 15 minutes active warm up protocol (general, task specific and functional) and a control (no warm up). General - constant pace exercise on static bicycle at 60% age predicted maximum heart rate; Task Specific - leg curl exercise with 6 kg load at pace of 70 beats per min; Functional - exercise on bicycle, stepper and trampoline with variable speed and resistance. After each routine, PT and HQ ratio were determined with 5 maximum concentric contractions on right lower limb with isokinetic testing at 60, 180 and 300 °/sec. The HQ ratio was calculated as the ratio between concentric PT of hamstring and quadriceps.

**RESULTS:** There was no significant difference ( $p > 0.05$ ) between each warm up exercise and with control in PT on either quadriceps or hamstring in all test speeds. Also, none of the warm up exercises caused a significant ( $p > 0.05$ ) modification in the HQ ratio.

**CONCLUSIONS:** Active warm up (general, task specific and functional) in comparison to control did not alter PT and HQ ratio with isokinetic testing in concentric mode. Our finding suggested that 15 minutes of warm up failed to improve muscular torque, despite general believe of warm up from athletes and coaches. Also the risk of lower limb injury after may not alter if use HQ ratio as an index.

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**3010 Board #157 May 30 8:00 AM - 9:30 AM**  
**The Effects Of Proprioception Training On Neuromuscular And Sensorimotor Control Abilities In Subjects With Functional Ankle Instability**

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**PURPOSE:** To examine the effects of 6-week proprioception training on neuromuscular and sensorimotor control abilities in subjects with functional ankle instability.

**METHODS:** Ten untrained subjects ( $21.10 \pm 2.42$  yrs,  $166.65 \pm 9.63$  cm and  $58.84 \pm 13.55$  kg) with 11 functional unstable ankles participated in this study. The proprioception training was performed for 30 minutes per day and 3 days per week for 6 weeks. Ankle active and passive joint position sense (JPS), balance steadiness and alpha-motoneuron excitability were measured in the measurement weeks which occurred one week prior to the inception of the proprioception training and one week following the conclusion of proprioception training. The JPS was measured using Biodex system III isokinetic dynamometer (Biodex Medical, Inc., Shirley, NY). Joint reposition absolute errors were recorded in degrees of error from three target angles in active mode and passive mode. The force platform (AMTI Inc., Watertown, MA) was used to measure balance steadiness as the center of pressure (COP) displacement radius in open eye (OE) and closed eye (CE) condition. The maximal M-wave and the H-reflex amplitude were measured in the soleus muscle. Multivariate repeated measurement ANOVA was used to evaluate the effects of training on JPS (mode x target angle x time) and balance steadiness (condition x time) respectively. Repeated measures t-test was used to determine if any difference in Hmax/Mmax ratios before and after training.

**RESULTS:** The results showed there were main effects in the COP displacement radius between OE and CE conditions ( $P < .05$ ,  $F = 25.65$ ) and joint reposition absolute errors between active mode and passive mode. ( $P < .05$ ,  $F = 5.92$ ) There were no significant differences in the COP displacement radius in either OE or CE conditions between pre and post-training and also joint reposition absolute errors in either active mode or passive mode between pre and post-training. However, there was a significant ( $P < 0.05$ ) decrease (10%) in Hmax/Mmax ratios (from  $55.74 \pm 5.65\%$  to  $50.11 \pm 6.28\%$ ) after training.

**CONCLUSIONS:** Motoneuron excitation decreased following the 6-week training. However, 6-week training could not significantly influence the balance steadiness and proprioception in subjects with functional ankle instability.

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**3011 Board #158 May 30 8:00 AM - 9:30 AM**  
**Effects Of Pre-operative Exercise Training On Knee Strength And Proprioceptive Functions After Anterior Cruciate Ligament Reconstruction**

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(No relationships reported)

Anterior cruciate ligament (ACL) has mechanical and proprioceptive functions.

**PURPOSE:** To examine the effect of a short period pre-operative exercise intervention (4weeks) on the muscle strength and proprioceptive functions of patients after ACL reconstruction.

**METHODS:** Sixty male patients(31.5±6.2) who had undergone ACL reconstruction by auto graft-hamstring tendon. Subjects were randomly assigned into two groups: Pre-op exercise group (PEG, n=30) and Pre-op non-exercise group (PNEG, n=30). PEG participated in 4 weeks of pre-operative and 12 weeks of post-operative rehabilitation program with 3 days per week for each program, PNEG only participated in the 12 weeks of post-operative rehabilitation program. The pre-operative rehabilitation program includes gait training and proprioception, quadriceps strengths exercise. The program can be used safely without compromising the initial goals of surgery. We measured concentric peak torque measurements of the knee extensors and flexors at 60°/sec and 180°/sec on an Isokinetic dynamometry. Proprioceptive functions has been assessed using Joint position sense(JPS) and dynamic postural stability. Dynamic postural stability was measured as a stability index in the anterior-posterior and medial-lateral planes with the Biodex Stability System. All tests were measured 4 weeks preoperatively and 3 months postoperatively.

**RESULTS:** At the 60°/sec and 180°/sec of involved knee extensor strength result of PEG was significant higher than PNEG ( $p<.01$ ). In PEG, it increased by  $28.7\pm5.2\%$  at 60°/sec and  $21.7\pm4.4\%$  at 180°/sec for the extensor strength (In PNEG:  $19.6\pm5.7\%$  and  $15.4\pm4.9\%$ , respectively). For the dynamic postural stability index, the improvement of PEG was significantly higher than the result of PNEG( $11.7\pm7.9\%$  vs  $26.2\pm9.2\%$ ,  $p<.05$ ). But, we found no significant difference between the PEG and PNEG for Joint position sense( $1.25\pm0.65^\circ$  vs  $1.40\pm1.03^\circ$ ,  $p=1.00$ ).

**CONCLUSIONS:** The 4 weeks of pre-op exercise may elicit many positive changes for the ACL reconstruction patients. Therefore, the pre-op exercise in ACL reconstruction helps the patient to provide dynamic knee stability and return to work and sport as soon as possible.

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**3012 Board #159 May 30 8:00 AM - 9:30 AM**  
**Effect Of Forced Adduction On Emg Activity Of The Vastus Medialis Oblique And Vastus Lateralis**

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Atrophy of the vastus medialis oblique (VMO) muscle often occurs after knee injury. Since traditional quadriceps exercises do not selectively increase VMO activity, adduction is often added. The literature is divided as to the effectiveness of this practice. Few studies have explored this effect during isotonic closed chain exercises. Additionally, no information is available on the amount of force that must be applied during adduction to elicit a greater response from the VMO than the vastus lateralis (VL) muscle.

**PURPOSE:** To examine the effects of several levels of forced adduction on the electrical activation of the VMO and VL during open and closed kinetic chain exercises and to investigate these effects by gender.

**METHODS:** Twenty subjects, 10 males and 10 females had their VMO and VL electromyographical activity measured during an isometric maximal voluntary contraction (IMC), straight leg raises (SLR), knee extensions (KE), and single leg quarter squats (QS) while using three different levels of forced adduction (0, 10, and 15 lbs).

**RESULTS:** The level of adduction had no significant effect on the activation of the peak or mean VMO, VL, or VMO/VL ratio. The different exercises did have a significant effect on VMO and VL activity. QS and KE elicited a significantly higher peak VMO, VL, and VMO/VL ratio than SLR. When analyzed by gender, males showed a greater peak VMO for KE and QS compared to SLR while females showed a greater peak VMO for KE compared to SLR and QS. Peak VMO/VL ratio revealed a significant gender difference with males showing a greater KE and QS response than females. Comparing the exercises to the IMC showed a significantly higher peak VMO/VL ratio during the QS exercise at 10 and 15 lbs adduction for males and 0 lbs adduction for females.

**CONCLUSIONS:** Although adduction did not significantly increase VMO activity, the findings do suggest that different exercises may elicit a stronger peak response from the VMO than the VL when compared to a maximal contraction. Single-leg QS may be a preferred exercise during VMO rehabilitation. This study also showed males and females respond differently to exercises with the different levels of adduction. Because of this, care should be taken when prescribing rehabilitation for the VMO between males and females; a generic technique may not be successful for both genders.

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**3013 Board #160 May 30 8:00 AM - 9:30 AM**  
**Associations Between Core Strength, Walking Speed, And Age In Women**

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(No relationships reported)

Age-related changes in muscle strength and walking speed are well described in the literature. Knowing what muscles to strengthen to improve walking speed in the geriatric population would improve patient treatment and outcomes.

**PURPOSE:** To investigate the relationship between core strength and self-selected walking speed as a function of age.

**METHODS:** We measured muscle strength in 8 young females (mean=20.6yr) and 10 older females (mean=51.4yr) who participated in a previous study of metabolic cost of walking with belly loads as a function of speed. At the onset of the previous experiment, women were given belly loads equal to 8% of body mass and asked to choose 3 walking speeds on a treadmill: slowest speed with normal gait (SSP), preferred mid-range speed (MSP), and fastest speed with normal gait (FSP). In the current study, manual muscle test scores of four pelvic stabilizing (core) muscle groups were assessed according to Kendall's protocol. Strength scores for back extensors, hip abductors (bi-laterally), upper abdominals, and lower abdominals were collected from each participant.

**RESULTS:** Relationships between abdominal strength and walking speed showed no difference between age groups (age group not significant in regression model): upper ( $p=0.034$ ) and lower ( $p=0.042$ ) abdominal strength were directly correlated with walking speed at MSP and lower abdominal strength was also directly correlated with walking speed at FSP ( $p=0.040$ ). Upper ( $p=0.053$ ) and lower ( $p=0.100$ ) abdominal strength was less in the older cohort while back extensor and hip abductor strength did not differ between age groups.

**CONCLUSIONS:** Because the relationship between abdominal strength and self-selected walking speed was consistent across age groups, it is advisable to assess and treat core muscle weakness in all patients who exhibit decreased walking speed. In the larger population, older individuals are more likely to present with weakened core muscles. Supported by NIH EARDA Grant G11HD03978 6 and the Center of Excellence for Women, Science, and Technology at the College of St. Catherine.

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**3014 Board #161 May 30 8:00 AM - 9:30 AM**  
**Relationship Between Changes In Serum Hormonal Concentration And Performance Following Concurrent Resistance And Endurance Training**

David J. Bentley, PhD<sup>1</sup>, Ehsan Ghahramanloo<sup>1</sup>, Lars McNaughton, FACSM<sup>2</sup>. <sup>1</sup>University of NSW, Sydney, Australia. <sup>2</sup>University of Hull, Hull, United Kingdom.

(No relationships reported)

It is well known that skeletal muscle mass is regulated largely by circulating levels of anabolic and catabolic hormones and that androgens play an important role in muscle

hypertrophy and subsequent strength development. Circulating testosterone and Cortisol have been proposed as physiological markers in both men and women to evaluate the anabolic-catabolic status of the body and have been used to explain the variation in skeletal muscle mass.

**PURPOSE:** To examine the relationship between changes in basal hormone (Cortisol and testosterone) concentration and muscular strength in response to three different training regimes (endurance, resistance and concurrent).

**METHODS:** The subjects recruited for study were 27 untrained young male students that were randomly assigned to an endurance (E), strength (S) or concurrent (C) training group. The E group performed running on treadmill at an intensity of 65% of HR<sub>max</sub> for 16 min at the beginning of training but increased to 80% HR<sub>max</sub> for 30 min toward the end of training period. The S group performed 3 sets with 10 repetitions of bench press, leg curl, lat pull down and squat at 50% of 1RM and increased to 4 sets with 12 repetitions 80% of 1RM. The C group performed the summation of E and S training requirements.

**RESULTS:** Groups S and C showed a significant increase in fat free mass but group E did not show any significant changes. No significant changes in basal Testosterone concentration (ng/dl) were found after training for either group. In group E there was a significant correlation ( $r=0.78$ ;  $p<0.05$ ) between the change (D) in Cortisol and D fat free mass.

**CONCLUSION:** In response to concurrent training it is possible that increases in hypertrophy and muscular strength occur without any modification of basal hormone concentration. However it is also possible that transient changes in anabolic hormone production or other growth factors following exercise reflect changes in strength and muscle morphology with concurrent training.

### 3015 Board #162 May 30 8:00 AM - 9:30 AM Evaluation Of Vibration Training Platforms

Heather Corrie<sup>1</sup>, Katherine Brooke-Wavell<sup>1</sup>, Tahir Masud<sup>2</sup>, Neil Mansfield<sup>1</sup>. <sup>1</sup>Loughborough University, Leicestershire, United Kingdom. <sup>2</sup>Nottingham University Hospitals NHS Trust and University of Derby, Nottingham, United Kingdom.

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(No relationships reported)

Whole-body vibration (WBV) training is an emerging treatment with potential benefits for muscle and bone health. There are several WBV devices and the differences are not easily quantifiable. The development of legislation designed to minimise occupational exposure to WBV has led to the formation of standards to quantify vibration 'dose' incorporating the human response at different frequencies.

**PURPOSE:** This experiment numerically describes the vibration delivered by six devices according to the methods outlined in the Physical Agents (Vibration) Directive [PA(V)D; 2002].

**METHODS:** Acceleration was measured and analysed according to ISO 2631-1 (1997). Comparisons were made between devices, at a range of user modifiable settings where available.

**RESULTS:** All of the devices produced sinusoidal vibration in the vertical axis. The Galileo with a tilting action was the only device which delivered noteworthy vibration in more than one axis. Combinations of displacement and frequency resulted in an extensive range in magnitude of vibration in the vertical axis [1.05-112.53 r.m.s. m/s<sup>2</sup>; 0.23-22.64 r.m.s. (weighted) m/s<sup>2</sup> (see Figure 1)]. The devices with user modifiable settings provided a range of frequencies at fixed displacements. This characteristic was such that vibration 'dose' was similar for different frequencies at each displacement setting for the devices delivering higher frequency vibration [see Figure 1(b)].

**CONCLUSIONS:** The marked differences in vibration magnitude between platforms emphasise the need to describe WBV training protocols in precise terms. PA(V)D provides a standardised way to quantify vibration 'dose' however more research is required to compare the human response to tilting and vertical vibration.

### 3016 Board #163 May 30 8:00 AM - 9:30 AM Relationships Among Measures Of Muscle Strength, Power And Functional Outcomes In Older Men

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(No relationships reported)

Many tests have been designed to evaluate skeletal muscle strength in older adults. Due to its low cost and ease of administration, handgrip dynamometry (HD) often serves as a surrogate measure for total body strength and is used as such to examine relationships between strength and physical function. Whether HD is a reasonable alternative for these purposes has not been well established.

**PURPOSE:** To examine the relationships among HD, leg and chest press (LP, CP) strength and power and functional outcomes in older men.

**METHODS:** One-Hundred and fifty-five men (72 ± 6 yr) performed dominant HD, LP and CP 1-repetition maximum (1RM) and LP and CP power tests. Unloaded and loaded timed 50-m walks (UW, LW) and a 12-step stair climb (USC, LSC) were used as functional measures. Loads consisted of carrying 20-25% body weight. Pearson product-moment correlations were calculated to determine associations. Statistical significance was set at  $P<0.05$ .

Variable	Unloaded Walk		Loaded Walk		Unloaded SC		Loaded SC	
	r	p	r	p	r	p	r	p
HD	-0.21	0.002	-0.35	<0.0001	-0.19	0.022	-0.26	0.002
LP 1RM	-0.46	<0.0001	-0.53	<0.0001	-0.44	<0.0001	-0.48	<0.0001
CP 1RM	-0.34	<0.0001	-0.44	<0.0001	-0.32	<0.0001	-0.39	<0.0001
LP Power	-0.53	<0.0001	-0.59	<0.0001	-0.48	<0.0001	-0.50	<0.0001
CP Power	-0.39	<0.0001	-0.48	<0.0001	-0.53	<0.0001	-0.39	<0.0001

**RESULTS:** HD was weakly, but significantly, correlated with LSC, LP and CP 1RM and power ( $r \leq 0.490$ ,  $P<0.05$  for all associations). LP 1RM was significantly correlated with CP 1RM ( $r=0.66$ ), LP power ( $r=0.77$ ), and CP power ( $r=0.65$ ). For all functional measures, HD exhibited statistically significant, but weaker correlations than those seen with the dynamic strength and power measures:

**CONCLUSION:** These data suggest only weak relationships between HD and dynamic strength and power measures and with two common measures of physical function. Leg press power demonstrated the strongest relationship with physical function measures. The use of HD as a strength measure for examining relationships between strength and physical function should be avoided.

### 3017 Board #164 May 30 8:00 AM - 9:30 AM Acute Effects Of Aquatic Exercise On Gait Patterns In Patients With Lower Extremity Arthritis

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(No relationships reported)

**PURPOSE:** It is well-established that individuals with lower extremity arthritis experience difficulty in walking; it is difficult for them to walk fast and for a long distance. However, they are capable of walking and moving their lower extremities in water with ease. Our previous studies have shown the acute effects of aquatic exercise on their postural control. The purpose of this study was to investigate its effects on their gait patterns.

**METHODS:** Subjects included 7 females with lower extremity arthritis (60.6 ± 6.1 years). They gave written informed consent to participate. They were asked to walk at their usual speed and at a fast speed (as fast as possible) before and after an aquatic exercise session. The gait patterns were recorded with digital video camera from the side (60 fps).

The image data was analyzed using 2-D panning direct liner transformation (DLT) method; further, the average values of walking speed, step length and step frequency were calculated. The exercise session in water lasted 70 min; it consisted of 20-min warm up and walking, 15-min resistance exercise and stretching in water, 10-min break, 20-min walking or swimming, and 5-min cooling down. The pre- and post-exercise data were statistically compared using paired *t*-test.

**RESULTS:** Significant increases were observed ( $p < 0.05$ ) in walking speed (1.53 vs 1.65 m/sec; pre vs post), step length (59.5 vs 60.8 cm), and step frequency (2.54 vs 2.68 Hz) in walking at a fast speed following an aquatic exercise session, while there were no significant differences in these variables in walking at a usual speed. However, the difference between step lengths with right and left leg support in walking at a usual speed decreased significantly (6.66 vs 3.99 cm) ( $p < 0.05$ ) following an aquatic exercise session.

**CONCLUSIONS:** This study revealed the acute effects of aquatic exercise on gait patterns of patients with lower extremity arthritis; walking speed and step length, and step frequency in walking at a fast speed increased, and difference between right and left step lengths in walking at a usual speed decreased following an aquatic exercise session.

**3018 Board #165 May 30 8:00 AM - 9:30 AM**

### The Influence Of Exercise Volume In Chronic Non-specific Low Back Pain Rehabilitation

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(No relationships reported)

Approximately 80% of North Americans suffer from low back pain, and 85% of these are diagnosed as chronic non-specific low back pain (CLBP). In 2005, the economic cost associated with back pain was ~\$38 million as reported by Workers' Compensation Board-Alberta.

**PURPOSE:** To determine the impact of 3 different volumes of CLBP rehabilitation (exercise therapy) on the outcome measures of strength, pain, and quality of life (QOL).

**METHODS:** One hundred and twenty (N=30/group) CLBP males were randomly assigned to one of the following groups: 2 days/wk (2D), 3 days/wk (3D), 4 days/wk (4D) rehabilitation, or Control (C; no rehabilitation). Rehabilitation group participants completed a 2-wk exercise familiarization period. Musculoskeletal (repetition maximum) testing occurred following familiarization at baseline, wks 8 and 12. The participant's pain (11-point visual analogue scale; VAS) and QOL (Short Form-36: Physical and Mental Composite Summaries) were measured at baseline, wks 8 and 12.

