

The relationship between job stress and body mass index using longitudinal data from Canada

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Abstract

Objective This paper examines the effect of job stress, as measured by the job strain model (high job demands and low job control) on an individual's body mass index (BMI) using data from the Canadian National Population Health Survey.

Methods We use panel data estimation methods to account for unobserved individual-level heterogeneity to better examine the relationship between job-related stress and BMI.

Results Results from the fixed effects and random effects models show no statistically significant difference in BMI levels between individuals in jobs with high/medium strain compared to jobs with low strain. However, in the cross-sectional OLS model, job stress has a positive and significant effect on BMI. These analyses control for socio-demographic factors, lifestyle behavior, workplace social support, occupational and provincial fixed effects. The results suggest that the mixed findings in the previous studies may in part be due to unobserved characteristics that cannot be controlled for using standard cross-sectional analysis.

Conclusion This study results suggest the need for further longitudinal evidence in order to have a better understanding of the relationship between job stress and body weight.

Keywords Job stress · Body mass index · Unobserved heterogeneity · Panel data

Introduction

The upward trend in obesity and its adverse effects have been documented in the extant literature (Visscher and Seidell 2001; Hu 2008). While obesity can result from a complex interaction between genetics and personal lifestyle characteristics, a growing body of research has shown that environmental factors such as psychosocial working conditions may have contributed to the obesity epidemic (Dallman et al. 2003; Kouvonen et al. 2005; Wamala et al. 1997). Contemporary work environments have become more stressful. Two of every three workers in the US consider the work place a significant source of stress, and more than half of workers report that job stress reduces their productivity (American Psychological Association 2009).

Some potential pathways by which stress can affect body weight have been documented. For example, severe stress causes the body to secrete cortisol (a hormone released in response to stress) which acts to deposit abdominal body fat and increase appetite (Raine 2004). Stress may also lead to poor eating habits and hence increase body weight (Dallman et al. 2003; Oliver et al. 2000; Pak et al. 2000; Bowman and Vinyard 2004; Stunkard and Allison 2003; Oliver and Wardle 1999). Furthermore, stress-induced fatigue may encourage a sedentary lifestyle (Schneider and Becker 2005; Karasek and Theorell 1990; Amick et al. 2002).

The widely used job stress measures are Siegrist's (1996) effort–reward imbalance and Karasek's (1979) demand–control models. According to the effort–reward imbalance model, stress results from a lack of fairness in contractual obligations where job rewards are less proportionate to job tasks or efforts. The Karasek's job strain model which is the dominant job stress theory, characterizes stress as a

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combination of high psychological demands and low decision latitude. Decision latitude reflects an individual's control over his duties and authority to make decisions. Psychological demands reflect workload issues such as time pressures, conflicting demands, pace of work and degree of concentration required.

A large body of literature has examined the association between psychosocial working conditions, as measured by the Karasek's model, and body mass index (BMI). Empirical evidence about the impact of job strain, or any of its components, on body weight is inconclusive (for a comprehensive review, see Overgaard et al. 2004; Siegrist and Rodel 2006). In some studies, body weight is associated with job demands (Ostry et al. 2006; Jonsson et al. 1999; Niedhammer et al. 1998), with job control (Kivimäki et al. 2002; Steptoe et al. 1999; Martikainen and Marmot 1999) and with job strain (Kouvonen et al. 2005; Martikainen and Marmot 1999; Hellerstedt and Jeffrey 1997). However, other studies report no significant association between body weight and job strain or any of its components (Netterstrom et al. 1991; Theorell et al. 1993; Amick et al. 1998; Brisson et al. 2000; Ishizaki et al. 2004). For example, Ostry et al. (2006) find gender differences in the association between psychosocial working conditions and BMI. Their results show a positive association between psychological demand, working long hours and BMI among males, while no significant association is found among females. Among Finnish public sector employees, Kouvonen et al. (2005) report that lower job control and higher job strain are associated with a higher BMI. They find that the strength of this association is affected by the way work stress scores are constructed.

