

# THE IMPACT OF PSYCHOSOCIAL AND PHYSICAL WORK EXPERIENCE ON MENTAL HEALTH: A NESTED CASE CONTROL STUDY

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## ABSTRACT

This investigation is a nested case control study based on a large cohort of sawmill workers employed in 14 sawmills in British Columbia (BC) in Western Canada. The purpose of the study was to assess the association between objectively measured physical and psychosocial work conditions and objectively measured mental health outcomes using a longitudinal study design. The investigation ensured that all cases and controls were free of mental health disease for a 5-year period prior to commencement of the study. The study found that Sikh sawmill workers had elevated odds for all the mental health outcomes investigated, and that workers with low duration of employment had elevated odds for adjustment reaction and acute reaction to stress. After controlling for sociodemographic and nonphysical/nonpsychosocial work condition confounders, high psychological demand was associated with elevated odds for neurotic disorder.

Several studies conducted over the past 20 years have identified job stress as an important risk factor for adverse mental health outcomes (for recent comprehensive reviews on this topic see Michie & Williams, 2003; Van Der Doef & Maes, 1999). Specifically, empirical studies using Robert Karasek's (1979) demand/control model found strong support for the negative effects of job strain and low job control on psychological well-being (Van Der Doef & Maes). Similarly, a range of task and organizational-level psychosocial work conditions (including management style, work overload and pressure, lack of control over work, and unclear work role) were associated with self-reported psychological ill health (e.g., anxiety, depression, and emotional exhaustion) and sickness absence (Michie & Williams).

An overview of the literature<sup>1</sup> identified 14 cohort studies investigating the association between the demand/control model and mental health outcomes (Balog et al., 2003; Bildt & Michelsen, 2002; Bourbonnais, Comeau, Vézina, & Dion, 1998; Cheng, Kawachi, Coakley, Schwartz, & Colditz, 2000; de Lange, Taris, Kompier, Houtman, & Bongers, 2002, 2004, 2005; Ippolito, Adler, Thomas, Litz, & Holzl, 2005; Kawakami, Haratani, & Araki, 1992; Niedhammer, Goldberg, Laclerc, Bugel, & David, 1998; O'Campo, Eaton, & Muntaner, 2004; Stansfeld, Fuhrer, Head, Ferrie, & Shipley, 1997; Stansfeld, Fuhrer, Shipley, & Marmot, 1999; Wang, 2005; Ylipaavalniemi et al., 2005).

One of the best designed among the 14 identified cohort studies—a prospective study of 668 Dutch employees over four waves of data collection (1994 through 1997; de Lange et al., 2004)—tested relationships between psychosocial work conditions and mental health. In this study, while some evidence of reciprocal causal relationships between work characteristics and mental health was found, the effects of work characteristics on mental health were most prominent.

In another well-designed four-year cohort study of depression among Swedish workers that also adjusted for coping ability and stressful life events, high job strain remained significantly associated with subclinical depression (relative risk [*RR*] = 2.8) for women (Bildt & Michelsen, 2002). In the GAZEL study of French workers, Niedhammer et al. (1998) found that high psychological demands (odds ratio [*OR*] = 1.77 men, 1.37 women), low job control (*OR* = 1.38 men, 1.41 women), and low social support (*OR* = 1.58 men, 1.29 women) predicted subsequent depressive symptoms at 1-year follow-up. The same pattern of associations (with little difference between men and women) was found at 3-year follow-up in this same cohort (Paterniti, Niedhammer, Lang, & Consoli, 2002).

A Canadian study of female nurses found statistically significant effects of high job strain on psychological distress (*OR* = 1.98) and emotional exhaustion (Bamberg, 1994) (*OR* = 5.0), after adjusting for "Type A behaviour," domestic workload, recent stressful life events, and social support outside work (Bourbonnais et al., 1998). Recently, in the Canadian National Population Health Survey (*n* = 6,663), job strain was significantly associated with elevated risk for major depressive episode (*OR* = 2.35) after adjustment for selected sociodemographic, clinical, and psychosocial variables (e.g., educational level, number of chronic medical illnesses, and child and adulthood traumatic events; Wang, 2005). In summary, of the 14 cohort studies identified in our literature search, 11 demonstrated a statistically significant association between high job strain or low job control and adverse mental health, and 3 failed to demonstrate such associations (Balog et al., 2003; O'Campo et al., 2004; Ylipaavalniemi et al., 2005).

