

Exposure to Work and Nonwork Stressors and the Development of Heart Disease Among Canadian workers Aged 40 Years and Older

A 16-year Follow-up Study (1994 to 2010)

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Objective: The aim of this study was to evaluate the contribution of work, nonwork, and individual factors to self-reported heart disease, and to evaluate gender-related differences over a period of 16 years among Canadian workers aged 40 years and more. **Methods:** Using the National Population Health Survey (NPHS, 1994 to 2010), we estimated multilevel logistic regression models ($N = 2996$). **Results:** Couple-related strains, being a man, age, hypertension, and body mass index, are associated with an increased risk of heart disease. In analysis stratified by gender, physical demands at work and having high child-related strains were associated with heart disease specifically among women. Psychotropic drug use increased the risk of heart disease only in men. **Conclusion:** Our study suggests that work stressors measured by Statistics Canada NPHS are largely not associated with the risk of heart disease, except in women exposed to physical demands at work.

In Canada, heart disease ranks second among the 10 leading causes of death, and around 1.3 million of Canadians are living with this disease.¹ There are many factors that increase the risk of heart disease. Some of them are biological and lifestyle factors are well documented such as hypertension, diabetes, and tobacco use. Other factors related to work and nonwork stress factors are less known.

The scientific literature on work stress as potential risk factors for heart disease started developing in the 90s. First, studies have evidenced associative patterns between job strain using the job demands-control model (JDC) by Karasek^{2,3} and coronary heart disease.^{4,5} JDC model assumes that high job demands combined with low job control lead to job strain and stress. Some studies failed to reproduced causal association between the JDC model and coronary heart disease, after adjusting for other work factors (ie, occupational prestige) and individual variables (ie, age, gender, blood pressure, body mass index (BMI), cigarette smoking, diabetes).⁶ Adjustment for covariates showed a significant reduction in the magnitude of associations.^{7,8} Second, effort-reward imbalance model (ERI) by Siegrist⁹ has also been advocated to explain cardiovascular disease. ERI model attributes stress to an imbalance between efforts invested and rewards received. Like JDC, ERI contribution to coronary or ischemic heart disease seems unclear, as mixed results have been reported.^{8,10–12} However, a recent multicohort study tends to give proofs that workers with ERI have

an increased risk of coronary heart disease independently of job strain experienced.¹³ Finally, studies testing subdimensions separately are needed to make sure that some work factors are not overlooked due to merged factors into one scale. For job strain, the associations with myocardial infarction seemed to be fully explained only by the control dimension of decision latitude involved in the JDC.¹⁴ Overall, insufficient evidences were found to determine whether psychosocial work factors were significant risk factors for ischemic heart disease.¹⁵

Studies on heart disease in working population testing for nonwork or individual factors are scarce, but are still needed to make clear if other determinants are associated or possible confounders. Eaker et al⁶ found that high job strain was not associated with the incidence of coronary heart disease or total mortality in men and women, while gender, low education, low occupational prestige, and low income were found to affect coronary heart disease. Other researchers stated that social isolation or lack of social support have an impact on coronary heart disease.^{7,11} Also, gender differences were not systematically tested, but mostly controlled for.¹⁶ Insufficient evidence concerning women and gender differences remained.¹² Lifestyle factors (ie, tobacco use, inactivity, etc.) were quite often investigated in studies on coronary heart disease, but their effects seemed to be more deleterious on health than job strain effect did.^{17,18} Regarding personality traits, some scholars have studied the influence of Type A behavior on coronary heart disease, but not successfully.⁷ However, it seems that hostility and negative attitudes or emotions can lead to coronary heart disease.^{11,16}

Altogether, studies on heart disease were conducted in silo without considering the simultaneous influences of work, nonwork, and individual factors. In this study analyzing self-reported heart disease in a sample of Canadian workers followed over 16 years, we proposed and tested a model that revolves around a dynamic analysis of workers' health reflecting the diversity of living environments stressors (eg, workplace, family, social network) and individual characteristics (eg, demography, health status, personality traits, lifestyle, stressful childhood events) involved simultaneously in the daily-living of individuals. We firstly hypothesize that work and nonwork (family, networks) stressors as well as individual characteristics have a direct effect on the incidence of self-reported heart disease in workers. Second, as women and men are exposed and reacted differently to stressors,¹⁹ we hypothesize that gender moderates the association of work and nonwork stressors, and self-reported heart disease incidence.

METHODS

Data

Longitudinal data came from the National Population Health Survey (NPHS) of Statistics Canada covering a period of 16 years between 1994 and 1995 and 2010 to 2011. Every 2 years (cycles 1 through 9), the survey gathered data on a representative sample from the Canadian population that included 17,276 individuals (response