In a cross-sectional study of 6,995 white collar workers in 21 organizations, Brisson et al. (2000) examine whether psychosocial factors at work are associated with smoking, sedentary behavior, and BMI. The study documents no consistent association between the prevalence of sedentary behavior, and BMI and decision latitude, psychological demands, or high job strain. Using data on 3,843 employees from 32 worksites in Minnesota, Hellerstedt and Jeffrey (1997) study the association between job strain and several health behaviors, including BMI. The authors show that job demands and job strain are positively associated with BMI only for women. Findings from other job stress models such as the effort–reward imbalance model are equally inconclusive about the relationship between job stress and BMI (e.g., Kouvonen et al. 2005; Kivimäki et al. 2002). In a prospective cohort study of 812 employees, Kivimäki et al. (2002) find that an effort–reward imbalance predicted increased BMI for over a 10-year window. In a cross-sectional Finnish study, Kouvonen et al. (2005) report that higher effort–reward imbalance is associated with a higher BMI when using aggregated scores for job stress; however,

the association becomes weak when individual scores are used.

The inconclusive findings in the literature have been attributed to differences in study design, measurement of job stress, and the characteristics of study populations (Kouvonen et al. 2005). However, most of the previous studies are based on cross-sectional evidence, which cannot control for unobserved individual-level characteristics (also known as unobserved heterogeneity). Unobserved factors such as preferences, food self-control and stress-coping ability can bias the relationship between job strain and BMI.

In this study, we revisit the relationship between job strain and BMI, and examine whether findings from standard cross-sectional analyses are confirmed when panel estimation methods are used to control for unobserved individual characteristics.

Methods

Data and variables

The data for this study come from the Statistics Canada National Population Health Survey (NPHS) household component. The NPHS is a nationally representative sample of the Canadian population which collects respondent's self-reported health-related behavior, as well as corresponding economic and socio-demographic variables. The NPHS commenced in 1994/1995 with a subsequent follow-up every 2 years. The survey includes household residents in all Canadian provinces excluding those living on Indian Reserves and Crown Lands, full-time members of the Canadian Forces Bases and some remote areas of Ontario and Quebec. Since the first cycle, there have been seven follow-up surveys, and so cycle eight (2008/2009) is currently available. The first three cycles (1994/1995, 1996/1997 and 1998/1999) had both cross-sectional and longitudinal components. The NPHS became strictly longitudinal from cycle four (2000/2001). This study uses data from cycle four (2000/2001) to cycle eight (2008/2009) since job strain information was not available in cycles two and three (1996/1997 and 1998/1999). We restrict our sample to adults aged 18–65 years. Excluding missing observations, the unbalanced panel sample includes 28,371 person-year observations.

The dependent variable in this study is the BMI, which is derived from the self-reported anthropometric measurements (height and weight) available in the NPHS. The BMI is calculated as body weight in kilograms divided by height in meters squared. Job strain, the main independent variable of interest is an index (score) that is derived from job-related questions about decision (control) latitude made up

Table 1 Items of job strain and workplace social support factors in the work stress Questionnaire

Decision latitude: skill discretion and decision authority	
	Your job requires that you learn new things
	Your job requires a high level of skill
	Your job allows you freedom to decide how you do your job
	Your job requires that you do things over and over
	You have a lot to say about what happens in your job
Psychological demands	
	Your job is very hectic
	You are free from conflicting demands that others make
Social support	
	You are exposed to hostility or conflict from the people you work with
	Your supervisor is helpful in getting the job done
	The people you work with are helpful in getting the job done

Source: Statistics Canada National Population Health Survey Household Component 2009

http://www.statcan.gc.ca/imdb-bmdi/document/3225_D10_T9_V3-eng.pdf

of skill discretion and decision authority, and psychological demands (see Table 1). Each item in Table 1 is rated on a five-point scale: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree. Job strain is measured as a ratio of psychological demands and decision latitude, where higher values indicate greater job strain (Karasek and Theorell 1990). We stratify individuals based on the distribution of scores into tertiles to represent low (reference category), medium, and high levels of strain.

This study follows the standard practice in the BMI/obesity literature by using a number of control variables. We control for demographic factors (such as age, gender and marital status), lifestyle behaviors (such as smoking, alcohol consumption and physical activity), socioeconomic status (such as, income level and educational attainment), individual's health status, occupational and provincial fixed effects. We also included year dummies in all regression estimations to capture any time trend in BMI. Age is used in continuous form, and age squared is also included to capture a nonlinear relationship between age and BMI. Household income is grouped into four categories: low income, low middle income, high middle income (reference category), and high income. This classification is based on total household income and the number of people living in the household (for a detailed description, see Statistics Canada 2009). Gender is captured by a dummy variable (male = 1, female = 0). Four dummy variables represent individual educational attainment: less than secondary, secondary, some post-secondary (reference category), and post-secondary. Marital status is represented by three dummy variables: married, separated and single (reference category). Smoking status is classified as: never