While the literature suggests that some psychosocial work conditions may be risk factors for a range of mental health outcomes, these cohort studies suffered from two limitations. First, mental health outcomes were measured through individual self-report only. No objective measures, such as diagnoses obtained from physicians' records or from hospital discharge registers, were utilized either alone or to validate the self-reports. Second, exposure data were also obtained by self-reports. Objective measures of psychosocial and physical work exposure have been used in some studies (see, for example, Johnson & Hall, 1988; Johnson, Stewar, Fredlund, Hall, & Theorell, 1990), but these were not utilized in the 14 cohort studies reviewed.

This investigation is a nested case control study based on a large cohort of sawmill workers employed in 14 sawmills in British Columbia (BC) in Western Canada. The purpose of the study is to address previous methodological limitations by assessing the association between objectively measured physical and psychosocial work conditions and objectively measured mental health outcomes using a longitudinal study design. As well, we ensured that all cases and controls had been free of mental health disease for a 5-year period prior to commencement of the study.

## METHOD

### Participants

This study is based on a cohort of male sawmill workers for whom we have obtained data on physical and psychosocial work conditions, and on mental health outcomes. The cases and controls for this study were selected from a cohort originally gathered to assess the effects of chlorophenol anti-sapstain exposure among BC sawmill workers. Fourteen medium- to large-size (150 to 450 workers each) sawmills were identified in BC, and personnel records of workers employed in one of these mills for at least one year between 1950 and 1998 were used to identify the study participants. Sociodemographic information and complete job history records were abstracted from personnel records for 28,794 eligible male workers. (A complete description of methods used to assemble this cohort can be found in Hertzman et al., 1997).

Age, marital, and ethnic status (classified as Caucasian, Sikh, or Chinese), duration of employment, occupational status (manager, tradesman, skilled worker, unskilled worker), and job mobility (classified as upward, downward, or stable) while employed at a study sawmill were obtained from personnel records.

Between 1996 and 2001, a total of 2,879 cases with mental health diagnoses and 8,637 controls (3 controls for each case, matched for age) were identified.

### Exposure Variables

Retrospective estimates of job control, demands, noise, and social support were obtained in two ways:

1. Four job evaluators (two union and two management representatives), each of whom had over 35 years experience in the BC sawmill industry, completed a shortened version of Karasek's Job

Content Questionnaire (JCQ), retrospectively estimating exposure variables for all basic job titles in the sawmill industry prior to 1975 (Karasek, 1979; for a complete description of these methods see Ostry et al., 2001a, 2001b, 2006).

2. A panel of senior workers in each study sawmill was randomly selected and asked to complete the shortened versions of the JCQ for basic job titles in their sawmill for the time periods 1975 to 1985, and 1985 to 1998 (see Ostry et al., 2001b).

Estimates from job evaluators (for the period prior to 1975) and senior workers (for the period between 1975 and 1998) for control, psychological demand, physical demand, social support, and noise were then linked to the job history database in the sawmill cohort. In addition, exposure to job stress in terms of duration of employment, occupation, job mobility, control, psychological demand, physical demand, social support, and noise was determined for each year a worker was employed at a study sawmill. Exposures were based on the job title held at a given time by a worker and linked to his or her job history file.