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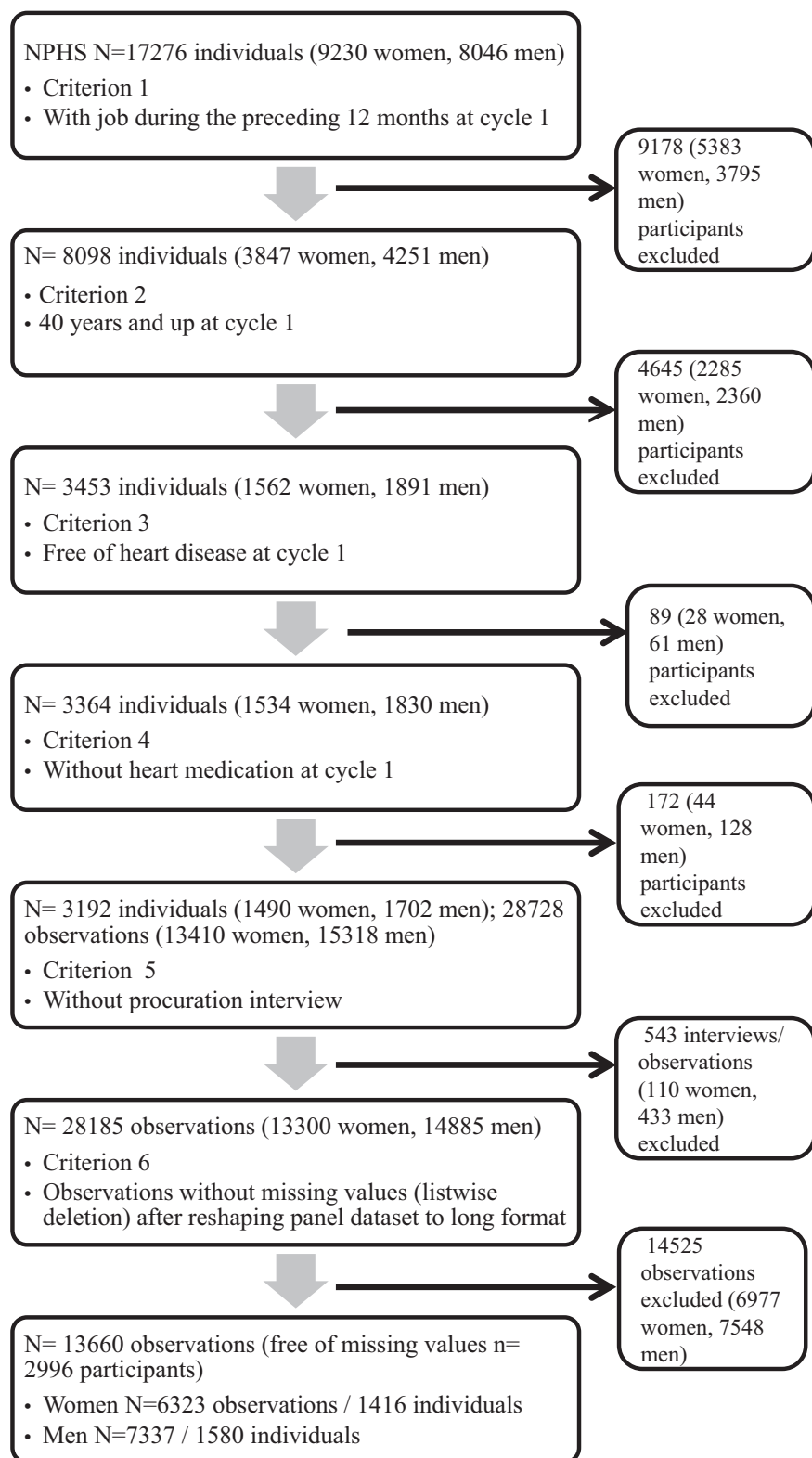


FIGURE 1. Flow chart–study sample (NPHS 1994 to 2010).

rate 69.7% to 92.8%). In this study, a cohort of workers was selected at Cycle 1 (1994 to 1995) based on the following criteria: 1) respondents had to have held a job during the preceding 12 months, 2) to be aged 40 years and over, 3) to be free from heart disease and

not using heart medication at T1, and 4) having not responded to the survey by procuration. After listwise deletion of missing values, the sample yielded 13,660 observations for the period 1994 to 2010 (level-1), nested in 2996 workers (1416 women, 1580 men) (Fig. 1).

TABLE 1. Descriptive Statistics: NPHS 1994–1995

Variables	Men (n = 1,394)		Women (n = 1,292)		Diff. M/W <i>P</i>
	Mean, %	sd	Mean, %	sd	
Work					
Skill utilization	7.43	2.34	7.05	2.36	0.000
Decision authority	5.94	1.78	5.41	1.88	0.000
Psychological demands	4.42	1.85	4.61	1.85	0.000
Physical demands	2.02	1.33	1.89	1.27	0.011
Social support at work	8.00	2.05	8.14	2.06	0.075
Job insecurity	1.24	1.13	1.34	1.16	0.022
Work schedule (irregular)	21.28	—	18.65	—	0.174
Working hours (total)	46.41	17.19	35.79	15.52	0.000
Nonwork					
Marital status (couple)	84.82	—	75.34	—	0.000
Family income	3.90	0.93	3.85	0.95	0.186
Child at home	21.01	—	18.09	—	0.211
Couple-related strains	0.23	0.61	0.28	0.70	0.034
Child-related strains	0.42	0.66	0.47	0.70	0.087
Social support outside work (high)	78.63	—	86.85	—	0.000
Individual					
Age, years	49.29	7.20	48.60	6.96	0.012
Level of education	6.83	3.31	6.98	3.16	0.217
Locus of control	20.19	4.19	19.88	4.25	0.054
Stressful childhood events	0.66	0.94	0.83	1.11	0.000
High-risk alcohol consumption	9.57	—	5.13	—	0.001
Cigarettes	5.63	10.89	3.75	8.04	0.000
Physical activity	18.56	20.49	18.43	18.71	0.872
Hypertension (diagnoses)	9.78	—	8.40	—	0.331
Diabetes (diagnoses)	2.89	—	1.32	—	0.034
Depressive symptoms	0.20	0.98	0.36	1.36	0.000
Psychotropic drug use	3.49	—	7.17	—	0.000
Body mass index (BMI, kg/m ²)	27.66	4.08	26.37	4.60	0.000

Measures

The primary outcome was heart disease and was based on self-reports of diagnoses. Respondents were asked about chronic conditions that “have lasted or are expected to last 6 months or more and that have been diagnosed by a health professional.” The question was asked as follows: “Do you have heart disease?”²⁰ This binary variable was then coded 0 = no, 1 = yes.

Work factors were measured using questions adapted from the Job Content Questionnaire (JCQ),²¹ including skill utilization (three items), decision authority (two items), psychological demands (two items), physical demands (one item), social support in the workplace (three items), and job insecurity (one item). Measurements of work factors also included the total number of hours worked in the primary job and in other jobs per week, as well as irregular work schedules (0=regular schedule, 1=irregular schedule). Skill utilization, decision authority, psychological and physical demands, social support, job insecurity, and working hours per week were used as continuous variables in analyses.

Nonwork factors encompassed family and network-related measures. Family variables included marital status (1=living as couple, 0=other), family income classed according to five levels of income sufficiency, parental status according to the presence or absence of children under age 12 (1=present, 0=absent), couple-related strains (three items), and child-related strains (two items).²² Social support outside the workplace was based on four items (no–yes). The scale was dichotomized as low (0=0 to 3) and high (1=4) social support, in order to take care of the high asymmetry.