smoker (reference category), current smoker, and former smoker. Similarly, never drinker (reference category), current drinker, and former drinker represent drinking status. Individual physical activity level is represented by three categories: active, moderate, and inactive (reference category). Ethnicity is captured by a dummy variable (immigrant = 1, Canadian born = 0). We include a measure of social support in the workplace, in which a higher social support score indicates lower workplace support. It has been suggested that social support is an important stress modifier (Viswesvaran et al. 1999; Azagba and Sharaf 2011). For example, in a recent study, Azagba and Sharaf (2011) find that workplace social support reduced the effect of job strain on health care utilization. Workplace social support is derived based on three items (see Table 1). Health status is represented by individual health utility index (hui) which is a more objective measure than self-rated health. Provincial dummy variables are included with British Columbia as the reference category. Also, seven occupational categories are extracted from the 2007 North American Industry Classification System available in the NPHS. We classify an individual's occupation into one of seven groups: mechanical, trade, professional, managerial, health, service, and farm (reference category).

Estimation method

The following simple reduced form model of adult BMI is estimated:

$$\text{BMI}_{ijt} = \alpha_0 + \alpha_1(\text{jobstrain})_{ijt} + \alpha_2 X_{ijt} + \alpha_3 \tau_t + \alpha_4 Q_{ijt} + \alpha_5 OC_{ijt} + \varepsilon_{ijt} \quad (1)$$

where i, j and t index for individual, province of residence and time period. BMI is a measure of adult body weight. jobstrain represents the categories of strain levels, X is a vector of other control variables including: age, age squared, income, sex, education, marital status, workplace social support, ethnicity, physical activity status, smoking and drinking status. τ represents the year effects. The province fixed-effect variable, Q , is included to capture regional and other cultural factors that may influence an individual's BMI. OC represents occupational classifications and ε_{ijt} is the standard time variant residual term which is adjusted for clustering at the individual level.

We first estimate Eq. 1 by pooled ordinary least square (OLS), since the existing literature is mostly cast in a pooled cross-sectional framework. To correct for observation clustering, the standard errors in the OLS regression are adjusted for clustering at the individual level. OLS estimates from Eq. 1 may result in a confounding bias when unobserved individual-specific characteristics are crucial in the determination of the outcome variable, in our case the

BMI (Wooldridge 2002). The observed individual covariates may not reflect genetics, environmental influences, food preference, stress-coping ability and other lifestyle characteristics. To capture the influence of potential unobserved individual factors, we use panel data estimation methods. Accordingly Eq. 1 can be rewritten as:

$$\text{BMI}_{ijt} = \beta_0 + \beta_1(\text{jobstrain})_{ijt} + \beta_2\mathbf{X}_{ijt} + \beta_3\tau_t + \beta_4\mathbf{Q}_{ijt} + \beta_5\text{OC}_{ijt} + \mu_i + v_{ijt} \quad (2)$$

The error term, ε_{ijt} , from Eq. 1 becomes $\mu_i + v_{ijt}$ where μ_i represents time invariant individual-specific effects and v_{ijt} is the standard residual term. We estimate Eq. 2 by the random effects (RE) model and the fixed effects (FE) model. In the RE model, μ_i is assumed to be uncorrelated with other covariates in the model and in the FE model μ_i is permitted to be correlated with the regressors. While estimates from the FE model are consistent and less efficient than the RE estimates, the RE estimates are inconsistent if the FE specification is the appropriate model (Wooldridge 2002). However, a Hausman test (at the 1% significance level) suggests that the FE is the preferred model. We report estimates from both the FE and RE models. A comprehensive presentation of panel data methods is also provided elsewhere (Petersen 2004). Longitudinal attrition (non-response) bias would result if the response pattern of individuals has an effect on BMI. To test for non-response bias, we use the simple-addition variable test by Verbeek and Nijman (1992). Three variables reflecting survey response patterns are created: the number of cycles in which the individual appears in, a dummy indicating if an individual responds in the next cycle, and also a dummy showing whether the individual responds in all cycles. We run separate regressions (OLS and RE) for the unbalanced sample with each of the attrition variables included. These test results do not reject the null hypothesis ($p < 0.1$) of no attrition bias in all six models. Stata 11 is used to conduct the analyses, and the estimations are weighted using the NPHS sampling weights.