### Outcome Variables

The cohort of 28,794 sawmill workers for whom information about work stress was obtained by job evaluators and senior workers was probabilistically linked to the British Columbia Linked Health Database (BCLHDB). The BCLHDB consists of person-specific, longitudinal records on all residents of British Columbia. These files contain data on physician services, hospital discharges, drug prescriptions, long-term care services, mental health client registry, Work Compensation Board records, income assistance records, cancer incidence, deaths, cause of death, and births from 1985 to the present. The records are housed at the University of British Columbia's Centre for Health Services and Policy Research (CHSPR) and are managed jointly by the Centre, the University, and the Ministry of Health. A Data Access Subcommittee consisting of health ministry personnel, staff from the BC Ministry of Information and Privacy, and CHSPR has been established to handle requests for linkage to the BCLHDB and to ensure that such requests meet scientific and ethical standards, are in the public interest, and conform with British Columbia's Freedom of Information and Protection of Privacy Act. Each file is stored separately but has been indexed with an individual service-recipient-specific code so that the records of groups of individuals can be linked across files for specific research projects.

While there is evidence indicating that an individual's reaction to stressful life events may be mediated by genetic predispositions (McGuffin, Katz, Aldrich, & Bebbington, 1988; Plomin, Lichtenstein, Pedersen, Davies, & Belward, 1990), the present work focuses on those mental health outcomes that may be more strongly associated with environmental factors rather than family history of mental health disease. Because evidence indicates that social environment can contribute to the onset of psychotic mental states and may not be the primary cause of such disease (van Os, 2003), we excluded psychotic disorders from the analyses and focused instead on neurotic disorder, anxiety/depression, acute reactions to stress, adjustment reaction, and alcohol and drug-related disorders. Cases therefore included all participants with a first ICD9 diagnostic code of 292, 300, 303, 304, 305, 308, 309, and 311.

In order to ensure that persons with pre-existing mental health outcomes were excluded from analysis, all participants with any mental health diagnosis (recorded in the BCLHDB) in the period between January 1, 1991, and March 31, 1996, were eliminated from the potential pool of cases and controls. Thus all cases and controls were selected for the period from April 1, 1996, to March 31, 2001.

Using STTOCC (survival-time to case-control) on STATA 8.0, three controls were selected for each case matched by age. Controls were chosen randomly with replacement from the set at risk, that is, all the members of the cohort who worked in a study sawmill for at least 1 year. Thus, a control could be anyone at risk who also satisfied the matching criteria and who had not had a mental health diagnosis in the 5 years prior to April 1996.

### Analysis

Statistical analyses were conducted using conditional logistic regression on STATA 8.0. Univariate models were first run with each mental health outcome and exposure variable: duration of employment, occupation, job mobility, control, psychological demand, physical demand, coworker social support, and noise. Multivariate models were developed in two steps. In the first step sociodemographic variables (i.e., marital status and ethnicity) were forced into the model, and associations with nonphysical and nonpsychosocial variables (i.e. duration of employment and occupational status at a study sawmill) were tested. In the second step marital status, ethnicity, duration of employment, and occupational status were forced into the models, and associations were determined for psychosocial and physical work conditions.

## RESULTS

Univariate analysis (Table 1) shows that Sikh workers had significantly higher odds of being diagnosed with neurotic disorder ( $OR = 1.4$ ; 95%  $CI$  1.02–1.86), anxiety/depression ( $OR = 1.3$ ; 95%  $CI$  1.03–1.70) and alcohol dependence ( $OR = 2.4$ ; 95%  $CI$  1.39–4.02). On the other hand, Chinese workers had significantly lower odds of being diagnosed with anxiety/depression ( $OR = .21$ ; 95%  $CI$  .06–.67). Marital status was not significantly associated with any of the mental health outcomes.

For adjustment reaction the elevated odds noted for workers in the unskilled jobs were statistically significant ( $OR = 1.6$ ; 95%  $CI$  1.19–2.05) and for tradesmen the reduced odds were also statistically significant ( $OR = .56$ ; 95%  $CI$  .40–.80). For alcohol dependence increased odds were observed for skilled workers ( $OR = 1.6$ ; 95%  $CI$  1.06–2.34), and for drug psychosis reduced odds were observed for tradesmen ( $OR = .16$ ; 95%  $CI$  .03–.73).