**RESULTS:** The *p*-level was set at  $\leq 0.05$ . There were no significant differences between groups at baseline, but significant differences were present within groups across time and between groups on strength, pain, and QOL (Table). All rehabilitation groups were significantly different than the control group at wk 12.

**CONCLUSION:** A volume of 4 days/wk demonstrated greater improvement in outcome measures, especially pain and QOL, than either 2 or 3 day/wk programs. Sponsored by the Augustana Research grant.

	Baseline	Week 8	Week 12
<b>Bench Press (1RM; kg)</b>			
2D	46.8±8.2	51.0±9.1	53.2±9.7B
3D	45.9±8.5	52.8±8.8A	54.6±9.1B
4D	48.6±7.8	56.9±9.3AD	62.3±9.4BCD
C	44.1±8.8	45.8±9.1	46.1±8.9
<b>Lat Pulldown (1RM; kg)</b>			
2D	45.5±6.2	48.4±6.9	49.5±7.4B
3D	47.7±6.8	54.4±7.3A	56.3±7.7B
4D	48.4±5.7	57.0±6.3AD	61.9±7.1BD
C	35.9±5.3	37.0±5.0	37.3±6.1
<b>Leg press (1RM; kg)</b>			
2D	118.2±20.3	127.6±22.6	131.8±24.1B
3D	122.7±21.7	139.9±23.3A	145.5±25.2B
4D	125.1±22.1	145.4±22.4AD	155.9±24.8BCD
C	118.2±23.0	120.5±22.0	121.9±23.0
<b>Pain (0-10)</b>			
2D	4.8±0.9	4.3±1.1	3.9±1.2B
3D	5.1±1.0	4.4±0.9	3.8±1.1B
4D	5.3±0.9	4.5±0.9A	3.0±1.0BCDE
C	4.9±0.6	5.2±0.7	5.1±0.8
<b>Physical Composite Summary (0-100)</b>			
2D	41.1±4.8	44.0±5.3	47.6±5.9B
3D	42.4±5.2	45.8±5.7	48.7±6.2B
4D	40.6±5.3	47.7±6.1A	59.8±6.4BCDE
C	40.7±5.0	41.4±5.3	42.2±5.1
<b>Mental Composite Summary (0-100)</b>			
2D	44.6±5.2	46.3±6.2	48.7±6.3
3D	46.2±5.7	48.5±6.1	49.9±6.5
4D	47.6±6.0	51.2±6.3	57.9±6.8BDE
C	42.0±5.2	43.4±5.8	41.2±5.6

Values presented as (mean±SD).

<sup>A</sup> significant difference from baseline to wk 8.

<sup>B</sup> significant difference from baseline to wk 12.

<sup>C</sup> significant difference from wk 8 to 12.

<sup>D</sup> significant difference between 2D and 4D.

<sup>E</sup> significant difference between 3D and 4D.

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## G-24 Free Communication/Poster - **Observational Studies in Diverse Populations**

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

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### 3019 Board #166 May 30 9:30 AM - 11:00 AM

#### **The Effects Of A Healthy Lifestyle Intervention On Physical Activity And Aerobic Capacity In Minority Girls**

Jessica McLeod<sup>1</sup>, Stephanie Kellam<sup>1</sup>, Marilynn Graham<sup>1</sup>, Kendall McCarley<sup>2</sup>, Kayce Hall<sup>1</sup>, Rhonda Scherer<sup>1</sup>, Eugene Chaung<sup>1</sup>, Jill A. Bush, FACSM<sup>3</sup>, Norma Olvera<sup>1</sup>. <sup>1</sup>University of Houston, Houston, TX. <sup>2</sup>University of Denver, Denver, CO. <sup>3</sup>Towson University, Towson, MD.

(No relationships reported)

Despite the low activity levels in minority girls, few interventions have been conducted to promote physical activity levels with this population.

**PURPOSE:** To assess the impact of a 4-week healthy lifestyle summer program on: a) increasing minutes of daily moderate-vigorous physical activity (MVPA), b) increasing aerobic capacity, and c) increasing preference for physical activity in overweight Hispanic and African American girls. A secondary purpose was to assess the impact of the program on reducing weight, waist girth, and percentage of body fat.

**METHODS:** Thirty-eight Hispanic and African American girls aged 8-14y (11.5±1.4y) and their parents participated. Fifteen percent of the girls were at risk for overweight (BMI 85%-94%) and 85% were categorized as being overweight (BMI >95%). Girls participated in 3-4 different physical activities (e.g., Hip-Hop, Latin dance, Pilates, martial arts, yoga, spinning, sports, cheerleading, and circuit training) per day and received daily nutrition classes for 4-weeks. Girls also engaged in self-esteem enhancing activities. Participant's parents participated in 2 hour weekly workshops. Accelerometry and a timed one-mile run assessment were used to determine changes in physical activity and aerobic capacity respectively. Child's height and weight, waist girth, and body fat % were assessed pre-and post intervention.

**RESULTS:** The BOUNCE healthy lifestyle summer camp program had a significant impact on girls' average minutes of daily MPVA increasing from the 69.1 to 89.5 minutes ( $p<0.001$ ) and on aerobic capacity, with the average number of minutes taken to complete a one-mile run decreasing from 19.5 to 16.6 minutes ( $p<0.0005$ ) from beginning to the end of the program. The BOUNCE program also had an impact on physical activity preferences such that preferences for specific physical activities (listed above) taught during the intervention significantly increased ( $p<0.0005$ ). Additionally, participant's body weight ( $p=0.002$ ) and waist circumference ( $p<0.0005$ ) significantly decreased, but not their percentage of body fat ( $p=0.283$ ).

**CONCLUSIONS:** Results from this study indicated that a healthy lifestyle intervention can positively impact physical activity levels and aerobic capacity in overweight minority girls.

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### 3020 Board #167 May 30 9:30 AM - 11:00 AM

#### **Changes In Fatness In Norwegian Children, 2000-2005**

Elin Kolle, Jostein Steene-Johannessen, Lars B. Andersen, Sigmund A. Anderssen. *Norwegian School of Sport Sciences, Oslo, Norway.*

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(No relationships reported)

The prevalence of overweight and obesity among children is increasing worldwide. There is, however, a lack of studies investigating change in the distribution of body fat. This knowledge is essential as central adiposity has been shown to be more strongly associated with type 2 diabetes and dyslipidaemia, than overall fatness in adults. Moreover, visceral adipose tissue is directly associated with low density lipoprotein cholesterol and triglycerides, and inversely related to high density lipoprotein cholesterol among children.

**PURPOSE:** To investigate 5-year changes in waist circumference, skinfold measures, and body mass index (BMI) among 9- year-old children living in Oslo, Norway.

**METHODS:** A total of 854 9-year-olds measured in the European Youth Heart Study (2000) and in the Physical Activity in Norwegian Children Study (2005) were included in the analyses. Indicators of body fatness were skinfold thickness (triceps, biceps, subscapular and suprailiac), waist circumference and body mass index (BMI; in kg/m<sup>2</sup>). The International Obesity Task Force (IOTF) cut-offs were used to define overweight and obese subjects. Changes in fatness were tested by using general linear models, adjusted for age and sexual maturity.

**RESULTS:** In 2005, 9-year-old girls had significantly higher BMI ( $p = 0.04$ ), waist circumference ( $p < 0.001$ ), and all 4 skinfold measures ( $p<0.001$ ) than girls in 2000. Nine-year-old boys increased their waist circumference by 2.2 cm ( $p = 0.002$ ), and their triceps ( $p=0.02$ ) and suprailiac ( $p=0.02$ ) skinfold measures between the study periods. The overall prevalence of overweight and obesity was slightly higher in 2005, however, chi-square analysis revealed that the increase was significant in girls only ( $p = 0.04$ ).

**CONCLUSIONS:** In 9-year-old children living in Oslo, there have been increases in measures of fatness and central adiposity over the last 5 years. The increase was more pronounced in girls than boys. The results indicate that the reported increases in BMI under-estimates the increase in body fatness among children.

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### 3021 Board #168 May 30 9:30 AM - 11:00 AM

#### **The Gap In Physical Fitness Levels Among Young Children**

kosho kasuga<sup>1</sup>, takahiro nakano<sup>2</sup>, tomohtoko murase<sup>3</sup>, kayo kumagai<sup>1</sup>, kazuo oguri<sup>4</sup>, toshiki tachi<sup>4</sup>, kiyoji tanaka, FACSM<sup>5</sup>. <sup>1</sup>Gifu University, gifu, Japan. <sup>2</sup>Nagoya Gakuin University, nagoya, Japan. <sup>3</sup>Aichi University, nagoya, Japan. <sup>4</sup>Shizuoka Sangyo University, iwata, Japan. <sup>5</sup>University of Tsukuba, tsukuba, Japan. (Sponsor: Kiyoji Tanaka, FACSM)

(No relationships reported)

The physical fitness levels of Japanese pupils have been on a decline year by year after peaking in 1985. The decline is already apparent in young children, according to an in-depth analysis of the data collected on this group. Moreover, the difference between individuals is expanding, and this gap has come to be seen not only in the economy and scholastic abilities but also their physical fitness levels. However, the age at which the gap in fitness levels arises is unclear.

**PURPOSE:** The purpose of this study to examine the gap in physical fitness levels among young children from age of three until the age of five. The study analyzed data obtained through a pursuit measurement of the same subjects conducted for a period of three years.

**METHODS:** The subjects were 206 young children (104 boys and 102 girls) with standard physiques. We administered physical tests comprising seven types of exercises (grip strength, standing long jump, softball throw, 25-m run, side-step, upright hand standing time, and sitting trunk flexion) to understand their physical fitness characteristics; the tests were conducted every year in November for three years. Finally, the subjects were divided into the upper-ranking group (25%) and the lower-ranking group (25%) on the basis of the results of the physical tests at three-years old that corrected the age; further, the extent to which the gap between the two groups changed after two years was examined for each type of exercise. To conduct a statistical analysis of the data, a two-way ANOVA and the multiple comparisons were employed.



**RESULTS:** The analysis revealed a significant difference between the two groups for all types of exercises (in the case of both boys and girls). The gap reduced with each passing year for the side-step, 25-m run, and sitting trunk flexion. The exercise types for which the gap reduced until the age of four were grip strength and standing long jump. In the case of softball throw and upright hand standing time, the gap reduced until the age of four and then increased at the age of five. However, the gap did not reverse at the age of five for any exercise type.

**CONCLUSIONS:** The level of physical fitness at the age of five remains strongly influenced by that at the age of three. The results suggested that the gap in the physical fitness among Japanese pupils has already begun to be observed in young children.

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**3022 Board #169 May 30 9:30 AM - 11:00 AM**  
**Contribution Of Organized Sport Participation To Estimated Daily Energy Expenditure: Preliminary Results Of Portuguese Boys**

Aristides MC Machado Rodrigues<sup>1</sup>, José Proença<sup>1</sup>, Manuel J. Coelho e Silva<sup>1</sup>, Jorge Mota<sup>2</sup>. <sup>1</sup>University of Coimbra, Coimbra, Portugal. <sup>2</sup>University of Porto, Porto, Portugal.

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(No relationships reported)

**PURPOSE:** National Statistics from sport participation showed a substantial increase of 42% in the amount of regular participants in the period 1996-2003 (Adelino et al., 2005). In addition, organized sport is among the major sources of physical activity in children and youth. The present study examines the contribution of organized sport in daily energy expenditure.

**METHODS:** The sample is composed of 129 boys aged from 13 to 14 years. Somatic characteristics included weight, stature, sum of six skinfolds and waist circumference. Energy expenditure [EE] and EE in moderate-to-vigorous physical activity [MVPA] were assessed using the 3-day diary (Bouchard et al., 1983). The diary also provided information on TV viewing and screen activities [TV&SC]. Organized sport effect was tested on total EE, EEMVPA and time spent in TV&SC.

**RESULTS:** Organized sport contributed to 13.2% of daily energy expenditure and to 40% of its moderate to vigorous physical activity portion. Compared with peers who did not engage in sport activities, boys who participated in organized sports spent higher values of daily EE [46 Kcal/Kg/day versus 43 Kcal/Kg/day,  $p < 0.05$ ], specially during week days [47 Kcal/Kg/day versus 44 Kcal/Kg/day,  $p < 0.05$ ]. Sport participants were also more active in moderate to vigorous physical activity [16 Kcal/Kg/day versus 11 Kcal/Kg/day,  $p < 0.05$ ] and tend to spend less time in screen activities during week days [162 minutes/day versus 146 minutes/day, respectively for participants and non-participants].

**CONCLUSIONS:** In summary, organized sport is a major contributor of moderate-to-vigorous portion of daily EE although it only accounted for 13% of total daily EE. It is also of interest to note the trend for less time devoted to screen activities among sport participants, suggesting that participation in supervised sport may also contributes to avoid sedentary activities, more evident during week days.

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**3023 Board #170 May 30 9:30 AM - 11:00 AM**  
**Levels And Determinants Of Physical Activity In Puerto Rican Adolescent Girls**

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(No relationships reported)

Physical activity (PA) is known to decline from childhood to adulthood, particularly in girls during adolescence. Childhood obesity is a known health problem in Puerto Rico; however, physical activity has not been described in this population.

**PURPOSE:** The purpose of this study was to describe PA levels and determinants in a group of Puerto Rican adolescent females aged from 11-16 years.

**METHODS:** Forty adolescent females wore an ActiGraph accelerometer during 6 consecutive days, and completed a PA questionnaire. They were grouped according to their age (11-13, and 14-16 yr). Parents completed a socio-demographic and physical activity questionnaire. ANOVA and independent t-tests were used to identify differences in moderate to vigorous PA (MVPA) by age group and between adolescents and their parents. Multiple regression analysis was performed to evaluate PA determinants (socioeconomic status, parent's education and PA, shared PA between parents and daughters).

**RESULTS:** MVPA averaged  $87 \pm 54$  min/week in all adolescent females. No significant difference in MVPA was observed by age (11-13 =  $87 \pm 58$ , 14-16 =  $86 \pm 50$  min/week,  $P = 0.95$ ). A significant association was observed between parents and adolescents MVPA ( $r = 0.67$ ,  $P < 0.01$ ). The more influential factors in adolescents MVPA were the parents MVPA and the days the parents shared PA with their daughters.

**CONCLUSION:** Puerto Rican adolescent females failed to comply with the recommended 60 min of MVPA every day. Parents involvement must be considered in any intervention designed to help increase PA levels in this population.

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**3024 Board #171 May 30 9:30 AM - 11:00 AM**  
**Physical Activity Measurement Of 10-14 Year Old Northern Plains American Indian Youth**

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The health benefits of physical activity (PA) include improved cardiovascular, bone and muscle health, and decreased risk of obesity and related diseases like type 2 diabetes and heart disease. The ACSM and AMA guidelines state that for health, youth should engage in at least 60 min of moderate to vigorous physical activity (MVPA) at least 5 days per week or for aerobic fitness, 20 min of vigorous physical activity (VPA) three or more days per week.

**PURPOSE:** This pilot study assessed the feasibility of using 7-day accelerometry to measure PA in Northern Plains American Indian (AI) youth and to describe that PA as part of the outcomes of a primary prevention health curriculum.

**METHODS:** Youth, ages 10-14 years ( $n = 27$ ), were recruited from two Northern Plains AI reservation communities to participate in a pilot study of an age-adapted and culturally specific health curriculum. In addition to anthropometric, biological, and survey measures, students wore a wrist accelerometer to record PA for 7 days. Activity was recorded in 1 min epochs which were later converted to minutes of sedentary, light, moderate, and vigorous activity.

**RESULTS:** Usable PA data were obtained from 19 of the AI youth in the pilot. All met the youth PA health guidelines (mean MVPA =  $131 \pm 42$  min/day). When BMI were evaluated by age and gender percentile, students below the 85<sup>th</sup> percentile engaged in more daily MVPA (MVPA for  $< 85^{\text{th}}$  =  $146.2 \pm 45.1$  min/day) than youth at or above the 85<sup>th</sup> BMI percentile (MVPA for  $> 85^{\text{th}}$  =  $96.9 \pm 48.3$  min/day,  $p = 0.03$ ). None of the 19 AI youth met the fitness guidelines (VPA =  $4.0 \pm 7.1$  min/day).

**CONCLUSION:** These data show that the Northern Plains American Indian youth participating in this pilot study were meeting the national PA guidelines for health, but not fitness. The 7-day accelerometer compliance was lower than expected, however subsequent trials of the curriculum have provided opportunities to strengthen accelerometer methods in this population and increase AI youth compliance to the PA measurement. These preliminary data suggest that education focusing on ways to meet national guidelines for daily fitness is just as important as teaching ways to meet daily physical activity recommendations for health.

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3025 Board #172 May 30 9:30 AM - 11:00 AM

**Physical Activity Differences By Birthplace And Sex In Youth Of Mexican Heritage**

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( H. Oh, N/A, Salary; N/A, Salary; NA, Salary; N/A, Royalty; N/A, Intellectual Property; N/A, Consulting Fee; N/A, Honoraria; N/A, Contracted Research; N/A, Ownership Interest.)

**PURPOSE:** One of the goals of *Healthy People 2010* (USDHHS, 2000) is to reduce health disparities among different racial and ethnic segments of the U.S. population. Few studies have been conducted to examine physical activity (PA) differences by birthplace and sex in youth of Mexican heritage. The purpose of this study was to determine whether PA differs by birthplace and by sex in youth of Mexican heritage.

**METHODS:** Participants were 101 youth (43 boys, 58 girls, M  $\pm$  SD age of 14.8  $\pm$  1.4 yrs). Approximately 59% were US-born and 41% were Mexico-born. Physical activity was assessed using a piezo-electric pedometer with a moderate to vigorous physical activity (MVPA) timer. Participants wore the pedometers for 7-days and recorded daily time worn on a PA log. Independent *t*-tests were used to determine whether the average number of steps taken per day (steps/d) and the average accumulation of MVPA time in minutes per day (min/d) differed by birthplace and sex. We intended to use chi-square tests to determine whether the percentage of youth who met the recommended values of 15,000 steps/d for boys and 12,000 steps/d for girls (Tudor-Locke et al., 2004) and the percentage of youth who met the recommended 60 min/d of MVPA (Strong et al., 2005) differed by birthplace and sex. However, insufficient numbers of youth met the PA recommendations.

**RESULTS:** Mexico-born youth took more steps, on average, than their US-born counterparts (8527.2  $\pm$  3059.1 vs. 7273.5  $\pm$  2859.4 steps/d, *p* = 0.038). However, MVPA time did not differ between Mexico- and U.S.-born youth (22.9  $\pm$  13.6 vs. 19.1  $\pm$  12.3 min/d, *p* = 0.146). By contrast to birthplace, sex-related differences were more consistent, as boys took more steps (8815.4 vs. 7016.7  $\pm$  2170.2 steps/d, *p* = 0.005) and accumulated more MVPA time (23.9  $\pm$  16.0 vs. 18.2  $\pm$  9.5 min/d, *p* = 0.043) than girls. Only 2 Mexico-born boys, 1 Mexico-born girl, 1 U.S.-born boy, and no U.S.-born girls met either one or both of the recommended amounts of PA.