Results

The summary statistics for variables used in the analysis are reported in Table 2. The average BMI of the sample is 26.1. A sizeable portion of the adult work force belongs to jobs with high (33%) and medium (24%) strain. About 54% of the sample is male and the average health utility index is 0.92. A score of 1 indicates perfect functional health. The physical activity index shows that about 48% of the adult working population is inactive.

The cross-sectional OLS results are reported in Table 3. Model 1 presents the baseline specification. An additional

Table 2 Summary statistics

Variables	Mean	SD
Continuous variables		
BMI	26.098	4.840
Health utility index	0.922	0.127
Social support	4.005	1.916
Age	40.158	12.143
Categorical variables		
Strain level		
High strain	0.325	0.468
Medium strain	0.244	0.429
Low strain	0.427	0.494
Gender		
Male	0.537	0.498
Female	0.462	0.498
Marital status		
Single	0.267	0.442
Married	0.630	0.482
Separated	0.101	0.302
Educational attainment		
Less than secondary education	0.099	0.299
Secondary education	0.139	0.346
Some post secondary	0.285	0.451
Post secondary	0.474	0.499
Income level		
Low income	0.031	0.174
Low middle income	0.114	0.318
High middle income	0.321	0.467
High income	0.465	0.498
Ethnicity		
Immigrants	0.151	0.358
Non-immigrants	0.848	0.358
Smoking status		
Never smoker	0.330	0.470
Current smoker	0.261	0.439
Former smoker	0.407	0.491
Drinking status		
Never drinker	0.035	0.184
Current drinker	0.886	0.317
Former drinker	0.076	0.266
Physical activity		
Active	0.249	0.432
Moderate	0.273	0.445
Inactive	0.475	0.499
Province of residence		
Newfoundland	0.016	0.125
Prince Edwards	0.004	0.069
Nova Scotia	0.029	0.170
New Brunswick	0.023	0.150
Quebec	0.247	0.431

Table 2 continued

Variables	Mean	SD
Ontario	0.372	0.483
Manitoba	0.036	0.186
Saskatchewan	0.031	0.175
Alberta	0.111	0.314
British Columbia	0.119	0.324
Occupations		
Mechanical	0.193	0.395
Trade	0.200	0.400
Professional	0.136	0.343
Managerial	0.172	0.378
Health	0.112	0.315
Farm	0.037	0.190
Service	0.143	0.350
Observations	28,371	

The statistics are weighted using the NPHS sampling weights. The mean of the categorical variables are equivalent to a percentage representation if multiplied by 100

covariate, workplace social support, is added in model 2. In model 3, we add individual health status and province of residence while occupational fixed effects are included in model 4. We find a significant positive association between job strain and BMI, after controlling for demographics, socioeconomic status, lifestyle behaviors, health status, social support, ethnicity, a time trend, and occupational and provincial fixed effects. In particular, compared to jobs with low strain, individuals in jobs with high strain have higher BMI, and this result is robust to the inclusion of additional control variables (see models 2, 3 and 4). Similarly, individuals in jobs with medium strain have a higher BMI compared to those in jobs with low strain though with a smaller marginal difference. For the other control variables, results show that males, married individuals and former smokers have a higher BMI compared to their reference categories. Being a current smoker compared to the reference group (never smoker) reduces the BMI, though we are not suggesting that this result resolves the debate about the effect of smoking on obesity. The physical