Workers with lower duration of employment in a study mill showed statistically significant associations for adjustment reaction ( $OR = .97$ ; 95%  $CI$  .95–.99). Downward job mobility was associated with increased odds of diagnosis for alcohol dependence ( $OR = 1.4$ ; 95%  $CI$  1.03–1.84), and decreased odds for drug psychoses ( $OR = .39$ ; 95%  $CI$  .16–0.92).

In terms of psychosocial work conditions, low control was significantly associated with elevated odds for drug dependence ( $OR = .94$ ; 95%  $CI$  .89–.99); high psychological demand was significantly associated with elevated odds for neurotic disorder ( $OR = 1.04$ ; 95%  $CI$  1.01–1.08).

**Table 1**  
**Univariate Analyses: Odds Ratios (OR) and Confidence Intervals (CI) for Four Mental Health and Four Alcohol or Drug-Related Diagnoses Among Sawmill Workers from 1996 to 2001**

	Non-drug or alcohol related mental health diagnoses OR (CI 95%)			
	Neurotic disorder (n = 822)	Acute reaction to stress (n = 526)	Adjustment reaction (n = 313)	Anxiety/depression (n = 1,115)
Ethnicity				
Caucasian	.79 (.59–1.05)	.87 (.61–1.26)	.99 (.61–1.59)	.89 (.69–1.14)
Sikh	1.4 (1.02–1.86)	1.29 (.87–1.90)	1.17 (.70–1.94)	1.3 (1.03–1.7)
Chinese	.75 (.34–1.63)	.63 (.24–1.63)	.52 (.15–1.80)	.21 (.06–.67)
Marital status	.99 (.95–1.03)	.97 (.93–1.02)	.97 (.91–1.03)	1.0 (.97–1.04)
Occupational status at time of event				
Manager	.91 (.62–1.34)	.78 (.46–1.334)	.82 (.45–1.49)	.83 (.59–1.17)
Tradesman	.94 (.78–1.13)	1.02 (.81–1.29)	.56 (.40–.80)	.89 (.76–1.05)
Skilled	1.17 (.95–1.44)	.80 (.61–1.04)	.96 (.68–1.35)	1.10 (.93–1.31)
Unskilled	.97 (.83–1.14)	1.16 (.95–1.43)	1.6 (1.19–2.05)	1.06 (.92–1.22)
Duration (years) of job at sawmill	1.0 (.99–1.01)	.98 (.97–1.00)	.97 (.95–.99)	1.0 (.99–1.01)
Downward job mobility while employed	.97 (.83–1.12)	.96 (.80–1.16)	.85 (.66–1.08)	.92 (.81–1.05)
Psychosocial and physical work conditions				
Control	1.01 (.98–1.03)	1.0 (.97–1.03)	.96 (.92–1.00)	1.00 (.98–1.02)
Psychological demand	1.04 (1.0–1.08)	.96 (.92–1.01)	1.01 (.98–1.04)	1.01 (.97–1.06)
Physical demand	1.03 (.87–1.21)	1.06 (.85–1.31)	1.02 (.88–1.18)	1.08 (.90–1.30)
Social support	1.0 (.90–1.1)	1.08 (.95–1.23)	1.0 (.92–1.09)	.97 (.87–1.09)
Noise	1.1 (.93–1.32)	.86 (.69–1.06)	1.01 (.87–1.17)	1.04 (.86–1.27)

(table continues)

