3:00 p.m.
CARDIORESPIRATORY DYNAMICS IN RESPONSE TO UPRIGHT AND SUPINE SINUSOIDAL WORK
R. W. Stremel, R. Casaburi and E. M. Bernauer, Dept. of Phys.

The influence of body position on the dynamics of oxygen uptake (VO2), heart rate (HR) and stroke volume (SV) (by impedance cardiography) during exercise was determined utilizing frequency analysis techniques. Four subjects performed cycle ergometer exercise in the upright and supine positions at work rates which varied sinusoidally between 300 kcal/min and 60% of max VO2. In each position, the subjects exercised at 7 to 10 sinusoidal periods, ranging from 0.5 to 15 min/cycle. From these and steady-state response data, amplitude and phase relations between each variable and the perturbing work load were extracted. HR and VO2 were well described by first-order linear dynamics with time constants (in mins) of:

<table>
<thead>
<tr>
<th>Position</th>
<th>HR</th>
<th>VO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upright</td>
<td>0.94 ± 0.11</td>
<td>0.85 ± 0.11</td>
</tr>
<tr>
<td>Supine</td>
<td>0.99 ± 0.11</td>
<td>1.11 ± 0.13</td>
</tr>
</tbody>
</table>

Neither the dynamics nor the steady-state amplitudes of the responses varied significantly with body position. In contrast, SV did not fluctuate significantly with work rate in either body position. We therefore conclude that, at the work rates studied, stroke volume does not play a significant role in the cardiorespiratory response to dynamic exercise.

Supported by Air Force contract # F44620-72-C-0011.

Richard W. Stremel
Div. of Respiratory Med.
Harbor General Hospital
Torrance, CA 90609

SECTION D-1 PART II
Wednesday, May 5
3:45 p.m. to 5:00 p.m.
Chairperson: Barbara Drinkwater
Univ. of California
Santa Barbara, CA

3:45 p.m.
VO2MAX AND RECTAL TEMPERATURE IN TEMPERATE AND HOT ENVIRONMENTS
E. Shwartz, A. Meroz, and H. Limfeld. Heller Institute of Medical Research, Sheba Medical Center, Israel

Thermal responses of eleven young men with high VO2max (mean and range = 80.2 and 55-66 ml x kg^-1 x min^-1) and of ten subjects with low to average VO2max (mean and range = 37.4 and 35-46 ml x kg^-1 x min^-1) were recorded during benchstepping at 40 and 80 W for 60 and 15 min respectively at room temperature of 23°C, and during 3 hr of benchstepping at 40 W in heat (40°C DB, 30°C WB). VO2max was determined on a treadmill by graded exercise to exhaustion. Subjects with high VO2max showed significantly lower rectal temperatures than subjects with low VO2max (37.0, 37.9, 37.9, and 38.5°C at rest and during exercise at 40 W, 80 W, and in heat respectively, as compared with values of 37.2, 38.2, 38.2, and 38.9°C respectively. Moderate correlation coefficients were found between VO2max and rectal temperature in the different conditions. Sweat rates did not differ between the two groups in the two environments. The results showed that the lower rectal temperatures which fit people, as compared with unfit ones, and consequently their relatively good responses in heat, is caused by their relatively low resting values and efficient cardiovascular system, and not by better sweat rate responses. This results in some advantages in heat dissipation during exercise in temperate and hot environments, but in only partial heat acclimation.

Esher Shwartz
Human Environ. Physiol. Lab.
Moffett Field, CA

4:00 p.m.
TEMPERATURE REGULATION DURING EXERCISE IN MAN AS A RESULT OF HYPERTONIC Na+ AND Ca++ SOLUTIONS.

The purpose of this study was to test the hypothesis that Na+ ingestion results in an increase and Ca++ ingestion a decrease in the equilibrium level of rectal temp (Tre) during submaximal exercise. In separate experiments 5 men (22-26 yr) drank 1.0-1.4L (167 ml/ kg) of hypertonic Na+ (245 mEq/L), hypertonic Ca++ (139 mEq/L) and isotonic Na+ (161 mEq/L) solutions 1.5 h before exercise. Then they exercised for 1.0h in the supine position on a bicycle ergometer (rel. VO2 of 45%) and recovered for 30 min; Tdb was 24°C. Ingestion of hyper. Na changed plasma volume (PV) +4.8% [Ca] -6.2%, and plasma [Na] and [Osm] were unchanged; isotonic Na changed PV +7.4%, [Ca] -5.9%, and plasma [Na] and [Osm] were unchanged; hyper. Ca changed plasma [Ca] +10.1% from 4.71 to 5.24 mEq/L, and PV, [Na] and [Osm] were unchanged. By the end of exercise [Na] and [Osm] were unchanged in all 3 tests, but [Ca] was elevated (P<0.01) with Ca ingestion. In spite of these fluid and electrolyte shifts, there were no significant differences in the equilibrium levels of Tre, Tsk, sweat rates or limb total blood flows. The results suggest that forced ingestion of these hypertonic solutions does not induce sufficient stimulation to influence temperature regulation during exercise.

Supported by NASA Grant (NCA-2OR180-506).

Glen R. Mangseth
1722 Birch Lane
Davis, CA 95616

4:15 p.m.
THE EFFECT OF ACUTE DEHYDRATION AND REHYDRATION ON ISOMETRIC AND ISOTONIC ENDURANCE

The primary purpose of this study was to evaluate the effect of dehydration and subsequent rehydration on local muscular endurance during isometric and isotonic work. Twenty subjects, age 21-30 yrs, were randomly assigned to isometric and isotonic groups. Experimental subjects for isometric work served as controls for the isotonic group, and vice versa. Exercise heart rate (EHR), one-minute recovery heart rate (RHR) and endurance time (ET) were evaluated at 75% of maximum voluntary contraction (MVC) at edehydration, after 4% weight loss, and following full fluid replacement. MVC, grip, arm curl, bench press, and leg press activities were investigated. Changes in plasma volume were estimated according to the technique described by Dell and Costill (J Appl. Physiol. 37: 247-248, 1974). Results revealed that EHR and RHR were significantly elevated during dehydration; ET averaged over all muscle groups was significantly shorter during isometric (30%) and isotonic (33%) work. Although EHR and RHR were essentially restored to control levels following rehydration, local muscular endurance (ET) remained significantly below predehydration levels. It was concluded that dehydration substantially decreases muscular endurance of hand, arm, and leg muscles at 75% MVC and full fluid replacement fails to restore this variable to control levels within four hours.

Supported in part by the Government of Thailand.

Douglas P. Smith
107 Montgomery Gym
Florida State Univ.
Talleahassee, FL

4:30 p.m.
RESPONSES OF ATHLETES AND NON-ATHLETES TO LOWER BODY NEGATIVE PRESSURE AND ACUTE DEHYDRATION
L. G. Myrve, U. G. Luht, and M. D. Venters. Lovelace Fdn., Albuquerque, New Mexico

To study the relationships between physical fitness and circulatory adjustments to orthostatic stress, tolerance to lower body negative pressure (LBNP) was determined in 5 runners (R) and 5 non-