

Work stress, smoking status and smoking intensity: an observational study of 46 190 employees

(Running title: Work stress and smoking)

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Anne Kouvonen¹, Mika Kivimäki¹, Marianna Virtanen², Jaana Pentti³ and Jussi Vahtera³

¹Department of Psychology, University of Helsinki, Finland

²Finnish Institute of Occupational Health, Helsinki, Finland

³Finnish Institute of Occupational Health, Turku, Finland

Correspondence to: Dr Anne Kouvonen (email: anne.kouvonen@luukku.com)

Address until June 15, 2004:

Institute of Work, Health & Organisations (I-WHO)
The University of Nottingham
William Lee Building 8
Nottingham Science and Technology Park
University Boulevard
Nottingham NG7 2RQ, UK

Phone: +44 115 84 66461

Fax: -

Address from June 16, 2004:

Department of Psychology
POB 9
FI-00014 University of Helsinki, Finland

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Abstract

Study objective: To examine the relationship between work stress, as indicated by the job strain model and the effort-reward imbalance model, and smoking.

Setting: Ten municipalities and 21 hospitals in Finland.

Design and Participants: Binary logistic regression models for the prevalence of smoking were related to survey responses of 37 309 female and 8881 male Finnish public sector employees aged 17-65. Separate multinomial logistic regression models were calculated for smoking intensity for 8130 smokers. In addition, binary logistic regression models for ex-smoking were fitted among 16 277 former and current smokers. In all analyses, adjustments were made for age, basic education, occupational status, type of employment and marital status.

Main results: Respondents with high effort-reward imbalance or lower rewards were more likely to be smokers. Among smokers, an increased likelihood of higher intensity of smoking was associated with higher job strain and higher effort-reward imbalance and their components such as low job control and low rewards. Smoking intensity was also higher in active jobs in women, in passive jobs and among employees with low effort expenditure. Among former and current smokers, high job strain, high effort-reward imbalance and high job demands were associated with a higher likelihood of being a current smoker. Lower effort was associated with a higher likelihood of ex-smoking.

Conclusions: This evidence suggests an association between work stress and smoking and implies that smoking cessation programs may benefit from the taking into account the modification of stressful features of work environment.

Key words: effort-reward imbalance; job strain; smoking.

Abbreviations: OR, odds ratio; CI, confidence interval; SES, socioeconomic status

INTRODUCTION

Work stress has repeatedly predicted increased health problems, in particular cardiovascular morbidity and mortality¹⁻⁹ but this association may not exclusively reflect stress-induced patho-physiological changes.¹⁰ It has been hypothesized that work stress may also indirectly affect health by increasing the likelihood of health-risk behaviours such as smoking, a known risk factor¹¹⁻¹² of coronary heart disease, cancer, emphysema and osteoporosis among other things. However, evidence on the association between work stress and smoking has remained uncertain.

According to the job strain model,¹³⁻¹⁴ the dominant work stress theory, health risk arises from high job demands and low job control and their combination, referred to as job strain. Previous empirical research, which predominantly relates to male populations,^{e.g. 15-19} has produced mixed results on the association between job strain components and smoking. There are several studies reporting the prevalence or intensity of smoking to be associated with high job demands,²⁰⁻²⁴ with low job control^{15 17 19 21} or with job strain.^{16 23 25} However, many other studies have reported no association between smoking and job demands,^{15 18-19 26} job control,^{18 24 27} or job strain.^{15 18 26 28-29} Furthermore, in one study,²⁰ low job control was associated with a smaller quantity number of cigarettes smoked^{cf. 22} and high job strain with lower prevalence of smoking.

The effort-reward model,³⁰ a more recent work stress theory focuses on a negative trade-off between experienced 'costs' and 'gains' at work. In this model, a high workload is hypothesized to be an important extrinsic factor contributing to high effort expenditure. Low rewards, the other component of imbalance, refer to shortage in terms of money, esteem and occupational status control. High effort-reward imbalance has been associated with a greater

likelihood of smoking³¹ but the extent to which this association is independent of job strain is unknown.