**Table 1**  
(continued)

	Drug or alcohol-related diagnoses <i>OR (CI 95%)</i>			
	Drug psychoses ( <i>n</i> = 28)	Alcohol dependence ( <i>n</i> = 237)	Drug dependence ( <i>n</i> = 180)	Nondependent drug abuse ( <i>n</i> = 193)
Ethnicity				
Caucasian	1.0 (.10–9.6)	.57 (.35–.95)	1.29 (.68–2.45)	.63 (.36–1.09)
Sikh	1.5 (.14–16.5)	2.4 (1.39–4.02)	1.03 (.53–1.99)	1.64 (.92–2.92)
Chinese	—	—	—	1.2 (.23–6.18)
Marital status	.95 (.73–1.23)	.95 (.88–1.02)	.95 (.88–1.03)	.96 (.89–1.04)
Occupational status at time of event				
Manager	3.0 (.19–47.96)	.44 (.18–1.06)	.71 (.25–4.00)	.54 (.18–1.66)
Tradesman	.16 (.03–.73)	1.1 (.77–1.57)	.51 (.31–.82)	1.33 (.90–1.97)
Skilled	1.42 (.51–3.9)	1.6 (1.06–2.34)	1.13 (.74–1.73)	.98 (.63–1.51)
Unskilled	2.03 (.79–5.16)	.82 (.60–1.11)	1.39 (.97–1.98)	.89 (.64–1.23)
Duration (years) of job at sawmill	.96 (.90–1.03)	1.01 (.99–1.04)	1.0 (.97–1.03)	.98 (.95–1.00)
Downward job mobility while employed	.39 (.16–.92)	1.4 (1.03–1.84)	.95 (.67–1.36)	1.05 (.77–1.44)
Psychosocial and physical work conditions				
Control	.94 (.82–1.06)	.99 (.95–1.04)	.94 (.89–.99)	1.0 (.96–1.05)
Psychological demand	1.04 (.84–1.29)	1.03 (.96–1.10)	1.0 (.93–1.07)	1.0 (.93–1.08)
Physical demand	1.71 (.59–4.95)	1.33 (.95–1.86)	.92 (.63–1.35)	1.05 (.76–1.44)
Social support	.96 (.53–1.74)	1.0 (.83–1.22)	.96 (.75–1.23)	.95 (.78–1.15)
Noise	1.8 (.56–5.85)	1.0 (.73–1.39)	.79 (.54–1.15)	.84 (.61–1.16)



In the first multivariate models (Table 2), after controlling for sociodemographic variables, low duration of employment was associated with increased odds of a diagnosis of acute reaction to stress ( $OR = .98$ ; 95%  $CI .96-.99$ ) and adjustment reaction ( $OR = .97$ ; 95%  $CI .97-.99$ ). In the final model (Table 3), after controlling for sociodemographic and nonphysical/nonpsychosocial work condition variables, high psychological demand was associated with increased odds for neurotic disorder ( $OR = 1.05$ ; 95%  $CI 1.01-1.09$ ).

**Table 2**  
**Multivariate Analyses: Odds Ratios (*OR*) and Confidence Intervals (*CI*) for Mental Health Diagnoses Among Sawmill Workers (1996 to 2001) After Controlling for Sociodemographic Variables**

	<i>OR (CI 95%)</i>
<i>Acute reaction to stress</i>	
Duration (years) of job at sawmill	.98 (.96-.99)
Sikh	1.38 (.93-2.05)
Chinese	.63(.24-1.67)
Marital status	.97 (.92-1.02)
<i>Adjustment reaction</i>	
Duration (years) of job at sawmill	.97 (.97-.99)
Sikh	1.24 (.74-2.08)
Chinese	.47 (.13-1.63)
Marital status	.96 (.90-1.02)
<i>Anxiety/depression</i>	
Duration (years) of job at sawmill	.99 (.98-1.01)
Sikh	1.35 (1.04-1.76)
Chinese	.21(.06-.68)
Marital status	1.00 (.97-1.03)

**Table 3**  
**Odds Ratios (*OR*) and Confidence Intervals (*CI*) for Fully Controlled Multivariate Model for Neurotic Disorder from 1996 to 2001 Among Sawmill Workers**

	<i>OR (CI 95%)</i>
Duration (years) of job at sawmill	.99 (.98-1.00)
Sikh	1.30 (.95-1.78)
Chinese	.75 (.34-1.64)
Marital status	.98 (.95-1.02)
Tradesman	1.01 (.67-1.52)
Skilled	1.23 (.81-1.88)
Unskilled	1.10 (.73-1.64)
Psychological demand	1.05 (1.01-1.09)



## DISCUSSION

There are four main results to this investigation. First, Sikh workers had elevated odds for all the mental health outcomes investigated. It should be noted that in the final fully controlled model for neurotic disorder, while Sikh ethnic status was not statistically significant, the odds of neurotic disorder among this subpopulation of workers was still 30% greater than among Caucasians. For alcohol dependence, Sikh workers had approximately twice the odds observed for Caucasian workers, and these results were statistically significant. For anxiety/depression and neurotic disorder, they were from 30 to 40% greater than the odds for Caucasian workers and also statistically significant.