Individual characteristics were measured by gender (0=men, 1=women); age (in years); level of education (14 levels, highest level attained); locus of control (seven items)²³; stressful childhood events (seven items)²²; high-risk alcohol consumption (Canadian gender-based

standards, 1 = more than 14 drinks in men per week and more than nine drinks in women per week, 0 = less than this amount or no drink at all); tobacco use (number of cigarettes smoked per day); leisure time physical activity (number of sessions ≥ 15 minutes during the preceding 3 months); hypertension [diagnosis in the preceding 12 months]; diabetes (diagnosis in the preceding 12 months); depressive symptoms (Composite International Diagnostic Interview–short form)^{24,25}; use of psychotropic drugs in the preceding 2 days and in the preceding month and BMI (kg/m²) corrected to adjust for gender bias in responses.²⁶

Analysis

The data are structured hierarchically such that measures taken over time (level 1) are nested within workers (level 2). Repeated-measures multilevel logistical regression models were estimated using MLwiN 2.32 (University of Bristol, Bristol, UK). The analyses were weighted at the individual level taking into account selection probability, nonresponse rates for each cycle, distribution by gender, age, and province of residence as given in the 1996 Canadian population census. To account for the design effects in the NPHS, standard errors were inflated by the square root of the design effects (1.64) at Cycle 1.^{27,28} All models were run separately for men and for women. Parameters were estimated by the first-order marginal quasi-likelihood method. Analyses were first carried out on both gender combined, then by gender. Gender differences in associations were conducted on the total sample testing cross-product interactions of gender by each work, nonwork, and individual variables.

RESULTS

Table 1 presents the sample descriptive statistics at cycle 1 (1994 to 1995, *N* = 2686), and Table 2 the correlations between studied variables.

TABLE 2. Correlation Matrix of Studied Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	
1-Heart disease	1													
2-Depressive symptoms	0.00	1												
3-Skill utilization	−0.01	0.00	1											
4-Decision authority	−0.01	−0.06 ^a	0.25 ^a	1										
5-Psychological demands	0.00	0.07 ^a	0.21 ^a	−0.05 ^a	1									
6-Physical demands	−0.02	0.01	−0.22 ^a	−0.03 ^a	0.00	1								
7-Social support at work	−0.02 ^b	−0.06 ^a	0.02 ^b	0.15 ^a	−0.17 ^a	−0.02 ^b	1							
8-Job insecurity	0.01	0.07 ^a	−0.06 ^a	−0.25 ^a	0.07 ^a	0.00	−0.15 ^a	1						
9-Working hours	0.00	−0.03 ^a	0.11 ^a	0.14 ^a	0.15 ^a	0.11 ^a	−0.03 ^a	−0.04 ^a	1					
10-Work schedule	0.00	0.00	−0.05 ^a	−0.03 ^a	0.00	0.08 ^a	−0.04 ^a	0.05 ^a	0.01	1				
11-Marital status	0.04 ^a	−0.08 ^a	0.01	0.04 ^a	−0.03 ^a	0.00	0.03 ^a	−0.04 ^a	0.01	−0.01	1			
12-Family income	0.03 ^a	−0.05 ^a	0.26 ^a	0.10 ^a	0.11 ^a	−0.21 ^a	0.00	−0.14 ^a	0.06 ^a	−0.04 ^a	0.27 ^a	1		
13-Child at home	−0.04 ^a	0.01	0.05 ^a	0.00	0.05 ^a	0.00	−0.01	0.04 ^a	0.05 ^a	0.01	0.11 ^a	−0.06 ^a	1	
14-Couple-related strains	0.02 ^b	0.05 ^a	−0.03 ^a	−0.04 ^a	0.02	0.04 ^a	−0.05 ^a	0.06 ^a	−0.02	0.03 ^a	0.18 ^a	−0.01	0.06 ^a	
15-Child-related strains	0.03 ^a	0.06 ^a	−0.04 ^a	−0.05 ^a	0.06 ^a	0.06 ^a	−0.06 ^a	0.04 ^a	−0.01	0.03 ^a	0.04 ^a	−0.02 ^a	0.03 ^a	
16-Social support outside work	−0.01	−0.07 ^a	0.05 ^a	0.03 ^a	0.01	−0.03 ^a	0.09 ^a	−0.05 ^a	−0.02 ^b	−0.01	0.15 ^a	0.14 ^a	0.00	
17-Gender	−0.07 ^a	0.09 ^a	−0.08 ^a	−0.16 ^a	0.10 ^a	−0.05 ^a	0.01	0.05 ^a	−0.28 ^a	−0.03 ^a	−0.17 ^a	−0.10 ^a	−0.07 ^a	
18-Age	0.10 ^a	−0.08 ^a	−0.11 ^a	0.05 ^a	−0.22 ^a	−0.05 ^a	0.02 ^a	−0.09 ^a	−0.15 ^a	0.03 ^a	0.00	0.06 ^a	−0.26 ^a	
19-Level of education	0.00	0.02 ^b	0.38 ^a	0.12 ^a	0.16 ^a	−0.25 ^a	0.00	−0.01	0.00	−0.03 ^a	−0.04 ^a	0.27 ^a	0.07 ^a	
20-Locus of control	−0.02 ^b	−0.12 ^a	0.17 ^a	0.26 ^a	−0.06 ^a	−0.10 ^a	0.22 ^a	−0.23 ^a	0.06 ^a	−0.04 ^a	0.03 ^a	0.14 ^a	−0.01	
21-Stressful childhood events	0.02	0.11 ^a	0.01	−0.03 ^a	0.10 ^a	0.05 ^a	−0.08 ^a	0.06 ^a	0.00	−0.01	−0.08 ^a	−0.04 ^a	0.02	
22-High-risk alcohol consumption	0.00	0.00	0.05 ^a	0.04 ^a	0.01	−0.02 ^a	−0.02	−0.02 ^a	0.01	−0.01	−0.01	0.05 ^a	0.00	
23-Cigarettes	0.00	0.05 ^a	−0.07 ^a	−0.03 ^a	−0.01	0.10 ^a	−0.02 ^a	0.04 ^a	0.07 ^a	0.03 ^a	−0.11 ^a	−0.16 ^a	0.00	
24-Leisure time activity	0.01	−0.01	0.09 ^a	0.03 ^a	0.04 ^a	−0.08 ^a	0.01	−0.03 ^a	−0.07 ^a	−0.02	0.01	0.12 ^a	−0.02 ^b	
25-Hypertension	0.14 ^a	0.01	−0.07 ^a	−0.01	−0.03 ^a	0.00	−0.01	0.00	−0.05 ^a	0.01	−0.02 ^a	0.00	−0.06 ^a	
26-Diabetes	0.08 ^a	−0.01	−0.03 ^a	0.00	−0.01	−0.01	−0.01	−0.01	0.02 ^b	0.03 ^a	−0.01	−0.01	−0.03 ^a	
27-Psychotropic drug use	0.04 ^a	0.23 ^a	0.00	−0.06 ^a	0.04 ^a	−0.03 ^a	−0.05 ^a	0.04 ^a	−0.09 ^a	0.01	−0.06 ^a	0.01	−0.04 ^a	
	14	15	16	17	18	19	20	21	22	23	24	25	26	27
14-Couple-related strains	1													
15-Child-related strains	0.16 ^a	1												
16-Social support outside work	−0.11 ^a	−0.03 ^a	1											
17-Gender	0.05 ^a	0.01	0.05 ^a	1										
18-Age	−0.02	0.02 ^b	0.01	−0.07 ^a	1									
19-Level of education	−0.04 ^a	−0.06 ^a	0.06 ^a	0.05 ^a	−0.09 ^a	1								
20-Locus of control	−0.17 ^a	−0.16 ^a	0.13 ^a	−0.03 ^a	−0.03 ^a	0.14 ^a	1							
21-Stressful childhood events	0.06 ^a	0.11 ^a	−0.05 ^a	0.11 ^a	−0.06 ^a	−0.03 ^a	−0.05 ^a	1						
22-High-risk alcohol consumption	0.01	0.00	−0.04 ^a	−0.08 ^a	−0.03 ^a	0.04 ^a	0.04 ^a	−0.01	1					
23-Cigarettes	0.02 ^b	0.06 ^a	−0.06 ^a	−0.09 ^a	−0.13 ^a	−0.15 ^a	−0.03 ^a	0.06 ^a	0.12 ^a	1				
24-Leisure time activity	−0.02 ^a	−0.01	0.06 ^a	0.03 ^a	0.03 ^a	0.12 ^a	0.09 ^a	0.03 ^a	0.00	−0.12 ^a	1			
25-Hypertension	0.00	0.05 ^a	−0.01	−0.01	0.22 ^a	−0.03 ^a	−0.07 ^a	−0.01	−0.01	−0.05 ^a	−0.02 ^b	1		
26-Diabetes	−0.01	0.03 ^a	−0.02	−0.05 ^a	0.11 ^a	−0.01	−0.01	0.00	−0.02 ^b	−0.03 ^a	0.01	0.18 ^a	1	
27-Psychotropic drug use	0.02 ^b	0.06 ^a	−0.03 ^b	0.11 ^b	0.05 ^b	0.04 ^b	−0.09 ^b	0.12 ^b	0.01	0.00	0.00	0.06 ^a	0.00	1
^a <i>P</i> < 0.01.														
^b <i>P</i> < 0.05.														