To extend understanding of the relationship between work stress and smoking, we examined whether work stress is associated with smoking status and smoking intensity in a large cohort of Finnish female and male employees. We tested whether the two alternative work stress models (the job strain model and the effort-reward imbalance model) independently link with smoking.

A recent survey reports that nineteen percent of Finnish women and 26% of men smoke daily. Among men, smoking is most frequent in 25-34 year-olds (30%), whereas in women smoking is most frequent among 15-24 year-olds (21%) and declines with age. Three percent of Finnish women and men report that they have quitted smoking one to 12 months ago and 16% of women and 19% of men report that they have quitted smoking more than a year ago.³²

A reformed Tobacco Control Act (enforced in 1995) prohibited smoking in all joint and public premises of workplaces in Finland. The employer has two options to implement the act: impose a total ban of smoking or allow smoking in designated smoking rooms or areas with separate ventilation systems and lower air pressure than non-smoking spaces.³³ Of Finnish employees, 36% report that no one is smoking at their workplace, 54% report that smoking is allowed in a separate room at their workplace, 5% report that it is allowed also in private rooms and other 6% that it is allowed also elsewhere.³²

METHODS

Study population

Data were drawn from the combined sample of two on-going Finnish cohort studies, the 10-Town Study and the Hospital Personnel Study.³⁴⁻³⁵ These studies are planned and carried out together to explore the relationships between behavioural and psychosocial factors and health. The studies are focused on the entire staff in ten towns and 21 central and regional hospitals. The sample covers almost 20% of the full-time employees working in Finnish municipal sector. In 2000-2002, 48 592 full-time employees (32 293 from the towns and 16 299 from the hospitals; 39 255 women and 9337 men) aged 17-65 years responded to a questionnaire with a response rate of 67%. Since 5% ($n = 2402$) of the respondents did not provide information about their smoking status, the final cohort comprised 46 190 employees (37 309 women and 8881 men).

The most common occupations among the respondents in the total sample were registered nurse (23%, $n = 10 990$), teacher (19%, $n = 9315$), practical nurse (13%, $n = 6221$) and cleaner (10%, $n = 4659$). The mean age in the sample was 44.6 years (range 17-65, $SD=9.42$). Any differences with the eligible population were small. In the 10-Town Study, figures for participants vs. eligible population ($n = 47 351$) were as follows: mean age 44.9 vs. 44.5 years, proportion of women 77% vs. 72%, proportions of higher grade non-manual, lower grade non-manual and manual employees 34%, 46%, 20% vs. 35%, 42% and 22%, respectively. The corresponding figures for the Hospital Personnel Study ($n = 23 610$) were: mean age 43.1 vs. 43.1 years, proportion of women 87% vs. 84%, proportions of higher grade non-manual, lower grade non-manual and manual employees 16%, 77%, 8% vs. 13%, 81% and 7% respectively.

The Ethics Committee of the Finnish Institute of Occupational Health has approved the study.

Work stress

The measures of the job strain model were derived from the Job Content Questionnaire.³⁶⁻³⁷ The job demands scale deals with workload and work pace (two items; Cronbach's alpha = 0.71; range 1-5; 3-year test-retest reliability $r = 0.55$) and the job control scale concerns decision authority and skill discretion (nine items; Cronbach's alpha = 0.82; range 1-5; 3-year test-retest reliability $r = 0.70$). Job demands and job control responses were summed to define the two work dimensions and the distribution of sum scores were further divided into tertiles to indicate low, intermediate and high levels on each scale. To create the job strain indicator, we dichotomized the job demand and job control scales at their median points and formed the following four categories: low job strain (low demands combined with high control), active jobs (high demands combined with high control), passive jobs (low demands combined with low control) and high strain (high demands combined with low control).¹³⁻¹⁴