**CONCLUSIONS:** We conclude that PA may differ by birthplace and by sex in youth of Mexican heritage, as U.S.-born girls were the least active segment of our sample. Culturally sensitive interventions to increase daily PA through school PE and community programs must become a higher public health priority for all youth of Mexican heritage and, in particular, for U.S.-born girls of Mexican heritage.

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3026 Board #173 May 30 9:30 AM - 11:00 AM

**Pedometer-determined Physical Activity Levels In A Diverse Sample Of College Students**

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(No relationships reported)

**PURPOSE:** Current research indicates that 30-50% of college students do not meet physical activity guidelines recommended by the American College of Sports Medicine. Limited research has been done regarding physical activity levels in a diverse sample of college students. The purpose of this study was to quantify physical activity levels using pedometers in a racially and ethnically diverse sample of college students.

**METHODS:** One hundred forty-six college men and women (72 caucasian students and 74 students of color) between the ages of 18-40 yrs participated in the study. The racial and ethnic composition included 37 African-American students, 24 Asian students, 10 Latino students, and 3 from "other" ethnic backgrounds. All of the participants signed an informed consent document, and completed a Demographic and Health History Questionnaire and a Physical Activity Preferences and Barriers Questionnaire. Participants wore a pedometer (Yamax SM200) for five days (i.e., Saturday through Wednesday), and logged pedometer steps and activities performed onto a five-day activity diary.

**RESULTS:** Descriptive statistics were computed and the data were analyzed with independent *t*-tests. Mean pedometer steps per day for the entire sample was 9803 (sd= 3652). Results indicated that there was a significant difference (*p*=.007) in pedometer steps between students of color and caucasian students. Pedometer steps for students of color averaged 8998 (sd= 3275) in comparison to an average of 10631 steps (sd= 3395) for caucasian students.

**CONCLUSIONS:** It is concluded that caucasian students had higher pedometer counts than students of color, and additional research is warranted examining factors related to physical activity behavior in multi-racial and ethnically diverse samples of college students.

Research was Supported by the University of Wisconsin Virginia Horne Henry Fund.

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3027 Board #174 May 30 9:30 AM - 11:00 AM

**Obesity And Motor Abilities Of Primary School Children With Migration Background**

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**PURPOSE:** Overweight and obesity in childhood is increasing worldwide while physical inactivity is decreasing steadily. The socio-economic status and migration background play important roles in this development. There is a need for drawing up effective strategies to prevent children from developing overweight. Within this paper the baseline data of the URMEL-ICE-study were presented.

**METHODS:** The URMEL-ICE-study is a randomized controlled intervention study for 1120 primary school children out of the region of Ulm, Germany, for primary prevention. Endpoints of the study are: anthropometric data (body height, body mass) and motor tests. For evaluating childrens' motor abilities eight standardized test items for assessing endurance performance, coordinative skills, physical strength, velocity and flexibility were combined. 1055 children (569 boys; 486 girls) took part in the baseline examination. The children were 7.5  $\pm$  0.4 years old; 54% were boys, 46% girls. 27.6% of the children had a migration background.

**RESULTS:** 13.7 % of the boys and 10.5% of the girls were overweight. Within the group of children with migration background 21.1% (boys) and 12.2% (girls) were overweight. 5.1% of the boys, 3.7% of the girls were obese; with migration background: 10.2% boys and 3.7% girls were obese. The children had disorders in all coordinative test items. Regarding the endurance performance and coordination skills children with a higher BMI-SDS produced the lowest results (*p*≤0.001). Children with migration background (*n*=283) achieved significantly lower scores in 7 out of 8 items of the motor tests than children without migration background (*n*=771).

**CONCLUSIONS:** Boys with migration background have the highest risk for developing overweight and obesity. In Addition, children with migration background have lower motor skills and a higher risk to develop motor disorders than children without migration background. Children with a higher BMI are at a disadvantage regarding the endurance performance and coordinative abilities; there are no differences between weight classes regarding the physical strength.

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3028 Board #175 May 30 9:30 AM - 11:00 AM

**Association Between Sedentary Activity and CVD Risk Factors in Korean Children and Adolescents**

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**PURPOSE:** This study investigated whether sedentary activity (SA) was associated with CVD risk factors in 577 healthy Korean children and adolescents, aged 12 to 18 years, in the 2005 the Korean National Health and Nutrition Examination Survey (KNHANES).

**METHODS:** SA was measured using self-report questionnaires including items for time spent on TV watching and computers or video games during weekday and weekend. Height, weight, waist circumference (WC), and CVD risk factors such as LDL cholesterol (LDL-C), HDL cholesterol (HDL-C), total cholesterol (TOT-C), triglyceride (TG), glucose, systolic blood pressure (SBP), and diastolic blood pressure (DBP) were measured by trained health examination staff at the mobile examination center. Overweight among children was defined based on the age and gender specific body mass index cutoff points established by the US Centers for Disease Control and Prevention. PA was measured using self-report questionnaires including questions for frequency and duration of moderate and vigorous PA during past seven days.

**RESULTS:** The odds ratios for low HDL-C (OR=1.12, 95%CI:1.05-1.18), high TG (OR=1.25, 1.17-1.33), high SBP (OR=1.27, 1.11-1.45), and high DBP (OR=1.07, 1.01-1.12) were significantly increased as BMI increased after adjusting for age, sex, and PA. PA and SA were not significantly correlated, but individual SA were positively correlated with each other ( $r=0.16-0.45$ ,  $p<0.001$ ) among boys and girls. Age, gender, and PA adjusted logistic regression revealed that the risk of high adiposity such as BMI (OR=1.16, 1.02-1.33) and WC (OR=1.30, 1.10-1.54), and low HDL-C (OR=1.28, 1.10-1.48) increased as daily TV time increased. The odds ratios for high central adiposity (OR=1.25, 1.06-1.48), high TG (OR=1.17, 1.00-1.37), and high SBP (OR=1.36, 1.00-1.44) increased as time spent on PC use increased.

**CONCLUSION:** SA in Korean children and adolescents was associated with adiposity indices such as BMI and WC and CVD risk factors such as Low HDL-C, high TG, and systolic hypertension. More efforts are needed to reduce SA in Korean children and adolescents.

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**3029 Board #176 May 30 9:30 AM - 11:00 AM**

**Physical Activity, Cardiorespiratory Fitness And The Metabolic Syndrome In Adolescents**

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(No relationships reported)

**PURPOSE:** To verify the relationship between physical activity and cardiorespiratory fitness levels with the metabolic syndrome in Brazilian adolescents.

**METHODS:** A random sample of 236 girls (mean age, 14.52±1.76 years) and 203 boys (mean age, 14.7±1.83 years) was selected for the study. Physical activity level was determined using the Bouchard questionnaire. Cardiorespiratory fitness was estimated by the Leger 20-meter shuttle run test. Terciles were used to classify the subjects as low, moderate and high physical activity and fitness levels. The metabolic syndrome components assessed included waist circumference, blood pressure, HDL-cholesterol, triglycerides, and fasting plasma glucose.

**RESULTS:** Higher prevalence of the metabolic syndrome was observed in adolescents with low physical activity (males, 13.6%; females, 7.7%) and low cardiorespiratory fitness (males, 20%; females, 10.3%) levels. Significant relationships were found for males between metabolic syndrome with low physical activity (OR: 5.13; 95% CI: 1.06-24.73) and low cardiorespiratory fitness levels (OR: 8.75; 95% CI: 1.89-40.46).

**CONCLUSIONS:** The prevalence of the metabolic syndrome is high among adolescents with low physical activity and fitness levels; a significant relationship between the metabolic syndrome, physical activity, and cardiorespiratory fitness levels was found only for male subjects. Prevention strategies for the metabolic syndrome should concentrate on enhancing fitness and physical activity levels early in life.

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**3030 Board #177 May 30 9:30 AM - 11:00 AM**

**Dyslipidemic States And Physical Activity In Children With Cerebral Palsy.**

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( M.H. Macias, University of Guanajuato, Salary.)

**BACKGROUND:** People with cerebral palsy (PC) have alterations with body movements and have a high risk to develop disorders associated with the sedentarism like a serum lipids disorders (dyslipidemia and cardiovascular diseases). There is scanty information about lipid profile and related dyslipidemic disorders in people with cerebral palsy. There for the purpose of the present study was to evaluate the prevalence of dyslipidemia in children with cerebral palsy.

**METHODS:** Twenty-nine children (44%=male; 66%=female) with diagnostic of cerebral palsy from two Centers of Multiple Attention in the state of Guanajuato were evaluated. Physical activity was calculated by a physical activity scale. A venous blood sample was obtained to determine the total cholesterol (Ct), High Density Lipoprotein Cholesterol (HDL-C), Low Density Lipoprotein Cholesterol (LDL-C), Triglycerides (Tg) and calculated the relationship CT/HDL, like atherogenic index.

**RESULTS:** Forty eight % of the participants presented a dyslipidemic state. Hipertriglyceridemia (32%) and low HDL-C (35%), were the conditions more frequently founded. Twenty-two percent presented a high atherogenic index. The physical activity of PC children was smaller than the recommended for their age (135.3 ± 79.6 min/week). Sixty-two percent attended rehabilitation sessions, 10% sport classes, and 14% both activities.

**CONCLUSIONS:** The results of this research showed a high prevalence of dyslipidemia and little time dedicated to physical activity practice. It should be convened to promote a more participation of physical activity and better diet in children to improve their metabolic state and thus have a better quality of life in people's.

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**3031 Board #178 May 30 9:30 AM - 11:00 AM**

**The Nycomed Pharma Norwegian Sports Medicine Award - Muscular Fitness is Associated with Metabolic Risk in Youth**

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In adults, low physical fitness is known to contribute to the early onset and progression of cardiovascular disease. Recent findings have shown a close relationship between metabolic risk factors and physical fitness in children and youth. Whilst these studies mainly focus on the effect of cardiorespiratory fitness (CRF), few studies have examined the independent effect of muscular fitness (MF).

**PURPOSE:** To investigate the associations of MF with clustered metabolic risk score in youth.

**METHODS:** This cross-sectional study included 2299 Norwegian 9- and 15-year-olds. A continuous score representing a metabolic risk profile was derived by computing standardized residuals for HOMA score, waist circumferences, triglycerides, high-density lipoprotein cholesterol, and systolic blood pressure. MF was evaluated by measuring lower limb explosive strength (standing broad jump), upper limb muscle strength (hand grip), abdominal muscular endurance (sit-ups) and endurance of the trunk extensor muscle (modified Biering-Sørensen test). MF score was computed by combining the standardized values of these four tests. CRF was measured directly during a maximal cycle ergometer test. Metabolic risk, MF and CRF were analyzed as continuous variables using multiple linear regression.

**RESULTS:** Metabolic risk was inversely associated with MF, independent of CRF, and after adjustment for age, sex and pubertal stage ( $b = -1.12$ ,  $P < 0.001$ ). CRF was, independent of MF, inversely associated with clustered metabolic risk ( $b = -0.337$ ,  $P < 0.001$ ). However, before adjusting for CRF/MF, the associations of MF and CRF with metabolic risk were almost equally strong ( $b = -0.315$ ,  $P < 0.001$ ;  $b = -0.443$ ,  $P < 0.001$  for MF and CRF, respectively).

**CONCLUSION:** Both MF and CRF were independently associated with metabolic risk in youth. Whilst measuring CRF directly is time-consuming and expensive, determining MF is cheap and feasible. Our results suggest that determination of MF might be a favourable method when investigating the association between physical fitness and metabolic risk in large populations.

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**3032 Board #179 May 30 9:30 AM - 11:00 AM**

**Relationship Between The Development Of Physical Strength And Physical Growth In Preschool Children**

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(No relationships reported)

A decline in the physical strength of children, observed in Japan in recent times, is becoming a serious problem. For the improvement of physical strength, the action that considered physical growth as well as the acquisition of exercise habit is important. Physical growth is particularly remarkable in preschool children. Further, the development of physical strength is strongly affected by physical growth. Therefore, it seems that education and guidance, which considered physical growth, are effective in improving it.

**PURPOSE:** The purpose of this study was to examine the relationship between the development of physical strength and physical growth in preschool children. In particular, we focused on a change in the variance of data between school years.

**METHODS:** The subjects of this study were 652 preschool children. We measured their stature, body weight, and nine parameters related to physical strength and motor ability. These parameters were grip strength, upright handstanding time, sitting trunk flexion, 25 m run, standing long jump, side step, beam cross jump, softball throw, and ball catch. We confirmed the change in the data between school years by one-way ANOVA. We examined the change in the mean and standard deviation (SD) of each parameter between students of different school years by graph statistics. Furthermore, we calculated the amount of change in these data by dividing the difference in the data by the SD of a school year below. In all analyses, we examined the difference among the states of change in physical growth, physical strength, and motor ability.

**RESULTS:** All parameters improved significantly. The states of change in the means and SDs of upright handstanding time, softball throw, side step, grip strength, ball catch, and body weight were similar. Further, the states of changes in side step and stature were similar. The examination of the amount of change also yielded a similar result.

**CONCLUSIONS:** From these results, these parameters whose states of change are similar to those in body weight and stature may be improved with growth. On the other hand, since changes in the sitting trunk flexion, 25 m run, and beam cross jump are different from those in body weight and stature, it is speculated that a special intervention that affects exercise skill and movement acquisition is necessary.

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**3033 Board #180 May 30 9:30 AM - 11:00 AM**

**Modeling Changes In Gross Motor Coordination Of Portuguese Children: Effects Of Bmi And Physical Activity**

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Adequate levels of gross motor coordination (GMC) are relevant for children to express their motor and cognitive skills. Longitudinal data concerning the influence of BMI and physical activity in GMC is scarce

**PURPOSES:** (1) to model annual changes in GMC of children, and (2) to evaluate the importance of time varying predictors: body mass index (BMI) and physical activity levels (PA).

**METHODS:** sample size comprises 285 children (143 boys; 142 girls) followed longitudinally for 4 years starting at the age of 6. GMC was assessed with the KTK (Körperkoordinations-test für Kinder) comprising 4 items: backward balance (BB), jumping sideways (JS), hopping on one leg (HL), and shifting platforms (SP). PA was evaluated with the Godin and Shephard questionnaire. BMI was computed as the ratio of weight (kg) to height<sup>2</sup>(m). Data analysis was done within the multilevel framework using HLM 6.0. Statistical evaluation of nested models was sequential using Deviance as a test statistic. Reliability estimates for all variables was computed with the intraclass correlation coefficient (R).

**RESULTS:** data showed high reliability for GMC tests (0.75<R<0.91), PA (0.65<R<0.80), height and weight (R=0.99). All GMC tests and BMI showed significant (P<0.05) mean increases with age. PA evidenced a small decline over the 4 years, more evident in girls (from 41.81±2.97 Met/15Min/Week at 6 years to 33.36±1.71 at 9 years). A series of nested models for each GMC test showed that data behaved in a non linear fashion, with baseline values being positively associated with annual changes in motor coordination. Across the 4 years, BMI shows a negative (P<0.05) impact in GMC, but PA showed a significant (p<0.05) positive association.

**CONCLUSIONS:** (1) boys and girls show similar significant increases in GMC from 6 to 9 years of age; (2) BMI is negatively associated with GMC changes; (3) on the contrary, PA is positively associated with motor coordination; (4) baseline values of GMC are positively associated with their changes; (5) even if BMI induces a reduction in GMC performance, a protective effect is evident for those children who are at the upper quartile of the distribution of PA across the 4 years. This shows the importance of promoting moderate to high levels of PA to induce relevant increases in GMC even if one is overweight.

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**3034 Board #181 May 30 9:30 AM - 11:00 AM**

**Construct Validation Of Physical Activity Measures In Adults With Intellectual Disabilities**

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Self-report measures have been utilized to capture the physical activity (PA) behaviors of adults with Intellectual Disabilities (ID). Despite a lack of validity evidence, researchers have relied on the assistance of secondary sources (e.g. parents, caregiver, etc) to measure levels of PA for individuals with ID.

**PURPOSE:** To examine the validity evidence for self-report with assistance from a secondary source as a measure of PA in adults with ID.

**METHODS:** Thirty-seven individuals with mild to moderate ID participated. Multitrait-Multimethod (MTMM) analysis was used to evaluate the psychometric properties. Convergent validities were determined by evaluating the outcomes of a self-report measure of PA, accelerometry, and pedometry. Results from a self-report measure of fat intake were used for evaluating evidence of discriminant validity. Participants wore an accelerometer and pedometer during waking hours for two 7-day periods. Following each 7-day period self-report measures for PA and fat intake were administered to the participants with assistance from a secondary source. Test-retest reliability using ICC conducted between interview-1 and interview-2 in self-reported PA bouts and fat intake, activity counts by accelerometer, and number of steps taken measured by pedometer. Correlation coefficients (r) were calculated to examine the association between self-reports with assistance measures and objective measures of PA.

**RESULTS:** Examination of the pattern of reliability and validity coefficients of the MTMM analysis revealed strong construct validity evidence. Reliability coefficients ranged from ICC (2, 2) = 0.78 to ICC (2, 2) = 0.96. Self-report with assistance as a measure of PA was ICC (2, 2) = 0.80. Convergent validity coefficients for self-reported PA, accelerometers, and pedometers were r = 0.34 (p ≤ 0.05) and r = 0.52 (p ≤ 0.01), respectively. Discriminant validity coefficients between self-reported fat intake and PA was r = -0.37 (p ≤ 0.05) and between self-reported fat intake and the objective measures of PA (accelerometers and pedometers) were r = 0.00 and r = -0.23, respectively.

**CONCLUSIONS:** The study demonstrated that self-report with assistance from a secondary source as a measure of PA in adults with ID has strong validity evidence.

This project was funded by the Arc of WA Trust Fund.



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**3035 Board #182 May 30 9:30 AM - 11:00 AM**  
**Correlations Between Physical Activity, Function, And Self-assessment Of Participation In Children With Duchenne Muscular Dystrophy**

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Duchenne muscular dystrophy (DMD) is a devastating degenerative disease caused from the lack of the muscle protein dystrophin. Boys with DMD experience a gradual decline in their ability to perform functional tasks with disease progression; however, the relationships among functional ability, physical activity, and participation have not been explored.

**PURPOSE:** The purpose of this study was to determine the relationships between physical activity level, functional abilities, and self-assessment of participation in boys with DMD.

**METHODS:** Seven ambulatory boys with DMD (mean age 7.1 + 1.1 years) participated. Physical activity was assessed for seven consecutive days with a GT1M ActiGraph activity monitor to obtain step count, peak step count, activity count, peak activity count (PAC), and METs (determined by the Freedson child energy expenditure prediction equation). Subjects also completed timed functional tests: 30 foot fast walk, rise from supine, rise from sitting, and ascending four stairs. The Children's Assessment of Participation and Enjoyment (CAPE) was administered to determine participation in three activity domains: Physical Activity, Recreational Activity, and Social Activity. Relationships were examined using Pearson correlation coefficients.

**RESULTS:** There were strong correlations found between PAC and the 30 foot walk ( $r = 0.893$ ,  $p < 0.01$ ), METs and Social Activity ( $r = 0.865$ ,  $p < 0.02$ ), Physical Activity and rise from supine ( $r = -0.991$ ,  $p < 0.001$ ), and Recreational Activity and rise from sitting ( $r = 0.893$ ,  $p > 0.01$ ). A trend was noted for an association between Physical Activity and ascending four stairs ( $r = -0.739$ ,  $p = 0.06$ ).