^a*P* < 0.01.^b*P* < 0.05.

According to Fig. 2, self-reported heart disease among men cumulated from 1.7% to 11% and among women from 1.3% to 5.2%.

Table 3 presents the multilevel logistical regression analysis on the pooled men–women and gender-stratified data.

In model comprising all subjects, work factors show no association with self-reported heart disease, but couple-related strains are the only nonwork factor associated with an increased risk of self-reported heart disease. In terms of individual characteristics, gender (women) is significantly associated with a reduced risk of heart disease over time, while age, hypertension, and BMI are associated with an increased risk of heart disease. Also, the risk of heart disease increased significantly over time. Whenever the adjustment made, mostly, the same significant variables remained across models, to the exception of job insecurity and child at home. Job insecurity is no longer significant when adjusted for even nonwork factors or individual characteristics. Child at home lost its significance when adjusted for individual characteristics.

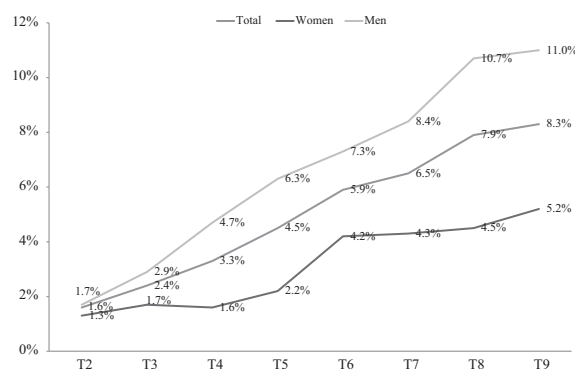


FIGURE 2. Percentage of self-reported heart disease in 40 years old Canadian workers over time (NPHS 1996 to 2010).

TABLE 3. Results of Multilevel Logistic Regression Models on 16 Years Incidence of Heart Disease on Whole Sample (NPHS 1994–2010, 13,660 Observations)