Table 3 The effect of job strain on BMI: cross-sectional OLS results

	Model (1)	Model (2)	Model (3)	Model (4)
Strain level				
High strain	0.708 (0.121)***	0.719 (0.119)***	0.577 (0.116)***	0.570 (0.115)***
Medium strain	0.255 (0.096)***	0.258 (0.097)***	0.218 (0.095)**	0.220 (0.095)**
Demographic factors				
Male	1.643 (0.134)***	1.644 (0.134)***	1.662 (0.133)***	1.618 (0.134)***
Married	0.338 (0.173)*	0.337 (0.173)*	0.328 (0.173)*	0.307 (0.172)*
Separated	0.108 (0.254)	0.107 (0.254)	0.046 (0.253)	0.043 (0.253)
Age	0.297 (0.033)***	0.298 (0.033)***	0.296 (0.033)***	0.298 (0.033)***
Age square	-0.003 (0.000)***	-0.003 (0.000)***	-0.003 (0.000)***	-0.003 (0.000)***
Educational attainment				
Less secondary	0.222 (0.229)	0.223 (0.229)	0.235 (0.229)	0.204 (0.230)
Secondary	-0.005 (0.205)	-0.006 (0.205)	-0.056 (0.203)	-0.084 (0.203)
Post secondary	-0.409 (0.146)***	-0.409 (0.146)***	-0.369 (0.146)**	-0.359 (0.150)**
Income level				
Low income	-0.061 (0.261)	-0.060 (0.261)	-0.186 (0.256)	-0.175 (0.259)
Low middle income	0.036 (0.145)	0.036 (0.145)	-0.003 (0.142)	-0.015 (0.142)
High income	-0.130 (0.107)	-0.130 (0.107)	-0.132 (0.107)	-0.120 (0.106)
Ethnicity				
Immigrant	-0.792 (0.191)***	-0.792 (0.191)***	-0.850 (0.200)***	-0.832 (0.202)***
Smoking status				
Current smoker	-0.556 (0.164)***	-0.554 (0.164)***	-0.580 (0.163)***	-0.582 (0.164)***
Former smoker	0.373 (0.135)***	0.373 (0.135)***	0.372 (0.134)***	0.367 (0.135)***
Drinking status				
Current drinker	0.483 (0.257)*	0.485 (0.257)*	0.527 (0.255)**	0.558 (0.254)**
Former drinker	1.043 (0.294)***	1.044 (0.294)***	0.976 (0.291)***	0.995 (0.290)***
Physical activity				
Active	-0.686 (0.119)***	-0.687 (0.119)***	-0.675 (0.119)***	-0.678 (0.119)***

Table 3 continued

	Model (1)	Model (2)	Model (3)	Model (4)
Moderate	-0.228 (0.101)**	-0.229 (0.101)**	-0.200 (0.099)**	-0.203 (0.098)**
Year dummies (time trend)				
Year_2002	0.239 (0.062)***	0.240 (0.062)***	0.215 (0.063)***	0.217 (0.063)***
Year_2004	0.366 (0.071)***	0.365 (0.071)***	0.322 (0.070)***	0.319 (0.071)***
Year_2006	0.631 (0.083)***	0.631 (0.083)***	0.603 (0.083)***	0.607 (0.084)***
Year_2008	0.811 (0.096)***	0.809 (0.096)***	0.781 (0.096)***	0.786 (0.096)***
Social support		-0.012 (0.025)	0.008 (0.025)	0.005 (0.025)
Health utility index			-2.085 (0.440)***	-2.069 (0.440)***
Observations	28,371			

Robust standard errors in parentheses. All the estimations (except the random effect which is not supported by weight in Stata) are weighted using the NPHS sampling weights. Model 1 presents the baseline specification. An additional covariate, workplace social support, is added in model 2. In model 3, we add individual's health status (HUI) and province of residence. In model 4 we add occupational fixed effects

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Table 4 The effect of job strain on BMI: fixed effects results

	Model (1)	Model (2)	Model (3)	Model (4)
Strain level				
High strain	0.001 (0.046)	-0.0004 (0.046)	0.004 (0.046)	0.006 (0.046)
Medium strain	0.020 (0.043)	0.020 (0.043)	0.024 (0.042)	0.025 (0.042)
Demographic factors				
Age	0.089 (0.075)	0.089 (0.075)	0.096 (0.075)	0.092 (0.075)
Age square	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***
Married	0.469 (0.096)***	0.470 (0.096)***	0.477 (0.096)***	0.482 (0.096)***
Separated	-0.005 (0.137)	-0.004 (0.137)	-0.004 (0.136)	-0.0004 (0.136)
Education attainment				
Less secondary	-0.329 (0.313)	-0.331 (0.312)	-0.329 (0.313)	-0.329 (0.314)
Secondary	-0.345 (0.222)	-0.346 (0.221)	-0.366 (0.221)*	-0.370 (0.221)*
Post secondary	0.035 (0.092)	0.035 (0.092)	0.035 (0.092)	0.031 (0.093)
Income level				
Low income	-0.200 (0.147)	-0.201 (0.147)	-0.191 (0.146)	-0.183 (0.145)
Low middle income	-0.028 (0.073)	-0.028 (0.073)	-0.036 (0.073)	-0.032 (0.073)
High income	0.032 (0.051)	0.032 (0.051)	0.035 (0.051)	0.035 (0.051)
Smoking status				
Current smoker	-0.573 (0.129)***	-0.573 (0.129)***	-0.580 (0.129)***	-0.578 (0.129)***
Former smoker	-0.073 (0.098)	-0.073 (0.098)	-0.078 (0.098)	-0.078 (0.098)
Drinking status				
Current drinker	-0.028 (0.185)	-0.028 (0.185)	-0.027 (0.185)	-0.027 (0.186)
Former drinker	0.095 (0.160)	0.095 (0.161)	0.095 (0.161)	0.092 (0.162)
Physical activity				
Active	-0.263 (0.058)***	-0.263 (0.058)***	-0.261 (0.058)***	-0.257 (0.058)***
Moderate	-0.089 (0.046)*	-0.089 (0.046)*	-0.089 (0.046)*	-0.089 (0.046)*
Year dummies (time trend)				
Year_2002	0.398 (0.140)***	0.398 (0.140)***	0.375 (0.142)***	0.376 (0.143)***
Year_2004	0.669 (0.275)**	0.668 (0.275)**	0.630 (0.279)**	0.633 (0.280)**
Year_2006	1.081 (0.410)***	1.081 (0.410)***	1.025 (0.415)**	1.029 (0.417)**
Year_2008	1.416 (0.547)***	1.416 (0.547)***	1.344 (0.554)**	1.347 (0.556)**
Social support		0.003 (0.011)	0.002 (0.011)	0.002 (0.011)