**CONCLUSIONS:** The data from this pilot study demonstrate the presence of inter-relationships among physical activity level, functional ability, and participation in boys with DMD. These findings implicate the importance of including activity level and participation measures in clinical trials for the DMD population. Further research is warranted to better understand the correlations between these variables and how they are impacted with therapeutic interventions for patients with DMD.

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**3036 Board #183 May 30 9:30 AM - 11:00 AM**  
**Reviewing Physical Activity Interventions In Latin America: Does Including Conference Abstracts Add Value?**

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According to a recent systematic review of peer-reviewed articles and theses, there is a shortage of physical activity (PA) interventions taking place in Latin America that have been evaluated and published in the peer-reviewed literature.

**PURPOSE:** The goal of this systematic review of conference abstracts was to describe PA interventions taking place in Latin America and assess the value of including this form of grey literature in a literature review.

**METHODS:** Abstracts from an expert-derived sample from conferences of nine scientific organizations were searched for community-based PA interventions in Latin America. This study (1) described and calculated the yield of conference abstracts focused on PA interventions; (2) classified the interventions by type; (3) assessed the added value of reviewing conference abstracts; and (4) tracked which evaluated interventions were eventually published.

**RESULTS:** From 31 annual conference proceedings, 88 abstracts were identified as community-based interventions focused on increasing PA (23 were informational, 32 were behavioral and social, and 8 were environmental and policy approaches to increase PA; 25 had insufficient information to classify). Only 32 abstracts used a PA outcome and control group. After excluding interventions that were (1) duplicates; (2) published in 2006 or later (ineligible from previous systematic review); or (3) included in the previously review of peer-reviewed articles and theses, the value added by including conference abstracts was 11 PA interventions. None of these 11 interventions were subsequently published.

**CONCLUSIONS:** This review confirmed the limited evidence concerning the effectiveness of community-based PA interventions in Latin America. In addition, it highlighted the challenges and low added value of including grey literature in systematic reviews of community interventions, particularly in regions with limited evidence. There is a need for stronger evaluation design and execution, as well as publication of evaluated interventions, to build the evidence base concerning PA interventions in Latin America.

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**3037 Board #184 May 30 9:30 AM - 11:00 AM**  
**Influence Of Socio-economic Status On Habitual Physical Activity In 8- To 10-year-old Children**

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In adults, a lower socio-economic status (SES) is generally associated with lower physical activity (PA) levels; however, findings are inconclusive in children.

**PURPOSE:** The purpose of this study is to examine whether physical activity and/or sedentary behavior differs in children by SES.

**METHODS:** Subjects included 275 (119 males; 156 females) children 8-10 years of age. Height and body mass were assessed according to standard procedures and body mass index (BMI, kg/m<sup>2</sup>) was calculated. Self-reported household income was used to determine SES and create 5 groups ( \$100,000). Habitual, free-living PA was assessed by a pedometer. Participants recorded time worn and the number of steps accumulated on each day over a 7-day period. Measures of screen time (TV, computer use, video games) were determined by self-report. Differences in physical activity levels and sedentary behavior by SES were initially tested using ANOVA. Further analyses used ANCOVA controlling for leg length, sex, and BMI.

**RESULTS:** No significant SES group differences were observed for age (total sample 9.6 ± 0.9 years), height (total sample 138.5 ± 8.1 cm), and leg length (total sample 65.7 ± 5.1 cm); however, lower SES individuals had higher body mass and BMI compared to higher SES groups. Mean daily steps also differed significantly among SES groups with lower SES groups approximating 10,500 steps/day compared to about 12,000 steps/day in the higher SES groups. These differences remained significant ( $p < 0.05$ ) when controlling for leg length, but were not significant when further controlling for sex and BMI. Significant differences between SES groups were shown for sedentary behavior as well ( $P < 0.05$ ) with higher SES groups approximating 20 hrs/wk compared to almost 40 hrs/week of TV in lower SES groups and these differences remained significant when controlling for sex and BMI.

**CONCLUSIONS:** Children from a low SES display lower PA levels and spend more time in sedentary behavior; however, differences in PA were influenced by BMI. The higher BMI in these children might be another factor contributing to increased health risks among low SES individuals.

Funding provided by Medica Foundation, Healthy and Active America Foundation and Cargill, Inc.

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**3038 Board #185 May 30 9:30 AM - 11:00 AM**

## Physical Activity During Pregnancy And Offspring Characteristics At 8-10 Years

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(No relationships reported)

Few investigators have examined the influence of pregnancy physical activity (PA) on offspring characteristics in childhood.

**PURPOSE:** To evaluate the relationships between perinatal factors (birth weight, pregnancy PA) and offspring systolic blood pressure (SBP), body mass index (BMI), and aerobic fitness ( $VO_{2max}$ ) at age 8-10 years while also considering childhood PA.

**METHODS:** Study participants (n=16 mother/child pairs) were members of a cohort who were studied previously during pregnancy 8-10 years ago. Resting SBP (Dinamap), height, weight, and percent fatness (BodPod) were measured on both the mother and her child. Women and children performed treadmill tests to maximum voluntary exhaustion to determine  $VO_{2max}$ . Birth weight was abstracted from previous records. Pre-pregnancy, trimester-specific and average pregnancy PA (kcal/kg/wk) were calculated from historical recall surveys. Mothers rated their children's PA level (0-10 scale) at age 4 yrs, 6 yrs, and currently. Relationships between perinatal factors and offspring characteristics were evaluated via Spearman correlations and linear regression analyses.

**RESULTS:** Child SBP was related to third trimester PA ( $r_s = -0.622$ ,  $p=0.016$ ), child PA at 4 yrs ( $r_s = -0.498$ ,  $p=0.050$ ), and current child PA ( $r_s = -0.735$ ,  $p=0.001$ ). In multivariable regression analyses, child PA at 4 yrs and current PA remained significantly related to child SBP ( $R^2=0.637$ ). Second trimester ( $r_s = -0.534$ ,  $p=0.033$ ), third trimester ( $r_s = -0.501$ ,  $p=0.048$ ), and average pregnancy PA ( $r_s = -0.502$ ,  $p=0.048$ ) were significantly related to child BMI, as were maternal  $VO_{2max}$  ( $r_s = -0.526$ ,  $p=0.036$ ), and maternal BMI ( $r_s = 0.532$ ,  $p=0.034$ ); however, none of these were significant predictors in multivariable regression. Child  $VO_{2max}$  was related to pre-pregnancy PA ( $r_s = 0.506$ ,  $p=0.046$ ) and child percent fat ( $r_s = -0.596$ ,  $p=0.016$ ). Neither remained significant in multivariable regression. Birth weight was related to child SBP ( $r_s = -0.752$ ,  $p=0.031$ ) only among children of mothers who did not meet PA recommendations during pregnancy (n=8; < 7.5 kcal/kg/wk).

**CONCLUSIONS:** These pilot data suggest that PA during pregnancy may be related to child SBP and BMI at 8-10 years of age. Pregnancy PA may also disrupt associations between birth weight and child SBP.

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### 3039 Board #186 May 30 9:30 AM - 11:00 AM

#### Hierarchical Model Related To Adolescents Physical Activity: Environmental, Social And Personal Issues

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Physical activity is considered an important health related lifestyle for adolescents; however the comparison of place of living (rural or metropolitan area) is not well determined.

**PURPOSE:** Analyze the prevalence of physical inactivity (PI) in adolescents living at countryside (CS) and at the metropolitan area (MA) of São Paulo City - Brazil and the hierarchical factors that should explain PI behavior.

**METHODS:** 262 adolescents were evaluated (14.9±1.2 (male); 14.3±1.3 years old female) living in a countryside (4,000 inhabitants) of São Paulo State and at MA of São Paulo city (1 million inhabitants). All adolescents answered the São Paulo Lifestyle Survey that has questions related physical activity practice, television-DVD watching, computer, videogames, internet access and sleeping habits. Statistic analysis used was the hierarchical model (Poison Regression Analysis Prevalence Ratio - PR) ( $p<0.05$ ) to determine the strength among variables and PI level. Qui-Square Test was assessed to determine the significant prevalence. Three sets of independent variables were chosen to explain the relationship of PI, environmental, social-demographic and personal behavior, classified as: weak influence (gender, age, number of sibling, house type); medium (transport to/back from school, physical education class (PE) participation, barriers to physical activity); strong influence (time of TV watching, time of computer, videogames and sleeping time).

**RESULTS:** Significant values ( $p<0.05$ ) were found for PI (54.2%-MA and 33.3%-CS). Multivariate Regression analysis indicated that distance from house-school, transportation type to go-back from school, PE participation, barriers number were related to PI ( $p<0.05$ ). Adolescent PR showed that inactive transportation (bus/car) to / from school correlated to inactivity (RP:1.64 [IC95%:1.04-2.59]), as well low PE classes attendance (RP:2.05 [IC95%: 1.22- 3.44]) and over two barriers (RP:1.46 [IC95%: 1.00-2.15]). No interference on PI was related to total seating time for TV watching, computer and videogame.

**CONCLUSIONS:** Data evidence the necessity of positive intervention in adolescents to use active transportation; promote interesting program at PE classes and reduce the barriers perception.

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### 3040 Board #187 May 30 9:30 AM - 11:00 AM

#### Contribution Of Youth Sports, School Physical Education And Socioeconomic Position To Adulthood Leisure Time Physical Activity

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**PURPOSE:** To examine how participation in youth sports, attitude towards school physical education, parental socioeconomic positions (SEP), and adulthood SEP contribute to leisure-time physical activity (LTPA) in adulthood.

**METHODS:** The data derived from the National FINRISK 2002 sub-study which examined past and present self-reported physical activity among women (N=2813) and men (N=2362) aged 25-64-years. Gender-specific analyses were conducted by structural equation modelling. Results are presented as age-adjusted standardized regression coefficients (b). Participation in youth sports comprised a latent variable including participation in competitive sports and leisure-time exercise. Attitude towards school physical education formed a latent variable including five statements about school physical education. Parental SEP was measured with parental occupation. Adulthood SEP formed a latent variable including education and household income. Occupational physical activity (OPA) measured in metabolic equivalents (METhours/wk) was examined. Outcome variable was adulthood overall LTPA (METhours/wk).

**RESULTS:** The median value for overall LTPA was 19.3 METhours/wk in women and 19.0 METhours/wk in men. Adulthood SEP (women b=0.14, men b=0.08) had a positive association with overall LTPA in adulthood and a negative association with OPA (women b=-0.09, men b=-0.14). Participation in youth sports had a negative association with attitude towards school physical education (women b=-0.52, men b=-0.50) but positive association with overall LTPA in adulthood in men (standardized b=0.13). Attitude towards school physical education and OPA was not associated with overall LTPA.

**CONCLUSIONS:** SEP in both genders and participation in youth sports in men play a prominent role in overall LTPA in adulthood.

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### 3041 Board #188 May 30 9:30 AM - 11:00 AM

#### Physical Activity Levels Of Elementary Aged Children In Early Morning Care: Differences By Age And Gender

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(No relationships reported)

The prevalence of childhood obesity in the US has increased from 6.5% in 1980 to 18.8% in 2004. Low physical activity (PA) is a probable contributor to this increase in obesity. Numerous studies have examined PA levels in children during or after school. However, little is known about PA behavior before school, during early morning care (EMC).

**PURPOSE:** The purpose of this study was to describe the PA behaviors of elementary-aged children during EMC and examine any gender or age differences.

**METHODS:** All children participating in EMC (kindergarten through 5th grade) at two elementary schools were invited to participate. Those who consented wore an Actigraph GT1M accelerometer while attending EMC for one week ( $n=13$ , mean age =  $7.8 \pm 1.7$ , 31% male, mean BMI =  $17.4 \pm 1.9$ , mean BMI percentile =  $65.8 \pm 22.5$ ). Data was analyzed from the time children arrived at school until the first morning bell. Each child completed 3-5 monitoring sessions. The percentage of time spent in sedentary behavior (SB), light physical activity (LPA), and moderate-to-vigorous physical activity (MVPA) was calculated using the Freedson child equation. Age group and gender differences were analyzed using a generalized linear model in SAS PROC GLIMMIX. Pair-wise comparisons were evaluated for significance using pre-planned single degree freedom contrasts.

**RESULTS:** For all participants, the average percentage of time spent in SB, LPA, and MVPA was 38% (95% CI, 34.7, 42.2), 34% (95% CI, 30.9, 38.1), and 27% (95% CI, 24.4, 30.7), respectively. On average, girls spent significantly more time in SB and less time in MVPA than boys. No gender difference was observed for LPA. Younger children (5-6 yrs) spent significantly less time in LPA and more time in MVPA than older children (10+ yrs). The middle age group (7-9 yrs) spent more time in LPA than the younger age group, but showed no other differences.

**CONCLUSIONS:** There were significant gender and age differences in PA levels during early morning care. The overall percentage of time spent in MVPA was low suggesting that EMC is a possible time to improve PA behavior among elementary-aged children.

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## G-25 Free Communication/Poster - *Occupational Physiology and Medicine*

MAY 30, 2009 7:30 AM - 11:00 AM

ROOM: Hall 4F

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### 3042 Board #189 May 30 8:00 AM - 9:30 AM

#### Concurrent Mental And Physical Stress: Cardiorespiratory And Neuroendocrine Responses

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Military personnel, law enforcement officers, firefighters, and rescue workers are often presented with concurrent physical and psychological challenges while performing occupational duties. Activation of the sympathetic-adrenal (SA) and hypothalamic-pituitary-adrenal (HPA) axes during concurrent mental and physical challenge may result in negative health consequences.

**PURPOSE:** To examine cardiorespiratory (CR), stress hormone and perceptual responses to a combination of acute physical and mental stress.

**METHODS:** Sixteen participants completed a  $\dot{V}O_{2max}$  test followed by two experimental conditions. The dual stress condition (DSC) consisted of moderate-intensity cycling at 60%  $\dot{V}O_{2max}$  for 37 minutes with a modified Stroop Color Word (SCW) task and Mental Arithmetic (MA task) from 12 min to 32 min, whilst in the exercise alone condition (EAC), the participants rode at the same intensity without the mental challenge. CR measures included heart rate (HR), respiratory rate (RR), minute ventilation ( $\dot{V}_E$ ), ventilatory efficiency ( $\dot{V}_E/\dot{V}O_2$ ), oxygen consumption ( $\dot{V}O_2$ ), and respiratory exchange ratio (RER). Blood samples were collected prior to, during, and after exercise to measure cortisol (CORT), epinephrine (EPI) and norepinephrine (NE). The State Anxiety Inventory (SAI), the Ratings of Perceived Exertion (RPE) scale, and the NASA Task Load Index (NTLX) were used as psychometric measures.

**RESULTS:** The DSC resulted in significant elevations in SAI and NTLX scores at the conclusion of the dual-stress portion of the protocol. The DSC also elicited significantly greater responses in CR measures of HR, RR,  $\dot{V}_E$  and  $\dot{V}_E/\dot{V}O_2$  measures. CORT and EPI were significantly elevated in the DSC when compared to the EAC, and area-under-the-curve (AUC) calculations revealed greater overall releases of CORT, EPI, and NE in the DSC.

**CONCLUSION:** These results suggest that combined mental and physical challenge have a greater impact on the body's cardiorespiratory, hormonal and psychological stress response than a physical stress alone. This may have harmful implications for those exposed to such conditions on a regular basis.

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### 3043 Board #190 May 30 8:00 AM - 9:30 AM

#### Aerobic Fitness Impacts Cardiorespiratory And Stress Hormone Responses To Concurrent Mental And Physical Stress

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Studies have demonstrated that a combination of mental and physical challenge can elicit exacerbated cardiorespiratory (CR) and stress hormone responses above a single stimulus. However, an analysis of the effects of aerobic fitness on the CR and neuroendocrine responses to concurrent mental and physical stress between below average (Low-fit) and above average (High-fit) fitness individuals, has not been conducted.

**PURPOSE:** To examine the effect of aerobic fitness on cardiorespiratory and stress hormone (cortisol [CORT], epinephrine [EPI], and norepinephrine [NE]) responses to concurrent mental and physical stress.

**METHODS:** Eight above average (high-fit [HF],  $\dot{V}O_{2max} = 51.18 \pm 2.09$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) and eight below-average fitness (low-fit [LF],  $\dot{V}O_{2max} = 36.58 \pm 3.36$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) participants completed two experimental conditions. An exercise-alone condition (EAC) consisted of cycling at 60%  $\dot{V}O_{2max}$  for 37 minutes, while a dual-stress condition (DSC) included concurrent participation in a mental challenge for 20 minutes while cycling.

**RESULTS:** Heart rate, respiration rate, minute ventilation, and ventilatory efficiency were exacerbated in the DSC. The DSC elicited greater overall CORT, EPI, and NE responses. Additionally, LF participants had a greater overall release of CORT in the DSC. However, HF demonstrated greater EPI and NE responses, paralleled with elevated cardiorespiratory responses.

**DISCUSSION:** LF individuals seem to demonstrate unnecessary and possibly unfavorable CORT responses to the DSC compared to HF individuals. The higher levels of EPI and NE in HF participants may explain the elevated cardiorespiratory responses compared to LF participants.

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### 3044 Board #191 May 30 8:00 AM - 9:30 AM

#### Validation Of A Pattern-recognition Activity Monitor In Older Adults During Daily Living Activities

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The pattern-recognition capabilities of the Intelligent Device for Energy Expenditure and Activity (IDEEA) monitor offer advantages to assess complex daily living activities in older adults, compared to traditional accelerometry-based activity monitors.

**PURPOSE:** The purpose of the study was to evaluate the accuracy of the IDEEA for assessing daily living activities in older-adults.

**METHODS:** Twenty-six participants (14 men and 12 women, age= 74.1±4.0, BMI= 26.5 ±3.8) completed 9 light intensity occupational activities (sitting motionless, sitting/fidgeting, transferring from sitting to standing, dressing with a lab coat, stacking boxes, stepping, bending down and folding clothes, sweeping and walking) for 3 minutes each. Participants wore concurrently the IDEEA and a portable metabolic analyzer (Oxycon Mobile, OM). Data from both instruments IDEEA monitor and the OM, were processed on a minute-by-minute basis and merged by time. Mixed model analyses of variance were used to evaluate the accuracy of group level estimates of EE from the IDEEA. Tukey-Kramer paired comparisons tests were used to test for differences among levels of fixed effects as well as the interaction term.

**RESULTS:** The overall EE was overestimated ( $p<0.001$ ) by the IDEEA by 0.23kcal/min. The IDEEA monitor overestimated EE during sitting motionless (24.6%), fidgeting while sitting (46.0%), stepping (45.8%), folding clothes (0.1%), sweeping (5.4%) and walking (70.3%). The IDEEA underestimated transferring from sitting to standing (16.2%), dressing (19.6%) and stacking boxes (16.7%). Differences were significant for sitting/fidgeting ( $p=0.02$ ), transferring from sitting to standing ( $p=0.04$ ), dressing ( $p=0.04$ ), stepping ( $p<0.001$ ) and for walking ( $p<0.001$ ). Sitting motionless ( $p=0.09$ ), stacking boxes ( $p=0.13$ ), folding clothes ( $p=0.78$ ) and sweeping ( $p=0.04$ ) were non-significant.

**CONCLUSION:** Even though the overall method effect was significantly different, data showed agreement in variability across stages. The IDEEA demonstrated ability to detect subtle changes in EE associated with household tasks in older adults.