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Work														
Skill utilization			0.98	0.90–1.07			1.00	0.91–1.10			0.99	0.90–1.08	1.00	0.91–1.10
Decision authority			1.02	0.91–1.14			0.97	0.86–1.09			1.03	0.91–1.15	0.98	0.87–1.10
Psychological demands			1.01	0.93–1.09			1.03	0.94–1.13			1.01	0.93–1.10	1.03	0.94–1.13
Physical demands			1.01	0.85–1.19			0.98	0.82–1.16			1.00	0.85–1.18	0.99	0.83–1.17
Social support at work			0.96	0.88–1.03			0.95	0.87–1.05			0.96	0.88–1.04	0.95	0.87–1.05
Job insecurity			1.19 ^c	1.004–1.40			1.19	1.00–1.43			1.19	1.00–1.43	1.20	1.00–1.44
Work schedule (irregular)			0.95	0.63–1.43			0.89	0.58–1.38			0.96	0.63–1.46	0.90	0.58–1.40
Working hours (total)			1.00	0.98–1.01			1.00	0.98–1.01			1.00	0.98–1.01	1.00	0.98–1.01
Nonwork														
Marital status (couple)					1.60	0.88–2.92			1.22	0.64–2.34	1.63	0.89–2.96	1.23	0.64–2.34
Family income					0.92	0.74–1.14			0.98	0.78–1.22	0.94	0.75–1.17	0.98	0.78–1.24
Child at home					0.36 ^c	0.15–0.87			0.47	0.17–1.28	0.35 ^c	0.15–0.83	0.47	0.17–1.27
Couple-related strains					1.21	0.99–1.47			1.28 ^c	1.03–1.59	1.21	0.99–1.47	1.29 ^c	1.03–1.61
Child-related strains					1.07	0.85–1.36			1.01	0.79–1.28	1.07	0.85–1.36	1.02	0.80–1.29
Social support outside work (high)					0.72	0.46–1.11			0.79	0.48–1.32	0.73	0.48–1.13	0.81	0.49–1.34
Individual														
Gender (women)	0.30 ^a	0.17–0.53					0.29 ^a	0.16–0.52	0.31 ^a	0.17–0.54			0.29 ^a	0.16–0.53
Age	1.06 ^a	1.03–1.10					1.06 ^b	1.02–1.10	1.06 ^b	1.02–1.10			1.06 ^b	1.02–1.10
Level of education	1.00	0.92–1.10					1.00	0.92–1.09	1.01	0.93–1.10			1.01	0.93–1.10
Locus of control	0.97	0.92–1.02					0.99	0.94–1.04	0.97	0.92–1.03			0.99	0.94–1.05
Stressful childhood events	1.06	0.84–1.34					1.05	0.83–1.32	1.06	0.84–1.34			1.05	0.83–1.32
High-risk alcohol consumption	1.02	0.36–2.88					0.97	0.35–2.70	1.00	0.36–2.75			0.95	0.35–2.57
Cigarettes	1.00	0.97–1.03					1.00	0.97–1.03	1.00	0.97–1.03			1.00	0.97–1.03
Leisure time activity	1.01	0.999–1.01					1.01	1.00–1.01	1.01	1.00–1.01			1.01	0.999–1.01
Hypertension (diagnoses)	2.71 ^a	1.63–4.49					2.77 ^a	1.67–4.59	2.73 ^a	1.66–4.50			2.78 ^a	1.69–4.58
Diabetes (diagnoses)	1.99	0.89–4.45					2.04	0.93–4.46	2.05	0.91–4.59			2.09	0.95–4.60
Depressive symptoms	0.98	0.86–1.12					0.98	0.86–1.12	0.97	0.85–1.11			0.97	0.85–1.11
Psychotropic drug use	1.45	0.82–2.57					1.40	0.79–2.48	1.40	0.78–2.51			1.35	0.75–2.42
BMI, kg/m ²	1.05 ^c	1.01–1.09					1.05 ^c	1.01–1.09	1.05 ^c	1.01–1.09			1.05 ^c	1.01–1.09
Time														
Cycle 3	2.82 ^b	1.47–5.42	3.50 ^a	1.83–6.71	3.43 ^a	1.75–6.72	2.83 ^b	1.46–5.47	2.79 ^b	1.42–5.48	3.43 ^a	1.75–6.75	2.80 ^b	1.41–5.55
Cycle 4	3.17 ^b	1.57–6.39	4.66 ^a	2.36–9.16	4.72 ^a	2.35–9.45	3.21 ^b	1.58–6.53	3.32 ^b	1.62–6.80	4.78 ^a	2.37–9.65	3.37 ^b	1.62–7.00
Cycle 5	4.20 ^a	2.16–8.16	7.76 ^a	4.18–14.42	7.50 ^a	3.87–14.55	4.39 ^a	2.28–8.46	4.31 ^a	2.15–8.67	7.83 ^a	4.05–15.15	4.54 ^a	2.26–9.13
Cycle 6	3.69 ^a	1.93–7.04	7.95 ^a	4.28–14.77	7.34 ^a	3.75–14.37	3.92 ^a	2.07–7.41	3.77 ^a	1.89–7.53	7.66 ^a	3.90–15.04	4.02 ^a	2.01–8.05
Cycle 7	2.65 ^b	1.27–5.52	7.55 ^a	3.97–14.36	7.01 ^a	3.46–14.18	2.70 ^b	1.31–5.57	2.67 ^b	1.21–5.90	7.21 ^a	3.58–14.53	2.75 ^b	1.25–6.06
Cycle 8	4.63 ^a	2.28–9.42	15.24 ^a	8.12–28.61	14.13 ^a	7.09–28.16	4.73 ^a	2.34–9.56	4.70 ^a	2.15–10.26	14.61 ^a	7.28–29.35	4.83 ^a	2.20–10.61
Cycle 9	3.49 ^b	1.55–7.82	13.69 ^a	7.11–26.36	13.25 ^a	6.51–26.95	3.45 ^b	1.53–7.77	3.72 ^b	1.55–8.90	13.49 ^a	6.55–27.79	3.77 ^b	1.54–8.99
Random part														
σ ² Individuals		8.73		10.71		10.10		8.78		8.44		10.25		8.50
Goodness-of-fit														
χ ² (df)		303.42 ^a (20)		180.96 ^a (15)		186.58 ^a (13)		395.54 ^a (28)		348.02 ^a (26)		261.37 ^a (21)		446.40 ^a (34)
Intraclass correlation		0.726		0.765		0.754		0.728		0.720		0.757		0.721

CI, confidence interval; OR, odds ratio.

Note: ^a $P < 0.001$.^b $P < 0.01$.^c $P < 0.05$.

Tables 4 and 5 present results for men and women, respectively.

When comparing the role of work factors in men and women, only physical demands were associated with the risk of self-reported heart disease among women but not among men. Gender difference is significant ($\chi^2 = 6.27$, $df = 1$, $P < 0.012$). For nonwork factors, having high child-related strains were associated with risk of heart disease among women only and gender difference is significant ($\chi^2 = 10.22$, $df = 1$, $P < 0.001$). As for individual characteristics, age, diabetes, and psychotropic drug use increased the risk of heart disease in men but not in women. However, only drug use is however statistically different between men and women ($\chi^2 = 7.24$, $df = 1$, $P < 0.007$). BMI was associated with an increased risk of heart disease in women but not in men, but the men–women difference is not significant ($\chi^2 = 1.55$, $df = 1$, $P = 0.214$). Hypertension increased the risk of heart disease in men, and in women, and the magnitude of the association is not statistically significant between genders ($\chi^2 = 1.72$, $df = 1$, $P = 0.190$). Finally, the risk of heart disease increased significantly with time in men and appeared not significant in women.