Table 4 continued

	Model (1)	Model (2)	Model (3)	Model (4)
Health utility index			-0.284 (0.185)	-0.285 (0.184)
Observations	28,371			

Robust standard errors in parentheses. All the estimations (except the random effect which is not supported by weight in Stata) are weighted using the NPHS sampling weights. Model 1 presents the baseline specification. An additional covariate, workplace social support, is added in model 2. In model 3, we add individual’s health status (HUI) and province of residence. In model 4 we add occupational fixed effects
 *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Table 5 The effect of job strain on BMI: random effects results

	Model (1)	Model (2)	Model (3)	Model (4)
Strain level				
High strain	0.045 (0.036)	0.039 (0.036)	0.029 (0.036)	0.032 (0.036)
Medium strain	0.018 (0.033)	0.015 (0.033)	0.011 (0.033)	0.013 (0.033)
Demographic factors				
Age	0.240 (0.018)***	0.240 (0.018)***	0.241 (0.018)***	0.238 (0.018)***
Age square	-0.002 (0.000)***	-0.002 (0.000)***	-0.002 (0.000)***	-0.002 (0.000)***
Male	1.318 (0.097)***	1.317 (0.097)***	1.332 (0.096)***	1.318 (0.098)***
Married	0.328 (0.075)***	0.328 (0.075)***	0.325 (0.075)***	0.325 (0.075)***
Separated	-0.110 (0.107)	-0.110 (0.107)	-0.112 (0.107)	-0.110 (0.107)
Education attainment				
Less secondary	0.089 (0.136)	0.088 (0.136)	0.090 (0.136)	0.087 (0.136)
Secondary	-0.016 (0.123)	-0.017 (0.123)	-0.043 (0.122)	-0.043 (0.122)
Post secondary	-0.047 (0.063)	-0.046 (0.063)	-0.036 (0.063)	-0.040 (0.064)
Income level				
Low income	-0.103 (0.096)	-0.103 (0.096)	-0.113 (0.096)	-0.111 (0.096)
Low middle income	0.015 (0.057)	0.016 (0.057)	0.008 (0.057)	0.009 (0.057)
High income	-0.042 (0.040)	-0.042 (0.040)	-0.041 (0.040)	-0.044 (0.040)
Ethnicity				
Immigrant	-1.158 (0.150)***	-1.158 (0.150)***	-1.137 (0.155)***	-1.124 (0.155)***
Smoking status				
Current smoker	-0.548 (0.082)***	-0.549 (0.083)***	-0.543 (0.083)***	-0.544 (0.083)***
Former smoker	0.044 (0.066)	0.045 (0.066)	0.050 (0.066)	0.050 (0.066)
Drinking status				
Current drinker	0.208 (0.111)*	0.208 (0.111)*	0.213 (0.111)*	0.212 (0.111)*
Former drinker	0.240 (0.108)**	0.241 (0.108)**	0.234 (0.108)**	0.235 (0.108)**
Physical activity				
Active	-0.420 (0.041)***	-0.420 (0.041)***	-0.418 (0.042)***	-0.419 (0.042)***
Moderate	-0.148 (0.034)***	-0.148 (0.035)***	-0.146 (0.035)***	-0.147 (0.035)***
Year dummies (time trend)				
Year_2002	0.236 (0.035)***	0.236 (0.035)***	0.235 (0.035)***	0.235 (0.035)***
Year_2004	0.309 (0.039)***	0.310 (0.039)***	0.307 (0.039)***	0.308 (0.039)***
Year_2006	0.532 (0.046)***	0.532 (0.046)***	0.531 (0.046)***	0.533 (0.046)***
Year_2008	0.675 (0.054)***	0.677 (0.054)***	0.676 (0.054)***	0.677 (0.054)***
Social support		0.010 (0.009)	0.012 (0.008)	0.012 (0.009)
Health utility index			-0.382 (0.148)**	-0.380 (0.149)**
Observations	28,371			