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**3045 Board #192 May 30 8:00 AM - 9:30 AM**  
**Maximal Heart Rates And Body Mass In Male Police Officers Participating In Authentic Shooting Range Maneuvers.**

Robert B. Pankey, Melissa Kemp, Stacia Miller, Allie Campbell. *Texas State University, San Marcos, TX.* (Sponsor: John Walker, FACSM)  
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(No relationships reported)

**PURPOSE:** The purpose was to explore the relationship of elevated heart rates on law enforcement officers from normal (NOR), overweight (OVR) and obese (OBS) BMI groups who participated in deadly force encounter scenarios during authentic shooting range maneuvers. It was hypothesized that there would be significant differences in maximum heart rate (MXHR) between officers.

**METHODS:** Certified male law enforcement officers ( $n=41$ , ht.=70±3.2 in., wt.=201±38.1 lbs., age=35±7.3 yr.) from the Advance Law Enforcement Rapid Response Training (ALERT) program volunteered for this investigation. Heart Monitors were used to capture MXHR of each individual officer participating in the force-on-force scenario before and after their maneuvers. Each maneuver lasted approximately five minutes.

**RESULTS:** A single factor ANOVA was used to determine if maximal heart rates differed between groups participating in authentic shooting range maneuvers. A significant difference was found in BMI among subjects in NOR (22.5±1.84,  $n=8$ ), OVR (27.3±1.41,  $n=20$ , ) and OBS (34.1±3.90,  $n=13$ ) groups ( $p<.05$ ,  $F_{2,38}=56.1$ ). 31% of the subjects were classified OBS and 80% of the subjects were considered OVR and OBS, according to BMI categories (Powers, 2007). No significant difference was found in MXHR between groups NOR (178±12.61 bpm), OVR (177±35.45 bpm) and OBS (174±22.63 bpm) groups ( $p>.05$ ,  $F_{2,38}=.052$ ).

**CONCLUSIONS:** A non-significant finding in MXHR among groups in this investigation could be attributed to external factors such as good preparation, experience, as well as internal factors such as self control and good conditioning. High subject BMI levels did not seem to affect average maximal heart rates during shooting range maneuvers. In order to increase accuracy and decrease any chance of false reaction or inaccuracies, one should strive to maintain low heart rate while in a shooting scenario. Lower MXHR among subjects participating in the authentic shooting scenarios was perceived as a positive finding in this investigation. Investigations as this should serve to identify individuals with cardiovascular risk factors while maintaining vigilance over individuals who exhibit physiological or psychological changes on occasions of lethal force type maneuvers.

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**3046 Board #193 May 30 8:00 AM - 9:30 AM**  
**Longitudinal Comparison Of Body Mass Index And Percent Fat Changes In Charlotte Mecklenburg Police Department**

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Body composition is of primary concern in careers with high physical demands, such as police, and is commonly measured by body mass index (BMI) and percent body fat (BF). BMI uses height and weight ( $\text{kg/m}^2$ ), and the BF test measures subcutaneous fat (skinfolds). Little has been done in police organizations showing how these two methods differ in classifying police as they age and how the changes over time differ between genders.

**PURPOSE:** To compare BMI classifications of obesity with BF in police over 12 years with gender comparisons.

**METHODS:** Police recruit and in-service fitness tests were used to track changes in mass, BMI, BF, fat and lean body mass, and obesity in police. Comparisons were made between genders at recruit and in-service testing and the changes in these variables over time.

**RESULTS:** Sample included 286 police; 24 females, 262 males. Average number of years between tests is 12.6 ± 2.1 years. Mean age of initial recruit 24 ± 3 yrs and at in-service was 37 ± 3 yrs. Significant differences were found between genders in all body composition variables, except fat mass at both testing periods,  $p \leq 0.001$ . Comparing females vs. males at both testing periods BMI was significantly higher (initial-recruit 21.3 ± 2.1 vs. 25.5 ± 3.6; in-service 24.4 ± 3.3 vs. 29.4 ± 4.7) and percent body fat was significantly lower (initial 20.7 ± 4.5% vs. 14.7 ± 5.8%; in-service 26.0 ± 6.5% vs. 19.5 ± 6.2%) in males. There were significant differences,  $p \leq 0.05$ , between females vs. males in the amount of change that occurred from recruit to in-service tests in body mass (8.3 ± 6.3 kg vs. 12.6 ± 9.2 kg) and lean mass (2.8 ± 3.2 vs. 5.9 ± 4.9); males showed greater increases. Both genders increased in all body composition variables from initial-recruit to in-service tests,  $p \leq 0.001$ . A greater percentage of males (39%) than females (8%) were classified as obese at in-service by BMI, the gender percentages were similar with BF (females 25% vs. males 21%). There was considerable disagreement in those classified as obese between the two classification systems at in-service; showing 55 people that were classified as obese in BMI were classified as non-obese in BF.

**CONCLUSIONS:** BMI and BF showed considerable disagreement as to who was classified as obese. It is suspected that the increase in lean mass over time in these police influences this disagreement, especially in males.

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**3047 Board #194 May 30 8:00 AM - 9:30 AM**  
**Race Comparisons Of Longitudinal Changes In Strength Of Police Officers**

Steven M. Nusca<sup>1</sup>, Robert W. Boyce, FACSM<sup>1</sup>, Shelley C. Joye<sup>1</sup>, Glenn R. Jones<sup>2</sup>, Edward L. Boone<sup>3</sup>. <sup>1</sup>University of North Carolina at Wilmington, Wilmington, NC. <sup>2</sup>City of Charlotte, Charlotte, NC. <sup>3</sup>Virginia Commonwealth University, Richmond, VA.  
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Strength profiles of police officers from recruitment to in-service, especially when considering gender, race and age, provides a basis for designing effective training, hiring, and retention procedures. No longitudinal police research was found that compared strength changes over time relative to race.

**PURPOSE:** To identify differences in strength scores from initial-recruit to in-service tests and to compare racial differences using a retrospective longitudinal design.

**METHODS:** Strength variables included bench press, bench press/lean weight and bench press/weight. Body weight, percent body fat, and bench press scores were retrieved for the 1990 to 1995 recruit classes and were paired to the most recent scores on 2006 in-service fitness log. Sample included 309 police officers: 30 females (13 black, 17 white) and 279 males (41 black, 238 white).

**RESULTS:** Mean age at initial-recruit was  $24.6 \pm 3.4$  years and for in-service was  $37.1 \pm 3.7$  years. Average time between tests was  $12.5 \pm 2.0$  years. Bench press strength significantly increased ( $p \leq 0.05$ ) for all gender and racial groups from initial-recruit to in-service tests. Black males vs. white males were significantly ( $p \leq 0.01$ ) stronger in bench press strength at initial-recruit ( $95.1 \pm 24.6$  kg vs.  $84.1 \pm 21.1$  kg) and at in-service ( $109.5 \pm 20.3$  kg vs.  $97.5 \pm 20.6$  kg). No significant differences in the amount of change were found between genders and between races for all strength variables. All racial and gender groups increased in bench press/lean weight, however the increase in white females was not significant. No differences were found between black and white females in all strength variables at both testing periods. Black males were significantly stronger than white males in bench press/weight only at the initial-recruit test ( $1.12 \pm 0.27$  vs.  $1.03 \pm 0.23$ ,  $p \leq 0.05$ ). White males showed a significant increase in bench press/weight over time ( $1.03 \pm 0.23$  to  $1.06 \pm 0.22$ ,  $p \leq 0.05$ ) but they did not reach the strength level of the black males at in-service ( $1.09 \pm 0.20$ ).

**CONCLUSIONS:** Police departments, with the implementation of a properly designed physical fitness program, can expect to see increases in the strength of their personnel over the first half of their careers; however, there are gender and racial differences related to strength gain.

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**3048 Board #195 May 30 8:00 AM - 9:30 AM**  
**Age-related Decline In Physical Performance Capacity Is Offset By Aerobic Fitness.**

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(No relationships reported)

Maximal oxygen consumption ( $\text{VO}_{2\text{max}}$ ), muscle mass and strength decline with age. This loss with age commonly leads to a decrease in human physical performance and may have serious implications for occupations where maximal or near maximal effort is critical.

**PURPOSE:** To examine the effect of age and  $\text{VO}_{2\text{max}}$  on work decrement of a maximal "all out" task.

**METHODS:** Fifty-six males, ages 20 to 59 yrs were selected from a larger pool of subjects. Based on age and  $\text{VO}_{2\text{max}}$  subjects were assigned to one of four age groups: 20-29 yrs ( $\text{VO}_{2\text{max}}=44.8 \pm 2.8$  ml/kg/min; n=13), 30-39 yrs ( $\text{VO}_{2\text{max}}=43.4 \pm 4.1$  ml/kg/min; n=8), 40-49 yrs ( $\text{VO}_{2\text{max}}=41.7 \pm 4.0$  ml/kg/min; n=20) and 50-59 yrs ( $\text{VO}_{2\text{max}}=39.4 \pm 5.3$  ml/kg/min; n=15). Subjects performed a graded exercise test on a treadmill to determine  $\text{VO}_{2\text{max}}$  and on a separate day a one minute maximal arm ergometry test (AET) to determine anaerobic capacity. The experimental session entailed a performance run for 0.35 miles at a pace of 8.75 min/mile. Immediately following the run a second maximal AET was completed. The decrement in performance of anaerobic capacity tests (the difference between AET#1 and AET#2) was determined and examined by age and  $\text{VO}_{2\text{max}}$  ( $\text{FIT} = >42$  ml/kg/min;  $\text{LOWFIT} = <42$  ml/kg/min).

**RESULTS:** No differences in mean  $\text{VO}_{2\text{max}}$  were observed between the age groups. Percent decrements in performance of the subsequent maximal AET occurred within each age group. Performance decrements were seen in the 20-29, 30-39 and 40-49 yr groups (13.4, 11.8 and 17%, respectively) and were significantly ( $p < 0.05$ ) less when compared to the 50-59 yr group (31.2%). Both LOWFIT and FIT individuals in their 20's and 30's had a significantly lower percent decrement of anaerobic capacity than those in their 40's and 50's ( $p < 0.05$ ). Regardless of age, LOWFIT subjects had significantly greater percent decrements in performance on the post-run maximal AET ( $p < 0.05$ ) when compared with FIT subjects.

**CONCLUSION:** There appears to be an age related effect on maximal anaerobic tasks which is, to a large degree, offset when aerobic capacity levels, independent of age are maintained above 42 ml/kg/min.

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**3049 Board #196 May 30 8:00 AM - 9:30 AM**  
**Assessing Knowledge Of Cardiovascular Disease Risk Factors And Risk In Volunteer Firefighters**

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(No relationships reported)

Firefighting has one of the highest occupational fatality rates in the United States. Heart disease is responsible for 45% of these on-duty deaths with most occurring in volunteer rather than career firefighters. Most decedents had predisposing risk or pre-existing disease.

**PURPOSE:** The purpose of this study was to assess knowledge of cardiovascular disease (CVD) risk factors and trends of risk screening in volunteer firefighters.

**METHODS:** Participants included in this analysis were 227 volunteer firefighters. Self reported data were obtained on the presence of CVD, CVD signs and symptoms, risk factors (age, diabetes, obesity, hypertension, hyperlipidemia, and tobacco use), timing of blood pressure and blood lipid check-ups, and demographic and occupational data.

**RESULTS:** The mean age of participants was  $37 \pm 11$  years, BMI =  $29.5 \pm 5.9$ , and most of them were either overweight (34%) or obese (40%). Over 31% were current tobacco users but only 4% had been diagnosed as diabetic. Among firefighters who knew their blood pressure, systolic and diastolic blood pressures were  $124 \pm 15$  and  $79 \pm 10$  mmHg, respectively. Among firefighters who knew their blood lipids, total cholesterol, low density lipoprotein cholesterol, high density lipoprotein cholesterol, and triglycerides were  $189 \pm 49$ ,  $132 \pm 53$ ,  $50 \pm 26$ , and  $187 \pm 62$  mg/dl, respectively. The majority of firefighters were unaware of their risk for either hypertension (46%) or hyperlipidemia (86%). Most participants had had their blood pressure measured within the past year (93%), although 2% of them had never done so. In contrast, only 34% of them had their blood lipids checked within the past year while 39% had never done so.

**CONCLUSIONS:** Firefighters who had had blood pressure and lipids assessed did not have markedly elevated values. The prevalence of overweight, obesity, and smoking among this group were higher when compared with general population data. However, many volunteer firefighters are not aware of their risk for CVD and risk screening appears inadequate.

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**3050 Board #197 May 30 8:00 AM - 9:30 AM**  
**Differences Between Fire-instructors And Recruit Firefighters Pre-, During And Post Flashover Training**

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(No relationships reported)

**INTRODUCTION:** Identifying differences in responses to the stressful demands of FOT between experienced fire-instructors (INSTR) and recruit firefighters (RFF) is important to achieve safe task performance.

**PURPOSE:** To identify differences between RFF and INSTR pre-, during and post FOT.

**METHODS:** 8 FF and 6 INSTR of the Amsterdam Fire Service performed a regular FOT in a wood burned flashover container. During FOT, subjects wore standard turnout gear including SCBA. Mean heart rate (HR; Polar S810i, Finland) and core temperature ( $T_{\text{core}}$ ; CoreTemp<sup>TM</sup>, HQInc., USA) were obtained at the start of FOT (PRE), during FOT (Exp1@10min and Exp2@20min), directly after FOT (POST) and during recovery (Rec1@5min and Rec2@10min). Workload was expressed as percentage heart rate reserve (%HRR) as derived from HR. Anxiety (ANX) was recorded PRE and POST using a Visual Analogue Scale.

**RESULTS:** RFF and INSTR differed in years of experience ( $0.3 \pm 0.7$  vs  $18.8 \pm 4.9$  yrs) and number of FOTs ( $2 \pm 5$  vs  $107 \pm 44$ ).

Table 1: %HRR,  $T_{core}$ , and  $T_{skin}$  of RFF and INSTR during FOT.

	%HRR		$T_{core}$ ( $^{\circ}\text{C}$ )		ANX	
	RFF	INSTR	RFF	INSTR	RFF	INSTR
Pre	$38.9 \pm 14.4$	$37.4 \pm 5.5$	$37.86 \pm 0.30$	$37.40 \pm 0.46$	$0.65 \pm 0.91$	$0.00 \pm 0.00$
Exp1	$45.9 \pm 12.1$	$41.0 \pm 15.0$	$37.86 \pm 0.29$	$37.44 \pm 0.51$		
Exp2	$72.5 \pm 8.2$	$60.7 \pm 13.2$	$37.95 \pm 0.30$	$37.52 \pm 0.49$		
Post	$81.7 \pm 17.3$	$76.4 \pm 23.0$	$38.45 \pm 0.42$	$37.85 \pm 0.40$	$1.38 \pm 1.36$	$0.10 \pm 0.25$
Rec1	$59.5 \pm 15.8$	$68.5 \pm 11.7$	$38.74 \pm 0.48$	$38.06 \pm 0.35$		
Rec2	$57.1 \pm 14.8$	$52.4 \pm 7.8$	$38.79 \pm 0.55$	$37.91 \pm 0.83$		

During FOT,  $T_{core}$  was higher for RFF. No main effects were found for %HRR. No difference was found for PRE-ANX. POST-ANX was higher for RFF. A significant negative correlation was found between experience and  $T_{core}$  for POST ( $r = -0.55$ ), REC1 ( $r = -0.55$ ) and REC2 ( $r = -0.58$ ).

**CONCLUSIONS:**  $T_{core}$  and POST-ANX are higher for RFF, associated with a lower level of experience. Based on the higher  $T_{core}$ , the response to heat exposure seems to be less adequate in RFF. This should be taken into account in determining FOT training load and duration. The higher POST-ANX of RFF, where PRE-ANX was similar to INSTR, may indicate an underestimation of FOT, supporting the necessity of an adequate preparation of RFF prior to FOT.

### 3051 Board #198 May 30 8:00 AM - 9:30 AM Professional Firefighter Physical Fitness And Dietary Practices

Matt Beekley, FACSM<sup>1</sup>, Elizabeth Gwaltney<sup>1</sup>, Heather Kranenburg<sup>1</sup>, Josh Bixler<sup>1</sup>, James B. Brown<sup>2</sup>. <sup>1</sup>University of Indianapolis, Indianapolis, IN.

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(No relationships reported)

Professional firefighters encounter unique physical fitness demands. Typically, the job consists of working one day at the firehouse and two days off duty. Nutritional intake data are scarce in the professional firefighter population.

**PURPOSE:** The purpose of this study was to examine Indianapolis professional firefighters' physical fitness, and compare nutritional intakes on and off duty.

**METHODS:** 43 Indianapolis professional firefighters age 44 yrs (SD 8; 2 female, 41 male) from two firehouses completed physical fitness testing.  $\text{VO}_{2\text{max}}$  was predicted from Queen's step test. Body fat was predicted from sum of three skinfolds. Food dairies were analyzed by computer from 15 of these firefighters.

#### RESULTS:

Physical Fitness Results		
N = 43	Mean	SD
Height (cm)	180.9	4.8
Weight (kg)	93.1	15.0
Blood Pressure (mm Hg)	129/84	11/9
Predicted Body Fat Percentage	23.2	5.9
Predicted $\text{VO}_{2\text{max}}$ (ml.kg.min)	53.6	6.4
Sit and Reach Results (in.)	12.9	3.0
Grip Strength (kg; R+L combo)	104.8	18.6
Push-ups (1 minute)	30.9	14.3
Curl-ups (1 minute)	49.1	13.1

Dietary Analysis Results				
N = 15	On Duty Mean	SD	Off Duty Mean	SD
Calories	2216.5	686.4	2786.7*	828.9
Calories from fat	835.3	320.1	1212.8*	532.8
Total fat (g)	86.1	30.8	122.3*	44.7
Saturated fat (g)	26.0	8.3	40.0*	18.4
Cholesterol (mg)	261.0	155.3	397.8	264.1

\* = significantly different from On Duty Mean,  $p < 0.05$

**CONCLUSIONS:** Although the physical fitness of Indianapolis firefighters appears excellent, firefighters ate significantly more calories, calories from fat, total fat, and saturated fat off duty compared to on duty. Nutritional interventions to decrease the risk of heart disease in this population should consider both on and, particularly, off duty dietary changes.

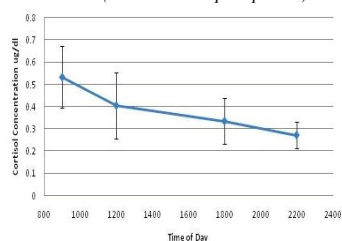
Supported in part by a Fire Act grant

### 3052 Board #199 May 30 8:00 AM - 9:30 AM

## Day To Day Differences In Periodic Cortisol Measurements Seen In Professional Firefighters

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(No relationships reported)



**INTRODUCTION:** Professional firefighters (PF) are routinely exposed to life-threatening environments. As a result, PF are at risk for the development of both psychological and physical stress related disorders.

**PURPOSE:** This study sought to assess day to day changes in the diurnal cycle of eight PF (age:  $45 \pm 7$  yrs &  $21.8 \pm 7.27$  yrs experience) Cortisol.

**METHODS:** Saliva samples were collected from eight PF at 09:00, 12:00, 18:00, and 22:00 hours during nine on-duty days and two off-duty days. Cortisol concentration was measured in saliva samples using ELISA.