Whenever the adjustment was made, the same significant variables mostly remained significant across models. Exceptions for men are child at home, which is no longer significant when adjusted

for work and individual characteristics, and leisure time physical activity when adjusted for work and nonwork covariates. The associations were, however, of a borderline significance in unadjusted models. Also, diabetes was not significant in the unadjusted model, while it becomes significant (suppressive effect) when all variables are considered. For women, a suppressive effect for social support outside work is apparent when work factors are taken into account, but the association vanishes when both work factors and individual characteristics are accounted for.

DISCUSSION

The objective of this study was to evaluate the contribution of work, nonwork, and individual factors to self-reported heart disease, and to evaluate gender-related differences over a period of 16 years among Canadian workers aged 40 years and more. Our results add to research on older workers' risk of heart disease, particularly studies that have drawn on broad cohorts such as the Whitehall II Study.^{5,10} Results of the present study suggest that work stressors have a modest contribution to the risk of heart disease in older workers, while nonwork stressors appeared more influent. Overall, couple-related strains, gender, age, hypertension, BMI, and time, were significant risk factors in the global sample. However, gender

TABLE 4. Results of Multilevel Logistic Regression Models on 16 Years Incidence of Heart Disease Among Men (NPHS 1994–2010, 7,337 Observations)

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Work														
Skill utilization			0.97	0.87–1.07			1.00	0.89–1.12			0.97	0.88–1.07	0.99	0.89–1.11
Decision authority			0.98	0.85–1.13			0.98	0.85–1.12			1.00	0.86–1.15	0.99	0.86–1.14
Psychological demands			1.07	0.98–1.18			1.08	0.98–1.20			1.08	0.98–1.19	1.08	0.98–1.20
Physical demands			0.92	0.75–1.12			0.89	0.72–1.10			0.91	0.74–1.11	0.90	0.72–1.11
Social support at work			0.96	0.88–1.05			0.96	0.86–1.06			0.96	0.88–1.06	0.96	0.86–1.07
Job insecurity			1.15	0.94–1.40			1.14	0.93–1.40			1.17	0.94–1.47	1.15	0.92–1.43
Work schedule (irregular)			0.83	0.52–1.32			0.79	0.48–1.32			0.87	0.53–1.42	0.84	0.49–1.41
Working hours (total)			0.99	0.98–1.00			1.00	0.99–1.01			0.99	0.98–1.00	1.00	0.99–1.01
Nonwork														
Marital status (couple)					1.99	0.88–4.48			1.74	0.73–4.17	2.02	0.89–4.59	1.78	0.74–4.29
Family income					0.88	0.68–1.16			0.95	0.72–1.25	0.88	0.67–1.17	0.94	0.70–1.26
Child at home					0.15 ^c	0.04–0.63			0.21	0.04–1.09	0.15 ^b	0.03–0.62	0.21	0.04–1.05
Couple-related strains					1.23	0.99–1.53			1.26	0.97–1.63	1.24	0.99–1.56	1.25	0.95–1.65
Child-related strains					0.91	0.71–1.16			0.82	0.64–1.06	0.92	0.72–1.18	0.83	0.64–1.07
Social support outside work (high)					0.80	0.47–1.37			0.94	0.84–1.05	0.84	0.48–1.45	0.89	0.47–1.67
Individual														
Age	1.06 ^c	1.01–1.10					1.06 ^b	1.02–1.11	1.05 ^b	1.003–1.10			1.05 ^c	1.01–1.10
Level of education	0.99	0.89–1.11					0.98	0.88–1.09	1.00	0.90–1.11			0.99	0.89–1.10
Locus of control	0.96	0.91–1.02					0.98	0.92–1.04	0.96	0.91–1.02			0.97	0.92–1.04
Stressful childhood events	0.98	0.71–1.36					0.95	0.69–1.31	0.97	0.71–1.32			0.96	0.70–1.31
High-risk alcohol consumption	0.97	0.29–3.27					0.90	0.27–3.02	0.93	0.29–2.97			0.87	0.27–2.81
Cigarettes	1.00	0.97–1.03					1.00	0.97–1.03	1.00	0.97–1.03			1.00	0.97–1.03
Leisure time activity	1.01 ^c	1.001–1.02					1.01 ^c	1.001–1.02	1.01 ^c	1.0005–1.02			1.01	0.999–1.01
Hypertension (diagnoses)	2.33 ^b	1.31–4.14					2.41 ^b	1.33–4.34	2.36 ^b	1.33–4.20			2.36 ^b	1.32–4.22
Diabetes (diagnoses)	2.24	0.87–5.74					2.42	0.98–5.98	2.44	1.00–5.96			2.54 ^c	1.05–6.13
Depressive symptoms	0.95	0.83–1.08					0.95	0.82–1.09	0.96	0.83–1.11			0.96	0.81–1.12
Psychotropic drug use	2.06 ^c	1.18–3.60					1.96 ^c	1.12–3.42	1.97 ^c	1.10–3.53			1.90 ^c	1.06–3.40
BMI, kg/m ²	1.04	0.99–1.09					1.04	0.99–1.09	1.04	0.99–1.09			1.04	0.98–1.09
Time														
Cycle 3	3.54 ^b	1.52–8.25	4.26 ^a	1.87–9.77	4.13 ^b	1.72–9.92	3.57 ^b	1.52–8.38	3.49 ^b	1.50–8.12	4.17 ^b	1.72–10.11	3.54 ^b	1.45–8.62
Cycle 4	4.44 ^a	1.86–10.63	5.78 ^a	2.50–13.36	5.93 ^a	2.46–14.30	4.47 ^a	1.84–10.86	4.37 ^a	1.79–10.67	5.89 ^a	2.38–14.58	4.60 ^b	1.82–11.61
Cycle 5	5.86 ^a	2.48–13.82	9.73 ^a	4.44–21.33	9.46 ^a	3.99–22.42	6.12 ^a	2.60–14.40	5.73 ^a	2.36–13.90	9.92 ^a	4.18–23.58	6.31 ^a	2.52–15.80
Cycle 6	4.95 ^a	2.15–11.38	9.37 ^a	4.31–20.40	8.71 ^a	3.64–20.84	5.20 ^a	2.28–11.84	4.85 ^a	2.00–11.76	8.96 ^a	3.71–21.67	5.31 ^a	2.13–13.19
Cycle 7	3.88 ^b	1.52–9.91	9.54 ^a	4.36–20.88	8.93 ^a	3.66–21.75	3.94 ^b	1.56–9.93	3.72 ^b	1.40–9.90	8.94 ^a	3.71–21.58	4.01 ^b	1.47–10.90
Cycle 8	6.20 ^a	2.46–15.60	17.87 ^a	7.97–40.08	16.61 ^a	6.75–40.88	6.10 ^a	2.44–15.29	6.15 ^a	2.26–16.73	16.78 ^a	6.66–42.23	6.33 ^a	2.28–17.63
Cycle 9	4.94 ^b	1.77–13.74	16.15 ^a	7.06–36.96	16.48 ^a	6.61–41.07	4.73 ^b	1.68–13.30	5.15 ^b	1.74–15.22	15.93 ^a	6.20–40.91	5.33 ^b	1.76–16.17
Random part														
σ ² Individuals		8.61		8.32		7.89		8.37		8.01		7.85		7.86
Goodness-of-fit														
χ ² (df)		255.28 ^a (19)		138.24 ^a (15)		140.17 ^a (13)		270.88 ^a (27)		245.58 ^a (25)		216.50 ^a (21)		291.29 ^a (33)
Intraclass correlation		0.724		0.717		0.706		0.718		0.709		0.705		0.705