Robust standard errors in parentheses. All the estimations (except the random effect which is not supported by weight in Stata) are weighted using the NPHS sampling weights. Model 1 presents the baseline specification. An additional covariate, workplace social support, is added in model 2. In model 3, we add individual’s health status (HUI) and province of residence. In model 4 we add occupational fixed effects
 *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

activity (active and moderate) and immigrant variables have the expected negative signs. The year dummies show a significant positive trend in the BMI over time.

Results from the panel data estimation methods are presented in Tables 4 and 5. Table 4 presents the results from the FE model while the RE model estimates are reported in Table 5. In contrast to the cross-sectional analysis, results from the panel data methods, FE and RE, show no statistically significant association between job strain and BMI. This finding is robust to the inclusion of workplace social support, individual health status, occupational and provincial fixed effects. Other covariates in the panel data models are generally similar to the OLS results. Results from the panel estimation methods (FE and RE) suggest that not controlling for unobserved individual heterogeneity can lead to misleading conclusions about the effect of job strain on the BMI.

Discussion

Several studies have examined the relationship between work-related stress and body weight with inconclusive findings (Overgaard et al. 2004; Siegrist and Rodel 2006). Most of those studies are cross sectional in their design and have used samples that are not necessary representative of the whole population. Differences between study design, measurement methods and study samples may explain the mixed findings in the existing literature (Kouvonen et al. 2005). However, in the current study we hypothesized that the inconsistent findings in the literature may be due to unobserved characteristics that are not controlled for because of the cross-sectional design of most of the previous studies. Unobserved factors such as preferences, genetics, food preference and stress-coping ability can bias the relationship between job strain and BMI. Accordingly, this paper examines the relationship between job stress and BMI using longitudinal data from the Canadian National Population Health Survey (NPHS). In particular, we examine whether findings based on cross-sectional estimation, which are mostly used in previous studies, are consistent with panel estimation methods that control for unobserved individual-level characteristics.

After controlling for demographic factors, lifestyle behaviors, socioeconomic status, health conditions, occupational and provincial fixed effects, results from a cross-sectional estimation method show a significant positive relationship between job strain and BMI. Individuals in jobs with high/medium strain have a higher BMI compared to those in jobs with low strain. Nonetheless, results from panel estimation methods (random and fixed effects models) show no statistically significant association between job strain and BMI. This differential finding between cross-

sectional and longitudinal estimation methods emphasize the importance of controlling for unobserved individual-level heterogeneity in estimating the effect of job stress on body weight. The findings of this study suggest the need for further longitudinal evidence in order to have a better understanding of the relationship between job stress and body weight.

The long time span covered by the current study enables us to capture the stress exposure duration. We use a measure of job strain that better represents individuals' long-term working conditions compared to the one-period (cross sectional) measure. A static measure may only reflect temporary effects and may lead to underestimation of the true association between job stress and BMI. The large sample size and the nationally representative nature of the data set provide statistical power at the national level that is not available in previous studies that used small and non-generalizable samples such as those focused on certain industries or occupations.

One limitation of this study is that the dependent variable, BMI, is self reported and so could be subject to measurement errors. It has been documented that individuals tend to over-report their height and under-report their weight (McAdams et al. 2007). This may bias the estimated association between job stress and BMI and affect the consistency of the estimated parameters. However, the panel structure of the data helps to mitigate this bias. Also, as long as the errors are not systematic and BMI is the dependent variable, consistent estimates can still be obtained.

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