**RESULTS:** Despite a downward trend in Fig. 1, ANOVA did not reveal a significant trend ( $P > .05$ ) for time and a main effect for days. The interaction between the on-duty and off-duty assessments also failed to reach significance. Lastly, the interaction between test day and time period was not significant ( $p > .05$ ).

**CONCLUSION:** Cortisol levels did not differ from day to day at any time point for PF. However, the non-significant trend of Cortisol levels throughout the day reflects a normal diurnal pattern. The data suggests that future research is needed to probe for Cortisol level differences between on-duty and off-duty days as well as Cortisol levels in response to emergency dispatch.

Figure 1. Mean Periodic Cortisol Concentration

### 3053 Board #200 May 30 8:00 AM - 9:30 AM

#### Effect Of Wearing Thermal Protective Clothing On Functional Balance In Male Firefighters

Pui W. Kong, David Hostler, Joe Suyama, Rakié Cham. *University of Pittsburgh, Pittsburgh, PA.* (Sponsor: Robert L Robertson, FACSM)

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(No relationships reported)

The incidence of fall related injuries among firefighters is high. During fire suppression, firefighters wear thermal protective clothing (TPC) which typically includes heavy fire-resistant outer garments, safety boots, gloves, a helmet, fire-resistant hood, and a self-contained breathing apparatus (SCBA). This protective equipment may impair balance by reducing visibility and adding mass on the body.

**PURPOSE:** We investigated the effect of wearing firefighting TPC on functional balance and the influence of morphometrics and physical activity on balance.

**METHODS:** Twenty-three male firefighters (age= $28.2 \pm 6.7$ yr, height= $177 \pm 1.2$ cm, mass= $91.3 \pm 21.2$ kg) provided informed consent to participate in this study. Subjects were surveyed about physical fitness: 12 reported performing resistance training and 11 reported no such training. All subjects performed a functional balance test under four conditions: 1) regular clothing, 2) TPC, 3) TPC with SCBA while carrying facemask, and 4) TPC with SCBA while wearing facemask. The balance test required subjects to walk forward and backward on a beam with a 180° turn half-way. The average walking time and number of errors made (e.g. falling off beam) were compared between conditions using a mixed design ANOVA (within-group factor = equipment condition; between-group factor = self-reported resistance training). Correlations between balance and physical characteristics were explored.

**RESULTS:** A significant main effect of equipment condition was found for the time to complete the task ( $p < 0.001$ ) and errors committed during the task ( $p = 0.003$ ). Subjects walked more slowly in the three TPC conditions compared with regular clothing ( $p < 0.001$ ). Overall, subjects reporting resistance training made 36.4% fewer errors than those without ( $p = 0.047$ ). Errors increased with the demands of TPC among subjects who did not participate in resistance training but remained unchanged among resistance trained subjects (equipment  $\times$  resistance training interaction  $p = 0.026$ ). No significant correlations between balance and age, height, mass or body mass index were identified.

**CONCLUSION:** Firefighters walk more slowly during a beam walking task as a strategy to maintain balance when wearing TPC. Resistance training may have a positive influence on functional balance when wearing TPC.

### 3054 Board #201 May 30 8:00 AM - 9:30 AM

#### Temperature Monitoring In Firefighters During And Following Exercise In Thermal Protective Clothing

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(No relationships reported)

**PURPOSE:** Accurate monitoring of firefighter temperature is important to assure safety during operations. Multiple devices exist to monitor core and skin temperature but little is known about their utility in firefighters. We compared multiple, commercially available thermometers during, and following, work in thermal protective clothing (TPC) to a gold standard core temperature.

**METHODS:** On three separate occasions, 18 euhydrated firefighters (16 males) aged  $28.2 \pm 11.3$  years wearing TPC, completed two consecutive bouts of exercise in a hot room separated by a 20-minute rest and rehydration period that mimicked the National Fire Protection Administration (NFPA) work-rest guidelines. During exercise in TPC, four-site skin temperature and an ambulatory monitor worn on the arm was compared to an ingested core temperature capsule. Between and following exercise periods, temperature was measured with four commercially available thermometers (temporal artery, tympanic, oral, and an adhesive thermometer applied to the forehead). The different techniques were compared to core temperature using the Bland-Altman test of agreement.

**RESULTS:** Core temperature ranged from 36.7 to 39.7°C. During exercise, the mean (95%CI) difference between core and four-site mean skin temperature was 1.2°C (-0.8, 3.2) and was 3.0°C (0.1, 5.8) between core and the ambulatory one-site temperature monitor. When comparing external thermometers to core temperature following exercise, confidence intervals around the agreement greater than 0.5°C made all devices unsuitable for clinical use. The smallest bias was 0.4°C (tympanic) and the largest was 1.5°C (temporal artery).

**CONCLUSIONS:** Clinically significant biases and wide 95% CIs were seen with all temperature monitoring techniques when compared with core temperature in realistic situations. Caution should be used when employing any of these techniques to estimate core temperature on the fireground.

### 3055 Board #202 May 30 8:00 AM - 9:30 AM

#### Effects Of Chronic Consumption Of Electrolyte Beverages By Mill Workers On Markers Of Metabolic Syndrome

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Electrolyte carbohydrate (ECHO) beverages have been shown to be more effective than water at maintaining euhydration and physical and cognitive performance during athletics. Given the consequences of loss of performance in the workplace, the use of said beverages may be warranted in occupations with hydration challenges due to high work rates, heat exposure and the use of personal protective equipment. However, occupational populations tend to be older with risk factors for hypertension, diabetes and cardiovascular disease, contraindicating the salt and sugar in hydration beverages.

**PURPOSE:** To investigate the effect of chronic consumption of ECHO on hydration and health in veneer mill workers.

**METHODS:** Blood lipid profile, fasting insulin and glucose, high sensitivity C-reactive protein (Hs-CRP) and blood pressure (BP) were monitored in 17 males (age 45 ± 11 yrs, height 168 ± 34 cm, weight 90 ± 18 kg, 23.0 ± 4.8% body fat). Workers were provided with ECHO (3 mEq/L K<sup>+</sup>, 18 mEq/L Na<sup>+</sup> and 6% sucrose-glucose mixture) or EB (identical in composition, appearance and taste except for artificial sweetener instead of sugars) ad libitum for 5 weeks in a double-blind random cross over design with 4 weeks of washout between treatments.

**RESULTS:** Workers were able to maintain a euhydrated state with both beverages, changes in body mass pre-post work shift were less than 0.5%.

Table 1. Mean ± SD for Metabolic Syndrome markers

	Pre-treatment		Post-Treatment	
	Baseline	Washout	EB	ECHO
Fasting Insulin (pmol/L)	67 ± 48	82 ± 62	64 ± 61	59 ± 55
Fasting Glucose (mmol/L)	5.6 ± 0.6	5.0 ± 0.8	5.4 ± 0.6	5.3 ± 0.5
Hs-CRP (mg/L)	3.0 ± 2.2	3.0 ± 2.3	3.1 ± 2.3	3.0 ± 2.4
Systolic BP (mmHg)	132 ± 16	134 ± 13	130 ± 12	132 ± 13
Diastolic BP (mmHg)	79 ± 9	81 ± 10	78 ± 7	78 ± 8
Total Cholesterol (mmol/L)	5.3 ± 1.0	5.2 ± 0.2	5.1 ± 1.1	5.1 ± 1.0
Triglycerides (mmol/L)	1.5 ± 1.1	1.4 ± 0.6	1.6 ± 0.9	1.5 ± 1.0
HDL (mmol/L)	1.2 ± 0.3	1.1 ± 0.2	1.2 ± 0.3	1.2 ± 0.4
LDL mmol/L)	3.3 ± 0.9	3.4 ± 0.9	3.2 ± 0.8	3.2 ± 0.7

**CONCLUSION:** Neither beverage caused any change in the measured markers of Metabolic Syndrome. It appears that in this population of workers, 5 weeks of consumption of approximately 2.5 L of EB or ECHO/day did not have any adverse effect on blood pressure, blood lipids or glucose tolerance.

Supported by grants from GSSI and Weyerhaeuser ILevel

### 3056 Board #203 May 30 8:00 AM - 9:30 AM Exercise Performance And Heat Stress In Paper Mill Employees

Markus Stark<sup>1</sup>, Günter Schwaberg<sup>2</sup>, Serge P. von Duvillard, FACS<sup>3</sup>, Peter Hofmann<sup>1</sup>. <sup>1</sup>Karl-Franzens University and Medical University Graz, Graz, Austria. <sup>2</sup>Medical University Graz, Graz, Austria. <sup>3</sup>University of Salzburg, Salzburg, Austria.  
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(No relationships reported)

Exercise Performance and Heat Stress in Paper Mill Workers

Heat Stress is a daily component of work stress in industrial workers such as paper mill workers. The World Health Organization provides reference values for the upper limit of tolerance for working in hot and humid conditions such as a HR of 110 bpm, independent of age and fitness level.

**PURPOSE:** The aim of the study was to investigate the relationship between exercise performance and heart rate (HR) response during several work shifts in the heat in workers of different age and fitness level.

**METHODS:** Seven companies from Paper Mill Industry participated in the project. 187 workers (age: 36.4±9 yrs, Ht: 177±6 cm, Wt: 82.5±12 kg) took part in the study. Exercise performance was determined by means of an incremental submaximal cycle ergometry (Daum Electronic 8008) exercise test measuring HR (S 610, Polar Electro, Finland), oxygen uptake (VO<sub>2</sub>) (Metamax I, Cortex Biophysik, Germany) and power output (P) and VO<sub>2</sub>max and Pmax were calculated. HR was measured for 8 h during each of 817 work shifts with a total of 6.000 h.

**RESULTS:** Mean values for Pmax (226±22 W, 2.23±0.45 W.kg<sup>-1</sup>) and VO<sub>2</sub>max (35.4±14.1 ml.kg<sup>-1</sup>.min<sup>-1</sup>) were within the limits of normal age related fitness level. The average HR during 8 h work shift was 92±11 bpm and well below the WHO limit of 110 min<sup>-1</sup>. However, some workers had an elevated HR of up to 200 min<sup>-1</sup> due to work specific heat stress and humidity (55±15°C WBGT, 10-60% humidity) performing specific tasks (e.g. disruption of normal paper production, cleaning the basement of the machine). There was a significant influence of age, fitness level, and task specific HR increase in the heat. The older and the less fit (R=0.288, P<0.05) the workers, the higher was the HR during 8 h shift, and in the short term (accumulated 60 min) task specific maximal HR (160±12bpm), challenges the fixed target HR of 110 bpm due to age related decline in HR is not provided for in WHO guidelines. The number of workers presenting HR above threshold increased with age and decreased with fitness level.

**CONCLUSION:** Our study suggest that the HR response during work in the heat and humidity was dependent on age and fitness level with some workers exhibiting low exercise performance level and eliciting elevated HR above the WHO recommendation.

## G-26 Free Communication/Poster - Technology, Gadgets, and Gaming

MAY 30, 2009 7:30 AM - 11:00 AM  
ROOM: Hall 4F

### 3057 Board #204 May 30 8:00 AM - 9:30 AM West Virginia Games For Health: Implementing Dance Dance Revolution Into Public Schools

Justine Vosloo<sup>1</sup>, Linda Carson<sup>1</sup>, Nidia Henderson<sup>2</sup>, Emily Murphy<sup>1</sup>. <sup>1</sup>West Virginia University, Morgantown, WV. <sup>2</sup>Public Employees Insurance Agency, Charleston, WV.  
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(No relationships reported)

Dance Dance Revolution (DDR) has been found to be a powerful tool in the fight against obesity that researchers believe can have a profound long-term impact on the health and lifestyle habits of a new generation. In January of 2006, the state of West Virginia (WV) and Konami Digital Entertainment, Inc., announced the placement of DDR systems into all WV public schools. To date 364 (50%) physical education (PE) teachers have received DDR training and equipment. The training schedule began with the 180 middle schools of which 166 (88%) have been trained, followed by 93 (83%) of the 112 high schools, and 105 (24%) of the 438 elementary schools.

**PURPOSE:** The purpose of this study was to determine the trained PE teachers' perceptions regarding the utility of DDR in a school setting.

**METHODS:** Surveys were sent out to all 364 trained teachers and 167 (46%) completed and returned the surveys.

**RESULTS:** 100% of the teachers surveyed felt that their students enjoyed DDR. The majority of the teachers first introduced DDR in PE as a whole class, but then most commonly use it as a station/circuit with other activities. 57% reported incorporating DDR into other school activities. The most common other activities included at lunch/recess, school dances, and as a reward activity. 29% reported concerns about implementing DDR into the school setting. The most frequent concerns were: maintenance of the equipment, theft, and lack of additional equipment. 32% reported having bought additional equipment from other sources. 28% were interested in developing a DDR club for social affiliation.

**CONCLUSIONS:** Implementing DDR into the school environment has been viewed positively by the majority of WV physical educators. These results support expansion of the project, with the goal of engaging public school students, including those not normally predisposed to exercise, in a fun physical activity that helps improve overall health at an impressionable age.

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**3058 Board #205 May 30 8:00 AM - 9:30 AM**  
**Field Evaluation Of Physical Activity In Wristband Type Motion Monitor**

Shinji Takahashi<sup>1</sup>, Koya Suzuki<sup>1</sup>, Tomohiro Kizuka<sup>2</sup>, Yosuke Sakairi<sup>2</sup>. <sup>1</sup>Tohoku Gakuin University, Sendai, Japan. <sup>2</sup>University of Tsukuba, Tsukuba, Japan.

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(No relationships reported)

**BACKGROUND:** To assess physical activity during daily free-living, objective methods are necessary. Recently, many type of accelerometer were developed and used for assessment of physical activity energy expenditure. In Japan, a multi sensor wristband (ViM sports memory) that includes a uniaxial accelerometer and a gyro-sensor has been developed. However, until now, no studies have been reported concerning the validity of this device in field situation.

**PURPOSE:** To examine the validity of the ViM for evaluation of physical activity by comparing with an indirect calorimeter (IC) during non-regulative activities in the field situation.

**METHODS:** Nine males (age: 20.6 +/- 0.7 yrs; body mass, 62.0 +/- 9.2 kg; height, 170.3 +/- 4.9 cm) and 8 females (age, 20.5 +/- 0.6 yrs; body mass, 55.7 +/- 6.7 kg; height, 158.7 +/- 5.3 cm) performed each 10 min of five type non-regulative activities (sitting rest, standing household task, video game (Wii sports), dance, and rope jump). The ViM was placed on non-dominant wrist position. During all activities, the IC (MetaMax 3B) measured energy expenditure (METs). The ViM recorded body motion, then the manufacture's software predicted energy expenditure (predicted EE, kcal/min) from outputs of the device. We calculated predicted METs by predicted EE values. To ensure steady state METs by the IC and the ViM, only the averaged values for final 7 min of each activity were used for data analysis. Data were analyzed with two-way ANOVA with repeated measurements; within-subjects factors were 2 measurement methods (IC and ViM) and 5 activity types. The criterion validity of the ViM was tested by correlation coefficients for each activity.

**RESULTS:** Two-way ANOVA results showed significant interaction ( $F(4, 56) = 26.3, p < 0.001$ ). There were significant differences between the IC and the ViM in all activities ( $p < 0.010$ ). Especially, the ViM fairly underestimated the IC at jump rope (IC: 7.9 +/- 1.6 METs; ViM: 5.1 +/- 0.4 MET,  $p < 0.001$ ). For the criterion validity of the ViM, there were no significant correlation coefficients for each five activity ( $r < 0.30, p \geq 0.25$ ) although correlation coefficient was significant for pooled data ( $r = 0.91, p < 0.001$ ).

**CONCLUSIONS:** The ViM significantly underestimates METs measured by the IC, and the criterion validity is low in field situation.

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**3059 Board #206 May 30 8:00 AM - 9:30 AM**  
**Rating Of Perceived Exertion With Various Modes Of Video Game Interaction**

Amanda Dye, Katie Schwisow, Kim Aszklar, Anna Willard, Justin Ulbright, W. Matthew Silvers. Eastern Washington University, Cheney, WA.

(Sponsor: Wendy Repovich, FACSM)

(No relationships reported)

Novel interaction modes for video games potentially offer a way to meet daily physical activity standards during game play.

**PURPOSE:** This study compared perceived exertion (RPE) during various modes of game play.

**METHODS:** Twenty-nine healthy, active college students (male: n=13, female: n=16) volunteered for participation. Each participant completed five game conditions in 5-min bouts: (CTRL) Super Mario Bros. 3 seated; (STAND) Super Mario Bros. 3 standing; (GH3) Guitar Hero 3 standing; (WII) Wii Sports Tennis standing; and (DDR) Dance Dance Revolution. Participants were taught how to use the Borg 15-point RPE scale prior to testing. Immediately following each condition participants indicated an RPE score that best represented their exertion level. Repeated measures ANOVA were used to investigate differences in RPE between game conditions.

**RESULTS:** Mean data for RPE are provided in Table 1. There was a statistically significant multivariate difference ( $p < 0.01$ ) for RPE. Pairwise comparisons indicated significant differences ( $p < 0.01$ ) between conditions, except for WII and GH.

Table 1. Mean $\pm$ SD values for RPE are summarized for each condition.						
	CONDITION					
VARIABLE	Rest	CTRL	STAND	WII	GH	DDR
RPE	7.1 $\pm$ 0.8	7.8 $\pm$ 1.1	8.7 $\pm$ 1.7	10.2 $\pm$ 1.4	9.6 $\pm$ 2.1	11.5 $\pm$ 1.6

**CONCLUSION:** DDR yielded the highest RPE scores, ranging from 10 to 13. ACSM recommendations indicate that RPE scores around 13 are representative of 40-50%  $\text{VO}_{2\text{max}}$ , which may be enough to elicit health benefits. Difficulty level for all game conditions was low and pilot data suggests that playing WII, GH, and DDR at higher difficulty levels increases RPE scores and associated cardiorespiratory responses. Therefore, the present findings indicate that DDR game play, even at novice levels, may be intense enough to maintain or improve health. Furthermore WII, GH, and DDR at expert levels may be intense enough to improve physical fitness.

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**3060 Board #207 May 30 8:00 AM - 9:30 AM**  
**Internet Delivered Active Living Every Day Efficacy: More Than Means And Goals**

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(No relationships reported)

Active Living Every Day via internet-delivery is a theory-based physical activity (PA) behavior change program with demonstrated efficacy. The internet-delivery (ALED-I) medium recently underwent revision/advancement to include an interactive and optional goal setting feature and real-time PA reporting/graphics from pedometer-measured PA. It is unclear how these recent advances may influence the PA efficacy of ALED-I and whether dominating PA measurement practices for pedometer studies may be missing important efficacy evidence.

**PURPOSE:** To determine the PA efficacy to include mean(s), minimum(s), and maximum(s) of the revised ALED-I PA behavior change program in sedentary and predominantly overweight middle-aged adults.

**METHODS:** Thirty-five participants completed the 16-week ALED-I program, of which 20 were randomly assigned to receive a monthly progressive step goal (G-group; +625 steps/day/month) over the 4-month study (2500 steps/day total increase). The remaining 15 participants were not assigned a goal (NG-group), but had access to the self-actuated goal setting feature inherent within the ALED-I program. At baseline and 16-weeks, PA was measured by pedometer as well as descriptive variables. Participants logged/reported their PA for at least 5 of 7 days per week including one weekend day. Multiple day data allowed calculation of weekly means as well as weekly minimum and maximum PA.