CI, confidence interval; OR, odds ratio.

Note: ^a*P* < 0.001.^b*P* < 0.01.^c*P* < 0.05.

moderated some work and nonwork stressors, and some individual characteristics. Physical demands at work and child-related strains were associated with the risk of heart disease among women only. Psychotropic drug use increased the risk of heart disease in men but not in women.

To our knowledge, our study is the first to highlight that physical demands at work are a risk factor for heart disease in working women. A prospective analysis of the French Gazel cohort of workers, aged 35 to 50 years at baseline, did find that high physical demands at work for women were predictive of poor self-reported health.²⁹ Our result helps to clarify the situation of working women in physically demanding jobs compared with studies based only male populations.¹⁷ Over time, physical demands at work may weight more strongly on the health of female than male workers.

Nonwork family stressors, such couple related-strains and child-related strains, have seldom been investigated while they appeared here to be important. Our results revealed couple-related strains to increase, on average, by 29% the risk of self-reported heart disease in men and women. However, child related-strains, on average, were found here to increase the risk of self-reported heart disease in women by 86%. This result shows that family and

gendered roles can be an important determinant of heart disease and particularly among women.

As for individual factors, age is known to be a noncontrollable biological factor of heart disease. However, due to hormonal protection, women risk factor related to age intervene later after menopause.^{30,31} However, the effect of age was not here significantly different between men and women. Our results concerning hypertension did not support those found elsewhere reporting that women are at a greater risk for heart disease than men when having high hypertension.³⁰ Our results about diabetes do not also support those recently published in several meta-analyses showing that women with diabetes had a greater risk in heart disease than men.^{32–34} However, in Canada, diabetes mortality rate is higher in men than women.³⁵ Prevalence of diabetes is also higher in men than women, and the gap between genders is wider after 45 years.³⁶ With regards to BMI, even if a waist–hip ratio would be better, our results did not confirm findings of a recent study indicating that abdominal obesity in women is related to a higher risk of coronary heart disease than men.³⁷ Such discrepancies regarding our results and those of previous are explained by the model used here in which work and nonfactor are considered together with individual risk factors.

TABLE 5. Results of Multilevel Logistic Regression Models on 16 Years Incidence of Heart Disease Among Women (NPHS 1994–2010, 6,323 Observations)