The literature on mental health disorders of South Asians is not conclusive. Most studies have been conducted in Britain. Some studies have reported lower rates of alcohol consumption and related mental health problems among adult Sikhs (Meltzer, Gill, & Petticrew, 1995) than among other ethnic minorities and Caucasian adults. Other studies, however, have reported higher alcohol consumption and alcohol-related mental health problems in the Sikh population than among other South Asians or among Caucasians (Cochrane & Bal, 1989; 1990; Orford, Johnson, & Puser, 2004).

The results from our study, using objectively measured mental health outcomes, are for Sikh sawmill workers living in Western Canada. This study population is unique in that it consists mainly of sawmill workers who are exposed to difficult, often monotonous, working conditions. The results may not be generalizable to the male Sikh population in Western Canada. Nonetheless, these results indicate that Sikh workers in primary industries in Western Canada may be at higher risk for some mental health problems than Caucasian sawmill workers.

Second, after controlling for marital and ethnic status, workers with low duration of employment at a study sawmill had statistically significant and elevated odds for adjustment reaction and acute reaction to stress. Third, in terms of psychosocial work conditions, after controlling for socio-demographic and nonphysical/nonpsychosocial work condition confounders, high psychological demand was associated with elevated odds for neurotic disorder. Fourth, associations between physical and psychosocial work conditions were found for two of the eight mental health outcomes (neurotic disorder and drug dependence) but not for the others.

A major strength of this study was its rigorous longitudinal study design, which included the use of objective measures of both the exposure and outcome variables, and ensured that cases and controls were free of any mental health diagnoses in the 5-year period prior to selection. As well, as noted in our methods section, we selected only those mental health outcomes which were most likely to be environmental as opposed to endogenous in origin.

There are two major limitations to this study. First, there is a potential for misclassification of exposure arising from objective and retrospective methods used. The combination of design rigour and any bias caused by exposure misclassification could have attenuated or masked associations between psychosocial and physical work conditions and the mental health outcomes under investigation. Second, we have no information on nonwork environmental factors which may have affected the mental health outcomes of cohort members.

In summary, the results from the present study indicate that psychosocial working conditions may be important risk factors contributing to adverse mental health outcomes among workers.

### NOTE

1. We searched Medline for the period from January 1986 to December 2005 using the combined search terms "job strain," "occupational stress," "job content questionnaire," "work stress," "job stress," "job control," "demand-control," and "Karasek." The search was limited by the combined search terms "depression," "anxiety," "mental health," "suicide," "schizophrenia," and "psychosis," and further limited to publications in the English language.

### RÉSUMÉ

Cet article rend compte d'une étude longitudinale de cas-témoins emboîtés réalisée sur une large cohorte de travailleurs de 14 scieries de la Colombie-Britannique. L'objectif était d'évaluer le lien entre d'une part des conditions de travail physiques et psychosociales (mesurées objectivement), et d'autre part les effets de celles-ci sur la santé mentale (mesurés objectivement). Aucun des sujets observés n'avait souffert de maladie mentale durant les cinq années précédant la recherche. L'étude a permis de montrer que, chez les travailleurs sikhs, les risques de toutes les maladies mentales étudiées sont plus élevés, et que, chez les travailleurs engagés depuis peu, les risques de troubles de l'adaptation et d'état réactionnel aigu à une situation très éprouvante sont plus importants. Finalement, nous avons observé que, les variables confusionnelles (facteurs sociodémographiques et conditions de travail non physiques et non psychologiques) étant maintenues constantes, la pénibilité du travail (« *high psychological demand* ») est associée à des risques plus élevés de troubles névrotiques.

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