**RESULTS:** Participants (N=35) were 51.4±8.3 years and overweight (BMI: 29.4±6.7 kg/m<sup>2</sup>). In the total sample, the ALED-I program increased PA by 1157 steps/day (8359±2487 to 9517±2676; *p*<0.01). After 16-weeks, there was no difference between the NG and G-groups with respect to change in PA (*p*=0.44). Complimenting the overall increase in PA, the least physically active day (minimum) increased 25% (4684±2061 to 6182±2807 steps; *p*<0.01), and the most physically active day (maximum) increased 10% (*p*<0.05).

**CONCLUSIONS:** A 16-week program using the revised ALED internet-delivery features, with or without prescribed PA goals, shows increases in PA similar to but not greater than those previously reported in overweight and sedentary adults. Multiple day PA reporting elucidated complimentary findings of reduced weekly physical inactivity (increased minimum) and increased peak PA (maximum). NIH Grant # P20 RR016474

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**3061 Board #208 May 30 8:00 AM - 9:30 AM**  
**Validity And Reliability Of A Multi-sensor Board For Measuring Common Physical Activities**

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(No relationships reported)

Measuring physical activity is an important component of health-related research. However, none of the currently available methods are fully satisfactory because of problems related to cost, convenience, and measurement error. Furthermore, available methods only capture a portion of the needed information. We developed a novel, portable multi-sensor board (MSB) to overcome these limitations.

**PURPOSE:** To establish the validity and reliability of a multi-sensor board (MSB) that infers common physical activities and estimates the associated energy expenditure.

**METHODS:** Data were obtained from 33 adults (17 female) aged 39.0 ± 15.1 years with body mass index 26.1 ± 4.4 kg/m<sup>2</sup>. Subjects walked/jogged on a treadmill over a select range of speeds and grades for 3 min. each (6 stages in random order) while being connected to a metabolic cart; 3 min. of sitting and 2 min. of standing preceded while 5 min. of sitting followed each bout. A single MSB was worn at the waist attached to a fanny pack for all sessions. Random subjects repeated the experiment on a separate occasion. The MSB uses a decision stumps classifier and Hidden Markov Models to infer activities, and the ACSM prediction equation and the subject's body weight to estimate energy expenditure based on the classified activity.

**RESULTS:** Accuracy of inferred activities compared with the ground truth (correctly identified activities / total activities \* 100) was 92.6 ± 4.5% with test-retest reliability *r* = 0.60. Accuracy of total caloric expenditure estimates (kcal MSB / kcal metabolic cart \* 100) was 97.1 ± 16.6%. Estimates were 88.5 ± 12.1% and reliability *r* = 0.48 when calculating accuracy from the absolute percentage error (kcal MSB - kcal metabolic cart / kcal metabolic cart \* 100).

**CONCLUSION:** The MSB provides valid and reliable measures of accuracy for inferring physical activities and estimating energy expenditure under laboratory conditions based on our preliminary data. Field experiments are underway where subjects perform a short routine (e.g., sitting, standing, walking, riding an elevator up/down, walking up/down steps, etc.) while being connected to a portable metabolic system to more closely mimic real-world conditions.

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**3062 Board #209 May 30 8:00 AM - 9:30 AM**  
**Heart Rate Response To Interactive Video Games In Young Adults**

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Interactive video games are increasingly becoming a popular activity among young adults. We have previously shown that interactive gaming (in a laboratory setting) leads to marked health benefits. However, little is known about the exercise intensities engaged in during free play, and whether these intensities meet international physical activity guidelines for health benefits.

**PURPOSE:** To determine the exercise intensities exhibited during free play of interactive video games.

**METHODS:** Five males (24 ± 2 yr) and five females (22 ± 1 yr) were observed during six one-hour sessions (one session/wk). During each session, participants were given the choice of playing with video games in either an interactive medium (i.e., while exercising) or an inactive medium (i.e., traditional video gaming). Participant behaviour was recorded via video cameras and sessions were coded according to the type of activity displayed. Coded behaviours were then grouped and analyzed in three behavioural clusters: interactive gaming (IG), non-gaming physical activity (NG), and sedentary behaviour (SB). Beat-by-beat heart rate was also recorded throughout each session.

**RESULTS:** Young adults spent the majority of their time engaging in IG (61 ± 14% of the total time), with little time spent in traditional sedentary video game play (6 ± 16%). Females spent 60 ± 21% of total IG time at a heart rate which met or exceeded a level associated with the accrual of health benefits according to Health Canada/CSEP's guidelines. Approximately, 38 ± 9% was spent in "light effort" (i.e., 50-63% of heart rate max), 10 ± 5% was spent in the "moderate effort" zone (i.e., 64-76% of heart rate max) and 12 ± 25% was spent in the "vigorous effort" zone or above (i.e., 77-100% of heart rate max). In comparison, males spent 34 ± 28% of total IG time at a heart rate that met or exceeded the health benefit zone (14 ± 5% in "light effort", 11 ± 12% in "moderate effort", and 9 ± 14% in "vigorous effort").

**CONCLUSION:** Average heart rates attained during free play involving interactive video games are sufficient to meet international physical activity guidelines for health benefits. These findings have important implications for the design of physical activity interventions, specifically for young adults. **FUNDING:** Hampton Endowment Research Funds.

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**3063 Board #210 May 30 8:00 AM - 9:30 AM**  
**Physiological Cost Of An Active Video Game Versus Other Exercise Modes In University Students**

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Physically interactive video games require the movement of large muscle groups and therefore may potentially provide enough physical activity to produce health benefits. A few studies have evaluated their potential for caloric expenditure in children but little is known about their effects in young adults.

**PURPOSE:** The purpose of this study was to determine if a physically interactive video game can provide enough exercise for health benefits in comparison to walking and participating in a fitness boxing video.

**METHODS:** University students were randomly assigned to 6 possible intervention sequences in which all participants completed one 30 min session of each of 3 interventions: Nintendo Wii Sport boxing, brisk walking, and a fitness boxing video. Height, weight, resting heart rate, and maximum heart rate were measured before the intervention. Based on the ACSM Positions Stands for cardiorespiratory and weight management benefits, two target heart rate ranges were calculated for each subject to evaluate possible health benefits associated with cardiorespiratory fitness (65-90%  $\text{VO}_2$  max) and weight management (55-69%  $\text{VO}_2$  max). During each intervention, heart rate (HR) and ratings of perceived exertion (Borg RPE) were recorded. A significant difference among the groups was assessed by repeated measures ANOVA. LSD pairwise comparisons were used to perform post hoc evaluations of differences between treatments.

**RESULTS:** 23 subjects (15 women) mean age 21 y, height 172 cm, weight 71 kg, and BMI  $24 \text{ kg}\cdot\text{m}^{-2}$  completed the study. Differences among and between the mean HR values of the walking ( $120 \pm 17$  bpm), Wii ( $134 \pm 21$  bpm) and fitness video ( $163 \pm 13$  bpm) interventions were all significant. Mean RPE was also significantly different among the walking, Wii, and fitness video interventions ( $9.6 \pm 2.6$  vs.  $11.5 \pm 2.7$  vs.  $14.4 \pm 1.8$ ). The Wii intervention placed 40.9% of the subjects within their weight management target ranges and 27.3% within the more stringent cardiorespiratory fitness benefit range.

**CONCLUSION:** Nintendo Wii Boxing provided marginal physiological stimulus in fit university students. We suggest that benefits may be greater in a less fit population.

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**3064 Board #211 May 30 8:00 AM - 9:30 AM**  
**Energy Expenditure Of An Interactive Video Game: A Preliminary Study**

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(No relationships reported)

Interactive video games (e.g., Dance Dance Revolution) have been utilized to increase energy expenditure (EE) and to change health-related behavior. A recent popular interactive game, Wii (Nintendo, Japan), is more skill-free and age- and user-friendly; however, the feasibility as a potential intervention tool to increase EE with moderate intensity physical activity (MPA) has not been examined.

**PURPOSE:** To determine EE and intensity of Wii Sports game activities.

**METHODS:** As a pilot study, eight healthy adults ( $M \pm SD$ :  $29.13 \pm 7.39$  yrs old & participating in MPA  $3.57 \pm 2.76$  times/week) were recruited (height, weight, & age:  $176.80 \pm 5.33$  cm &  $80.25 \pm 8.61$  kg in 3 males;  $166.24 \pm 4.61$  cm &  $59.94 \pm 4.24$  kg in 5 females). Experience of playing Wii was varied: never ( $n=3$ ), 1-10 times ( $n=4$ ), and more than 10 times ( $n=1$ ). Energy expenditure (EE;  $\text{VO}_2$ ) of individuals was measured by indirect calorimetry and heart rate (HR) monitor during quiet sitting and playing Wii (Tennis, Bowling, and Boxing) for about 10 minutes each, respectively. Between activities, participants rested 2-3 minutes to simulate a real life setting. A counter-balanced design was employed to avoid carry-over effect of the 3 game activities from the previous activity. Descriptive analysis was applied to determine EE and HR of each activity. Independent  $t$ -test with Bonferroni correction when needed and repeated measures ANOVA were employed to investigate the difference between sitting and the 3 activities and differences among the 3 activities, respectively. All alpha level was set .05.

**RESULTS:** Mean  $\pm$  SD of observed EE (MET-min) and HR was as follows (MET/HR):

Sitting  $1.05 \pm 1.11 / 68.85 \pm 9.78$

Bowling  $2.67 \pm 4.7 / 86.97 \pm 12.53$

Tennis  $3.43 \pm .86 / 98.93 \pm 11.07$

Boxing  $4.56 \pm 1.62 / 111.81 \pm 13.00$

MET scores and HR of all three activities were statistically different from sitting quietly,  $t = -3.52$  to  $-9.49$  with  $p < .001$  &  $p < .01$ , respectively. After repeated measures ANOVA, MET and HR were also significantly different among activities,  $F = 9.85$  &  $17.96$  with  $p = .013$  &  $p = .001$ , respectively.

**CONCLUSION:** Tennis and boxing of Wii games were determined as MPA, which is 3.0-5.9 MET. Larger sample size is needed to generalize the findings; however, results indicate that a well-designed intervention applying Wii may be able to increase MPA of individuals.

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**3065 Board #212 May 30 8:00 AM - 9:30 AM**  
**Oxygen Consumption With Various Modes Of Video Game Interaction**

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(No relationships reported)

Novel interaction modes for video games potentially offer a way to meet daily physical activity standards during game play.

**PURPOSE:** This study compared mean and peak oxygen consumption ( $\text{VO}_2$ ) during various modes of video game play.

**METHODS:** Twenty-nine healthy, active college students (male:  $n=13$ , female:  $n=16$ ) volunteered for participation. Each participant completed five game conditions in 5-min bouts: (CTRL) Super Mario Bros. 3 seated; (STAND) Super Mario Bros. 3 standing; (GH3) Guitar Hero 3 standing; (WII) Wii Sports Tennis standing; and (DDR) Dance Dance Revolution.  $\text{VO}_2$  was measured continuously during each condition with mean ( $m\text{VO}_2$ ) and peak ( $p\text{VO}_2$ ) 1-min values recorded for analysis. Mean resting  $\text{VO}_2$  also was measured. Repeated measures ANOVA were used to investigate differences in  $m\text{VO}_2$  and  $p\text{VO}_2$  between game conditions.

**RESULTS:** Mean data for  $m\text{VO}_2$  and  $p\text{VO}_2$  are provided in Table 1. There was a statistically significant multivariate difference ( $p < 0.01$ ) for  $m\text{VO}_2$  and  $p\text{VO}_2$ . Pairwise comparisons indicated significant differences ( $p < 0.05$ ) between conditions, except for CTRL and STAND ( $m\text{VO}_2$ :  $p = 0.16$  and  $p\text{VO}_2$ :  $p = 0.20$ ).

Table 1. Mean $\pm$ SD values for $m\text{VO}_2$ and $p\text{VO}_2$ are shown for each condition.						
	CONDITION					
VARIABLE	Rest	CTRL	STAND	WII	GH	DDR
mean $\text{VO}_2$ (ml/kg/min)	$4.22 \pm 0.57$	$4.76 \pm 0.79$	$4.93 \pm 0.79$	$7.77 \pm 2.34$	$5.45 \pm 0.76$	$11.88 \pm 3.49$
peak $\text{VO}_2$ (ml/kg/min)	--	$5.38 \pm 0.95$	$5.60 \pm 0.98$	$8.86 \pm 2.88$	$6.15 \pm 1.17$	$14.59 \pm 2.68$

**CONCLUSION:** DDR yielded the highest  $m\dot{V}O_2$  and  $p\dot{V}O_2$  corresponding to 3.4 and 4.2 METS of intensity, respectively. ACSM recommendations for physical activity indicate 450-750 met-minutes should be accumulated weekly to elicit health benefits. It appears then that 2-3 hours of DDR play per week, even at a novice level of difficulty, could meet these recommendations. Wii and GH, however, would require almost double the weekly time to elicit health benefits similar to DDR.

**3066 Board #213 May 30 8:00 AM - 9:30 AM**  
**Blood Pressure Responses With Various Modes of Video Game Interaction**

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 (No relationships reported)

Novel interaction modes for video games potentially offer a way to meet daily physical activity standards during game play.

**PURPOSE:** This study compared blood pressure responses during various modes of video game play.

**METHODS:** Twenty-nine healthy, active college students (male: n=13, female: n=16) volunteered for participation. Each participant completed five game conditions in 5-min bouts: (CTRL) Super Mario Bros. 3 seated; (STAND) Super Mario Bros. 3 standing; (GH3) Guitar Hero 3 standing; (WII) Wii Sports Tennis standing; and (DDR) Dance Dance Revolution. Immediately following each condition systolic (SBP) and diastolic (DBP) blood pressures were measured. Resting SBP and DBP also were obtained. Repeated measures ANOVA were used to investigate statistical differences in SBP and DBP between game conditions.

**RESULTS:** Mean data for SBP and DBP are provided in Table 1. There was a statistically significant multivariate difference ( $p=0.038$ ) for DBP, but not for SBP ( $p=0.658$ ).

Table 1. Mean $\pm$ SD values for SBP and DBP are shown for each condition.						
	CONDITION					
VARIABLE	Rest	CTRL	STAND	WII	GH	DDR
SBP (mm Hg)	118.7 $\pm$ 6.5	119.1 $\pm$ 9.4	118.3 $\pm$ 9.1	120.3 $\pm$ 7.2	119.2 $\pm$ 9.8	118.9 $\pm$ 17.3
DBP (mm Hg)	72.3 $\pm$ 8.0	76.8 $\pm$ 6.2	76.2 $\pm$ 6.7	76.1 $\pm$ 9.3	76.6 $\pm$ 9.2	79.3 $\pm$ 9.6

**CONCLUSION:** Blood pressure responses, as a whole, were similar across conditions, except for DDR, which elicited significantly higher DBP ( $p=0.01-0.05$ ) compared to REST, STAND, WII, and GH. The expected blood pressure responses across conditions were increases in SBP and no change/decreases in DBP due to vasodilation. It is possible that the observed increases in DBP may be attributed to testing error. Further study is warranted to verify these findings and the blood pressure implications for video game play in multiple populations.

**3067 Board #214 May 30 8:00 AM - 9:30 AM**  
**Heart Rate Responses With Various Modes of Video Game Interaction**

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 (No relationships reported)

Novel interaction modes for video games potentially offer a way to meet daily physical activity standards during game play.

**PURPOSE:** This study compared heart rate (HR) responses during various modes of video game play.

**METHODS:** Twenty-nine healthy, active college students (male: n=13, female: n=16) volunteered for participation. Each participant completed five game conditions in 5-min bouts: (CTRL) Super Mario Bros. 3 seated; (STAND) Super Mario Bros. 3 standing; (GH3) Guitar Hero 3 standing; (WII) Wii Sports Tennis standing; and (DDR) Dance Dance Revolution. Mean ( $HR_{mean}$ ) and peak ( $HR_{peak}$ ) HR values were recorded during each condition, as well as resting HR. Repeated measures ANOVA were used to investigate differences in  $HR_{mean}$  and  $HR_{peak}$  between game conditions.

**RESULTS:** Mean data for  $HR_{mean}$  and  $HR_{peak}$  are provided in Table 1. There was a statistically significant multivariate difference ( $p<0.01$ ) for  $HR_{mean}$  and  $HR_{peak}$ . Pairwise comparisons indicated significant differences ( $p<0.05$ ) between conditions, except for WII and GH.

Table 1. Mean $\pm$ SD values for $HR_{mean}$ and $HR_{peak}$ are summarized for each game condition.						
	CONDITION					
VARIABLE	Rest	CTRL	STAND	WII	GH	DDR
$HR_{mean}$ (beats/min)	72.4 $\pm$ 9.5	77.0 $\pm$ 8.9	86.7 $\pm$ 12.5	90.0 $\pm$ 13.0	90.3 $\pm$ 12.8	114.1 $\pm$ 18.2
$HR_{peak}$ (beats/min)	--	86.1 $\pm$ 10.0	91.7 $\pm$ 13.5	100.5 $\pm$ 14.1	99.3 $\pm$ 14.5	121.7 $\pm$ 16.5

**CONCLUSION:** DDR yielded the highest  $HR_{mean}$  and  $HR_{peak}$  scores compared to other conditions. DDR HR scores represent approximately 60% of age-predicted  $HR_{max}$  for the sample population, which is in line with ACSM recommendations for fitness development. Additionally, it appears that WII and GH HR scores represent approximately 50% of age-predicted  $HR_{max}$ , which may not be intense enough for fitness development, but may elicit improvements in health.

**3068 Board #215 May 30 8:00 AM - 9:30 AM**  
**Heart Rate Response To Free Play Of Active Video Games**

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 (No relationships reported)

Although the prevalence of overweight in children has remained stable between NHANES 2003-2004 data and the 2005-2006 data, the prevalence remains high, with 33.3% of



6-11 year olds having a BMI greater than the 85<sup>th</sup> percentile based on CDC recommendations. The popularity of video games has often been blamed for this high prevalence of overweight in children.

**PURPOSE:** The purpose of this study was to determine if children were given the opportunity to play active video games whether they would exercise at a level that would be conducive to increasing fitness and to compare this response in overweight and lean children.

**METHODS:** Thirty four participants had their height and weight measured at baseline. The mean BMI was 22.7 ( $\pm$  8.6) kg/m<sup>2</sup>, 13 of the participants had a BMI that was <85<sup>th</sup> percentile based on CDC recommendations, while 21 participants were >85<sup>th</sup> percentile. All participants were provided access to a wide variety of active video games once a week for 45 minutes, over a 7-week period. Each participant was connected to a HR monitor upon arriving and their average amount of time played and average HR were calculated. If a participant arrived late or left early, less time was available to play.

**RESULTS:** The average HR did not significantly vary between the exercise sessions ( $p>0.05$ ) or between BMI classification ( $p>0.05$ ). The number of participants who achieved an average HR that was at or above 70% of their predicted max HR varied between 6.2% and 26.6 %.

**CONCLUSIONS:** When given free access to playing a wide variety of active video games, children aged 6-11 years of age exercised at an intensity that was great enough to moderately increase their HR. However, most participants did not achieve a HR that would put them in the ACSM's training HR zone. There were no significant differences in response to the exercise sessions based on BMI category. It is important to continue to investigate methods of increasing physical activity in children.