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Work														
Skill utilization			0.98	0.85–1.14			1.02	0.85–1.21			0.99	0.86–1.14	1.02	0.85–1.22
Decision authority			0.96	0.80–1.16			0.92	0.73–1.15			0.97	0.81–1.15	0.92	0.75–1.13
Psychological demands			0.87	0.73–1.04			0.89	0.71–1.10			0.84	0.70–1.00	0.86	0.70–1.06
Physical demands			1.28	0.99–1.64			1.31 ^c	1.01–1.71			1.30	1.00–1.69	1.37 ^c	1.03–1.83
Social support at work			1.00	0.82–1.22			0.98	0.78–1.23			1.01	0.84–1.20	0.98	0.80–1.21
Job insecurity			1.26	0.94–1.69			1.33	0.94–1.87			1.23	0.90–1.69	1.33	0.95–1.85
Work schedule (irregular)			1.10	0.48–2.53			1.06	0.43–2.62			1.07	0.49–2.32	1.03	0.40–2.62
Working hours (total)			1.00	0.95–1.04			1.00	0.96–1.04			1.00	0.95–1.04	1.00	0.96–1.04
Nonwork														
Marital status (couple)					0.57	0.21–1.57			0.69	0.23–2.07	0.51	0.18–1.46	0.64	0.19–2.08
Family income					0.97	0.72–1.30			1.14	0.79–1.64	1.14	0.80–1.62	1.29	0.86–1.94
Child at home					1.27	0.34–4.78			1.77	0.41–7.60	1.24	0.34–4.52	1.68	0.39–7.18
Couple-related strains					1.39	0.88–2.18			1.41	0.91–2.17	1.39	0.90–2.14	1.44	0.91–2.28
Child-related strains					1.90 ^c	1.10–3.27			1.87 ^c	1.05–3.34	1.90 ^c	1.07–3.39	1.86 ^c	1.02–3.39
Social support outside work (high)					0.46	0.21–1.01			0.47	0.17–1.27	0.48 ^c	0.23–0.96	0.46	0.18–1.18
Individual														
Age	1.06	0.997–1.14					1.07	0.99–1.15	1.07	0.99–1.15			1.07	0.98–1.16
Level of education	1.04	0.91–1.18					1.07	0.92–1.23	1.03	0.91–1.17			1.06	0.92–1.22
Locus of control	0.99	0.88–1.11					1.02	0.89–1.16	1.03	0.90–1.16			1.05	0.92–1.21
Stressful childhood events	1.26	0.93–1.70					1.28	0.94–1.75	1.19	0.84–1.68			1.22	0.86–1.74
High-risk alcohol consumption	1.17	0.19–7.28					1.32	0.20–8.65	1.05	0.17–6.41			1.19	0.18–7.71
Cigarettes	1.00	0.94–1.08					1.00	0.93–1.07	1.00	0.93–1.07			1.00	0.93–1.07
Leisure time activity	1.01	0.99–1.02					1.01	0.99–1.03	1.00	0.98–1.02			1.00	0.98–1.02
Hypertension (diagnoses)	4.86 ^b	1.86–12.75					4.92 ^b	1.84–13.16	4.82 ^b	1.85–12.57			5.03 ^b	1.92–13.22
Diabetes (diagnoses)	0.73	0.14–3.85					0.75	0.16–3.51	0.59	0.11–3.34			0.62	0.12–3.17
Depressive symptoms	1.03	0.79–1.33					1.03	0.79–1.33	0.98	0.77–1.25			0.99	0.78–1.25
Psychotropic drug use	0.51	0.18–1.46					0.53	0.20–1.44	0.48	0.18–1.32			0.49	0.18–1.31
BMI, kg/m ²	1.07 ^c	1.01–1.14					1.08 ^c	1.01–1.14	1.08 ^c	1.02–1.15			1.08 ^c	1.01–1.16
Time														
Cycle 3	1.62	0.56–4.64	2.09	0.69–6.35	2.19	0.78–6.15	1.58	0.51–4.89	1.62	0.57–4.59	2.14	0.71–6.44	1.52	0.49–4.69
Cycle 4	1.17	0.35–3.89	2.45	0.79–7.61	2.48	0.78–7.84	1.38	0.42–4.50	1.41	0.44–4.56	2.91	0.87–9.67	1.66	0.53–5.20
Cycle 5	1.63	0.46–5.69	3.94 ^c	1.23–12.60	4.07 ^c	1.22–13.60	1.84	0.52–6.60	1.88	0.48–7.43	4.55	1.29–16.13	2.06	0.50–8.42
Cycle 6	1.88	0.63–5.64	5.22 ^b	1.65–16.56	4.72 ^b	1.64–13.56	2.21	0.71–6.88	2.07	0.72–5.96	5.49	1.82–16.60	2.41	0.81–7.17
Cycle 7	0.80	0.18–3.47	2.84	0.72–11.17	2.85	0.72–11.28	0.90	0.21–3.98	1.00	0.22–4.45	3.23	0.83–12.56	1.09	0.23–5.10
Cycle 8	2.24	0.68–7.41	9.41 ^a	3.11–28.53	9.47 ^a	3.16–28.34	2.50	0.75–8.35	2.49	0.71–8.72	10.34	3.14–34.04	2.64	0.71–9.82
Cycle 9	1.50	0.37–6.08	5.93 ^b	1.66–21.16	6.69 ^b	2.00–22.37	1.61	0.37–7.03	1.86	0.43–8.09	7.07	1.83–27.27	1.94	0.41–9.16
Random part														
σ^2 Individuals		7.25		14.13		11.76		7.75		6.08		12.65		6.62
Goodness-of-fit														
χ^2 (df)		78.01 ^a (19)		101.17 ^a (15)		96.09 ^a (13)		231.71 ^a (27)		160.68 ^a (25)		197.12 ^a (21)		312.22 ^a (33)
Intraclass correlation		0.688		0.811		0.781		0.702		0.649		0.794		0.668

CI, confidence interval; OR, odds ratio.

Note: ^a $P < 0.001$.^b $P < 0.01$.^c $P < 0.05$.

Finally, psychotropic drug use as a risk factor for heart disease was the first time tested in our study within a working population. We found here that the taking of psychotropic medications increased by 90% the risk of self-reported heart disease in men. Usually, women use more psychotropic drugs than men,^{38,39} but reasons for the use are similar between genders.^{40,41} However, some researchers have shown that the use of anti-depressant drugs specifically is associated with cardiologic side effects and risk of myocardial infarction,^{42,43} particularly in women.^{44,45} Some other studies explained that women with depressive disorders were less likely to develop myocardial infarction compared with men and men with depressive disorders tended to develop unhealthy behavior and by this way increased their risk of cardiac problems.^{46–48}

This study has limitations. First, the measure of heart disease is self-reported even if supported by diagnoses. Some biases might be expected with self-reported measures, but self-reports of heart disease diagnoses in NPHS likely reflect common conditions such as coronary heart disease, myocardial disease, and with time, ischemic heart disease mortality.⁴⁹ Furthermore, NPHS is a representative sample of the population and self-reported measures did not comport bias inherent to administrative data toward individuals

who use health services.⁵⁰ However, the percentage of errors in NPHS data is unknown.⁴⁹ Third, it would have been more precise to work with ischemic heart disease or myocardial infarction, but there were too low number of cases in the sample during the available following-up period. Fourth, we did not control for a high level of exposure to physical environmental risk (eg, noise, heat, etc), although the literature seems to show that these factors lead to possible increase in heart disease.^{51,52} Fifth, leisure time physical activity was based only on the duration that participants assigned to it for the 3 months preceding the survey. It does not measure the intensity of the physical effort. Recently, a study demonstrated that high-intensity endurance sports can be harmful for the heart muscle even in healthy individuals.⁵³ Last, interactions between NPHS cycles, work, nonwork, and individual variables were not tested. Some work variables, for example, may impact differently as time goes by and may have affected heart disease differently.

Despite these limitations, results of this study suggest that work stressors measured by the NPHS carried out by Statistics Canada are largely not associated with the risk of heart disease in older workers after 16 years of follow-up. A notable exception is for women exposed to physical demands at work, which was found here

to increase the risk of self-reported heart disease. More research is needed to better characterize components of physical demands at work that could be detrimental for women health. Our results support the importance of nonwork factors. Couple-related strains for both genders and child-related strains for women only are associated with self-reported heart disease. Physicians should pay attention to physical demands at work and the family environment of their female patients. Gendered roles at home can be important determinants of heart disease for female older workers. Physicians should also pay attention to male patients facing couple-related strains and who use psychotropic drugs as they represented important risk factors for heart disease. Overall, more research is needed to help better understand how work and nonwork stressors and individual characteristics simultaneously play and interact to promote heart disease in the working population.

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