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**3069 Board #216 May 30 8:00 AM - 9:30 AM**  
**Energy Cost Of Physically Active Video Gaming Against A Human Or Computer Opponent**

Jessica McWha<sup>1</sup>, Sarah Horst<sup>1</sup>, Gregory A. Brown, FACSM<sup>1</sup>, Brandon S. Shaw<sup>2</sup>, Ina Shaw<sup>3</sup>. <sup>1</sup>*the University of Nebraska at Kearney, Kearney, NE.*  
<sup>2</sup>*Tshwane University of Technology, Pretoria, Gauteng, South Africa.* <sup>3</sup>*Vaal University of Technology, Vanderbijlpark, South Africa.*  
(No relationships reported)

Playing a physically active video game increases energy expenditure above that of sedentary video game play. And anecdotal reports suggest that people play harder against other people than against the computer system. However, the energy expenditure of playing a physically active video game against another person has not been evaluated. Furthermore, most of the research on energy expenditure during physically active video game play has been conducted in children even though young adults represent a large portion of the video game market.

**PURPOSE:** To determine if there is a difference in energy expenditure while playing *Nintendo Wii Boxing* against a Human or Computer opponent, and to evaluate the energy expenditure in young adults.

**METHODS:** Twenty college-aged adults (10 males, 22.5  $\pm$  0.5 y :10 females, 21.0  $\pm$  0.4 y) were measured for body composition and maximal aerobic capacity (VO<sub>2</sub>max) before playing *Nintendo Wii Boxing* for 15 minutes against a human or computer opponent, in a randomized manner, while heart rate, oxygen consumption, and energy expenditure were measured.

**RESULTS:** Heart rate, oxygen consumption, and energy expenditure were all higher ( $P<0.05$ ) at VO<sub>2</sub>max than any other condition. Heart rates (beats/min) while playing the video game were higher ( $P<0.05$ ) for both the Human (103.8  $\pm$  4.3) and Computer (104.6  $\pm$  4.6) opponent than at rest (75.4  $\pm$  2.9), with no differences between gender or video game opponent. Oxygen consumption (ml/kg/min) while playing the video game was higher ( $P<0.05$ ) for both the Human (14.6  $\pm$  1.80) and Computer (14.4  $\pm$  1.66) opponent than at rest (4.4  $\pm$  0.51), with no differences between gender or video game opponent.

**CONCLUSIONS:** The present data support previous investigations indicating that playing a physically active video game increases heart rate, oxygen consumption, and energy expenditure, but the magnitude of increase is not sufficient to classify physically active video game play as even moderate intensity exercise. These data also indicate that the magnitude of increase in energy expenditure while playing a physically active video game is similar in children and young adults. The present data further suggest that playing against a computer or human opponent does not alter the magnitude of increase in energy expenditure associated with physically active video game play.

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**3070 Board #217 May 30 8:00 AM - 9:30 AM**  
**Salivary Cortisol And Blood Lactate Responses To Physically Active Video Gaming In Young Adults**

Sarah Horst<sup>1</sup>, Jessica McWha<sup>1</sup>, Gregory A. Brown, FACSM<sup>1</sup>, Brandon S. Shaw<sup>2</sup>, Ina Shaw<sup>3</sup>. <sup>1</sup>*the University of Nebraska at Kearney, Kearney, NE.*  
<sup>2</sup>*Tshwane University of Technology, Pretoria, Gauteng, South Africa.* <sup>3</sup>*Vaal University of Technology, Vanderbijlpark, South Africa.*  
(No relationships reported)

Physically active video games require the use of more body movement, and hence greater energy expenditure, than do traditional sedentary video games. Wang and Perry reported that blood lactate concentrations were not changed by playing a traditional sedentary video game, but the blood lactate and salivary cortisol response to a physically active video game have not been measured. Furthermore, informal statements by those who play physically active video games indicate that they put more effort into playing when they are competing against another person.

**PURPOSE:** To compare the blood lactate and salivary cortisol responses, as measures of physiological stimulation, when playing a physically active video game against a computer and human opponent.

**METHODS:** 20 healthy, college aged adults (10 males, 22.5  $\pm$  0.5 y: 10 females, 21.0  $\pm$  0.4 y) were assessed for body composition and maximal oxygen consumption (VO<sub>2</sub>max), with measurements of blood lactate and salivary cortisol concentrations before and after the VO<sub>2</sub>max assessment. On another day, the subjects engaged in 15 minutes of playing a physically active video game (*Wii Boxing*, Nintendo inc.) in a randomized manner against a human opponent or against the computer system with blood lactate and salivary cortisol concentrations measured before and immediately after each gaming session.

**RESULTS:** There were no differences in resting blood lactate concentrations between the males (1.2  $\pm$  0.2 mmol/L) and females (1.1  $\pm$  0.1 mmol/L). Blood lactate concentrations following the VO<sub>2</sub>max assessment were higher in the males (10.4  $\pm$  0.6 mmol/L) than in the females (8.4  $\pm$  0.4). Playing the physically active video game did not alter blood lactate in either gender or condition. The females had higher ( $P<0.05$ ) salivary cortisol concentrations than the males. However, there were no changes in salivary cortisol concentrations due to any intervention.

**CONCLUSIONS:** These data suggest that playing a physically active video game against a human opponent does not produce greater physiologic stimulation than when playing against the computer. Furthermore, the level of physical activity when playing a physically active video game is insufficient to result in changes in blood lactate or salivary cortisol, further indicating that physically active video game play is not vigorous exercise.

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**3071 Board #218 May 30 8:00 AM - 9:30 AM**  
**Do Active Video Games Help Children Lose Weight?**

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Active video games have been suggested as a possible alternative to exercise for helping solve the issue of obesity in youth. Currently, 33.3% of children aged 6-11 are classified as "at risk for overweight" or "overweight" according to the CDC guidelines.

**PURPOSE:** The purpose of this study was to determine if a 7 week class on health, with time given to play active video games, would lead to changes in BMI and body fat levels in children aged 6-11.

**METHODS:** Thirty one children aged 6-11 years completed at least 5 of the 7 training sessions and had their height, weight, BMI, and % body fat analyzed. Participants were instructed on basic health and nutrition for 45 minutes per week and were given access to playing a wide variety of active video games for 45 minutes at each weekly session. Height, Weight, BMI, and Body Fat (via skin fold measurements) were measured prior to beginning the class, following the completion of the class, and at 6 and 12 weeks after the completion of the class.

**RESULTS:** ANOVA revealed no significant differences existed in BMI during the follow up period ( $p>0.05$ ). Body Fat % was lower at 12 weeks post intervention compared to any other time point ( $p<0.05$ ).

**CONCLUSIONS:** Although 7 weeks of access to active video games did not impact BMI, there was a statistically significant drop in % body fat based on skinfolds 12 weeks after the intervention. Since the only decrease was shown 12 weeks post, it is likely that the active video games did not directly lead to a decrease in % body fat, but that the 7 week class and exercise session led to a lifestyle improvements which decreased body fat %. The results of this work and other work in this area would suggest that an intervention of active video games alone may not be sufficient to combat overweight in children. Active video games could be a component of a successful program.

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**3072 Board #219 May 30 8:00 AM - 9:30 AM**  
**Energy Expenditure And Cardiopulmonary Responses To Sedentary And Physically-interactive Video Gaming In College Males**

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(No relationships reported)

There has been a simultaneous rise in obesity and sedentary leisure activity rates in youth over the past three decades. The video gaming industry has responded to this by introducing physically-active video games meant to counter the more sedentary nature of their products.

**PURPOSE:** The purpose of this study was to compare energy expenditure and cardiopulmonary response patterns during sedentary vs. physically-interactive video tennis.

**METHODS:** Ten college-age males underwent maximal exercise treadmill testing to determine maximal oxygen consumption ( $\text{VO}_{2\text{max}}$ ), ventilatory factors ( $\text{VE}_{\text{max}}$ ,  $\text{TV}_{\text{max}}$ ) and heart rate ( $\text{HR}_{\text{max}}$ ). One week later subjects played seated, sedentary video tennis (SVT) for 18 minutes, rested 10 min. then played an 18-minute round of interactive video tennis (IAVT) while  $\text{VO}_2$ , kcal, HR, VE, TV, and breathing frequency (BF) were monitored. Mean values for all variables were compared using an ANOVA posthoc paired  $t$  test,  $p=.05$ .

**RESULTS:** Mean  $\text{VO}_2$ , HR, VE, TV, and kcal expenditure during IAVT ( $7.61 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ , 93.14 bpm, 13.46 L/min, .684L, 2.99 kcal/min) were significantly higher than SVT ( $4.88 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ , 80.07 bpm, 10.18 L/min, .583L, 1.88 kcal/min). There was no significant effect from either game format on BF. Mean VE and TV in both game situations were significantly lower than both resting and maximal VE and TV. When reported as % $\text{VO}_{2\text{max}}$ , % $\text{HR}_{\text{max}}$ , and % $\text{VE}_{\text{max}}$ , IAVT play elicited rates of 17.25%, 48.3%, and 15.25% respectively, whereas SVT rates were 11.22%, 41.57%, and 11.42%. Subjects reached a significantly higher Peak  $\text{VO}_2$  on IAVT ( $9.86 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) compared to SVT ( $6.51 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ).

**CONCLUSIONS:** IAVT elicited significantly higher values compared to SVT for all reported variables except BF, leading to the conclusion that IAVT gamers worked at a higher % $\text{VO}_{2\text{max}}$ , % $\text{HR}_{\text{max}}$ , % VE, and calorie cost compared to playing a similar, but seated, handheld video game. Ventilatory data indicated a ventilatory relaxation response in both game situations. Neither game elicited values to cause a training effect or burn significant calories. IAVT was comparable in energy expenditure to folding laundry or driving a car, suggesting that interactive video games touted as physically-active are still a low-active endeavor.

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**3073 Board #220 May 30 8:00 AM - 9:30 AM**  
**Assessment Of Cardiovascular Response And Metabolic Cost Of Speaking While Using An Active Workstation**

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**PURPOSE:** To assess indicators of speech quality and document the heart rate, blood pressure and metabolic requirement ( $\text{VO}_2$ ) of speaking while sitting, standing and walking.

**METHODS:** Thirty adults aged 37 $\pm$ 14 years participated in all conditions. Heart rate and  $\text{VO}_2$  were obtained continuously with a Parvomedics metabolic system and expressed as ml/kg/min while subjects read silently, and aloud, or engaged in spontaneous conversation in a sitting, standing or walking (1 mph) condition. Blood pressure and rating of perceived exertion (RPE) were obtained during the last minute of the respective tasks. Expert listeners, blinded to the purpose of the study and the protocol assessed randomized samples of the participants reading and spontaneous speech tasks during the 3 conditions.

**RESULTS:** Standing elevated metabolic rate 10-15% over the sitting position ( $3.3 \pm .7$  vs.  $3.6 \pm .9 \text{ ml/kg/min}$ ). Walking 1 mph while performing the respective tasks resulted in physical activity level of 2.0-2.3 MET. The ranges for heart rates for the tasks performed under sitting-standing-walking conditions were 78-83, 87-91, and 90-96 bpm respectively. RPE across conditions varied from .4 to 1.6. There was no significant difference in the average number of syllables included in each breath group across the conditions ( $p = .945$ ). The number of ungrammatical pauses that occurred when the participants were reading aloud was minimal (0 -1 ungrammatical pause per reading) and the occurrence of these ungrammatical pauses did not differ across the conditions. No dysfluencies (e.g., unusual speech patterns, stuttering) were detected.

**CONCLUSION:** The significant elevation in metabolic rate in the absence of any deterioration in speech quality or RPE support the utility of using active work stations to significantly increase PA in the work environment and thereby enhancing health.

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**3074 Board #221 May 30 8:00 AM - 9:30 AM**  
**Demographic And Behavioral Determinants Of Participation In Walking Program With Information Technology**

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**PURPOSE:** The investigation of the recruitment methods for programs and the characteristics of participants, along with the program contents, would lead to more effective operation of physical activity promotion programs. The purpose of the present study was to identify the determinants of the participation in walking program with the e-mail function of cellular phone.

**METHODS:** The sample was collected from the registrants of Japanese social research company. The company sent their registrants (30-49 years old) the requests for answering the questionnaire. The recruitment of the program was in the end of the questionnaire. In about 13,000 registrants receiving the requests, 4935 who answered all questions were identified as the subjects in the present investigation. The intervention program with e-mail newsletter was offered to all applicants.

**ANALYSIS:** Kraemer's signal detection analysis (Kraemer. *The American Statistician*, 1988; 42: 37-49) was used for selecting predictor of applicant from potential variables (gender, age, marital status, number of family, educational background, occupation, family income, hour per day spent in television watching, and hour per day spent in internet using, stage of

change for walking behavior, and self-efficacy for regular walking).

**RESULTS:** In all subjects, 1268 (25.7%) of them applied for the program. Signal detection analysis revealed that the predictors of applicant were stage of change, self-efficacy, and hour in internet using. As these variables, people were classified 6 groups: 1) precontemplation (N=1285, 9.9%), 2) contemplation (N=1197, 26.4%), 3) over-preparation, self-efficacy<11, Internet use<3 hours (N=958, 24.8%), (4) over-preparation, self-efficacy<11, Internet use≥3 hours (N=450, 34.4%), (5) over-preparation, self-efficacy 11-13 (N=567, 36.5%), and (6) over-preparation, self-efficacy≥14 (N=478, 47.1%).

**CONCLUSIONS:** The present study indicates that those who engage in walking, have higher self-efficacy for regular walking, or use internet more frequently tends to participate in the walking program using information technology.

**ACNOWLEDGEMENT:** The present study was Supported by a Grant-in-Aid for Scientific Research from the Japan Society for the Promotion of Science (16300197).

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**3075 Board #222 May 30 8:00 AM - 9:30 AM**  
**Effects Of E-mail Based Walking Program On Weekly Walking Time And Behavior**

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**PURPOSE:** The effectiveness of physical activity intervention mediated information technology has been highlighted. The purpose of the present study was to examine whether walking program with the e-mail function of cellular phone promotes walking behavior among Japanese people in 30-49 years.

**METHODS:** The participants were registrants in an internet monitor system, who concerned about a walking program for their health. One thousand one hundred eleven (male: N=554, female: N=557, 30-49 years) participants joined in this study as an intervention group. On the other hand, 1190 subjects (male: N=598, female: N=592, 30-49 years) were served as an age- and gender-matched control group. The participants in the intervention group were encouraged to execute a walking behavior with e-mails using their cellular phones twice a week for one month (8 times in total). The contents of the e-mail were depended on the level of participants' walking behavior investigated before this intervention. The primary outcome was time (in minute) of walking per week. The stage of changes in the walking behavior was measured as the secondary outcome.

**RESULTS:** ANCOVA adjusting baseline walking time and demographic variables showed an improvement in the walking time for the intervention group in comparison with that of control group after the intervention [Mean inter-group difference in change: 70.1 min/week, (P<0.05)]. Percentage of improved the stage of changes in the walking behavior was higher in intervention group (38.5%) than that of control group (22.3%) ( $\chi^2 = 61.19$ , P<0.05).

**CONCLUSIONS:** These results indicate that the walking program with the e-mail function of cellular phone promotes for the walking behavior in selected subjects for one month. Further research examining long term effect on walking behavior after the program would be needed.

**ACNOWLEDGEMENT:** The present study was Supported by a Grant-in-Aid for Scientific Research from the Japan Society for the Promotion of Science (16300197).

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**3076 Board #223 May 30 8:00 AM - 9:30 AM**  
**Effectiveness Of A Tailored Wellness Program On Biometricirics**

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The rising cost of healthcare has driven employers to invest in effective health education and communication strategies to reduce morbidity associated with behavioral and biometric risk factors. There is growing evidence for the use of computer-tailored, online behavioral health interventions.

**PURPOSE:** To determine whether a computer-tailored, online wellness program had an effect on body mass index (BMI), cholesterol, blood pressure, blood glucose, and waist circumference.

**METHODS:** We recruited subjects from a large mid-western college campus to participate in the computer-tailored wellness program. Information collected based on epidemiological need, stage of change, motivation, self-confidence, barriers and demographics, the automated system recruits participants into follow-up behavior change interventions. Self-reported baseline and follow-up biometric data (total cholesterol, high density lipoprotein (HDL), systolic (SBP) and diastolic blood pressure (DBP), fasting glucose, height, weight and waist circumference) either CHI squared ( $\chi^2$ ) for categorical variables or *t* tests for continuous variables.

**RESULTS:** Of the 432 employees enrolled, 23.8% (n = 129) completed the one-year follow up health risk assessment. The participants in this study were predominately women (78%), middle-aged, white/non-Hispanic and college graduates. At one year follow up, proportionally more men reported a HDL ≥ 40 mmol/L (+12%), waist circumference ≤ 40 in (+10%), and fasting blood glucose ≤ 100 mg/dL (+23%). Favorable trends were not noted for women at year-end. Although, hypertension was the second most common self-reported chronic condition, only 5% reported DBP >90mmHg and SBP >140mmHg. Body mass index (BMI) data showed proportionally fewer men in extremely obese (-5.6%), and overweight categories (-5.5%) and more men in the obese category (+5.6%). Women showed little proportional change in the BMI risk category expect for the significant increase in the extremely obese category (4.6%, p<0.05).

**CONCLUSION:** Participation in the computer-tailored wellness program resulted in a moderate positive shift towards healthier biometric data in men but not in women participants. The low program retention contributed to the suboptimal program performance on risk modification.

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**3077 Board #224 May 30 8:00 AM - 9:30 AM**  
**Evaluation Of An Internet-based Physical Activity Intervention Program For College Students**

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This study was designed to test the efficacy of an internet-based physical activity intervention program (IPAIP) that consisted of website components and e-mail tip sheets. The IPAIP was based on behavioral theory, and emphasized physical activity information. Some reports indicate that an internet-based physical activity intervention increases physical activity. Some intervention programs are composed of website components and e-mail tip sheets similar to this study; however, it has been unclear whether components of the program had much effect on attitudes toward physical activity.

**PURPOSE:** To examine changes in physical activity, and to evaluate the contribution of the components to the attitudes toward physical activity.

**METHODS:** A total of 81 college students (52 intervention: group I and 29 control: group C) in Japan completed a 14-week randomized controlled trial during the first semester. All participants answered the International Physical Activity Questionnaire (IPAQ). Group I responded to a questionnaire which was designed to measure the effects of the components and e-mail tip sheets, and the attitudes (interest, belief, and intention) toward physical activity.

**RESULTS:** Group I exhibited a significant increase (+270 kcal/day) in total physical activity compared with group C (+13 kcal/day). Group I exhibited a significant decrease (-77.1 min/day) in the average time spent sitting on weekdays compared with group C (+55.9 min/day). Factor analysis confirmed the existence of four factors underlying the questions to measure the effects of the components and e-mail tip sheets: choose and schedule for strength and stretching (factor 1), goal setting and schedule for physical activity (factor 2), learn about physical activity, strength and stretching (factor 3), and energy expenditure (factor 4). In a pass analysis, factor 1 (b = 0.33) and factor 3 (b = 0.33), factor 1 (b = 0.40) and factor 4

( $b = 0.36$ ), factor 2 ( $b = 0.58$ ) had significant direct effects on the interest ( $R^2 = 0.36$ ), the belief ( $R^2 = 0.42$ ), the intention ( $R^2 = 0.34$ ) respectively.

**CONCLUSION:** The IPAIP increased total physical activity and decreased minutes sitting on weekdays. It also seemed to have positive effects on attitudes toward physical activity. Factor analysis revealed that a part of IPAIP had direct effects on the interest and belief.