Effort in work was measured with the question "How much do you feel you invest in your job in terms of skill and energy?" (1='very little', 5='very much'). Rewards were measured by the following three items (Cronbach's alpha = 0.64): "How much do you feel you get in return from your work in terms of income, job benefits, etc.?", "How much do you feel you get in return from your work in terms of recognition and prestige?" and "How much do you feel you get in return from your work in terms of personal satisfaction?" (1='very little', 5='very much').³⁸ We created the indicator of effort-reward imbalance by calculating the ratio between the response score in the effort scale and the sum response score in the rewards scale. The resulting quotient was divided into thirds to indicate low, intermediate and high effort-reward imbalance.² Because part of the hospital sample did not contain the effort-

reward imbalance measure, the analyses including effort-reward variable involved 38 602 participants.

In regard to the scales calculated for total job demands, total job control and total rewards, if half or more of the component items were missing, a value of missing was recorded in the total.

Job strain and effort-reward imbalance measures were intercorrelated ($r = .265$, $p < 0.001$, two-tailed test).

Smoking

Smoking was measured in standard ways using the following questions: "Do you smoke or have you previously smoked regularly, that is, daily or nearly daily?", "If you have smoked, do you still smoke regularly?" and "How many cigarettes you smoke (or smoked) a day on average?" From this information, we derived smoking status (non-smoker vs. smoker) and, for smokers, smoking intensity (the number of cigarettes smoked per day). The intensity categories were: 1 = light smoker (1-9 cigarettes), 2 = medium smoker (10-19 cigarettes) and 3 = heavy smoker (20 or more cigarettes).²⁶

Other variables

The following background factors were measured: sex, age, basic education (common school, comprehensive or middle school, high school), occupational status (higher grade non-manual, lower grade non-manual, manual; based on the Statistics Finland classification of the 5-digit occupational titles), type of employment (permanent vs. temporary), marital status

(married/living with a partner vs. other). Sex, age, occupational status and type of employment were obtained from the employers' registers.

Statistical analyses

Binary logistic regression models were employed to calculate adjusted odds ratios (ORs) and their 95 percent confidence intervals (CIs) for smoking status and for ex-smoking according to work stress indicators. The relationship between work stress indicators and smoking intensity was studied using multinomial logistic regression models.³⁹ The hypothetically least stressful work condition was selected as the reference category in each indicator of work stress in all analyses.

All analyses were adjusted for potential confounders: age, basic education, occupational status, type of employment and marital status. To evaluate independent effects, job strain and effort-reward imbalance were additionally controlled for each other. Furthermore, we tested whether associations between work stress indicators and smoking were independent of sex and occupational status (SES) by applying cross-product terms sex X work stress measures and SES X work stress measures in the models analysing the relationship of work stress with smoking status and ex-smoking.

The analyses were conducted separately for women and men and were performed by using the SPSS 11.5 (SPSS, Inc., Chicago, Illinois) and SAS 8.2 (SAS Institute, Inc., Cary, North Carolina) software packages.

Due to missing values, the number of subjects varies between tables and between the examined variables.

RESULTS

Characteristics of the study sample are presented in table 1. Seventeen percent of women and 24% of men reported that they currently smoke daily or nearly daily. Fifteen percent of women and 22% of men were ex-smokers. Of smokers, 42% smoked 1-9 cigarettes a day, 44% 10-19 cigarettes a day and 14% 20 or more cigarettes a day. Men smoked more intensively: 30% of male smokers and compared with 8% of female smokers smoked 20 or more cigarettes a day ($p < 0.001$).

Table 1 Characteristics of the study sample (%)

	No. of participants (%)	Smoking status and intensity (cigarettes per day)			
		Non-smokers (n=37 961)	Light smokers (1-9 cigarettes) (n=3395)	Medium smokers (10-19 cigarettes) (n=3615)	Heavy smokers (20- cigarettes) (n=1120)
All	46 190	82.4	7.4	7.8	2.4
Sex					
Women	37 309 (81)	83.7	7.7	7.2	1.4
Men	8 881 (19)	76.8	5.9	10.3	6.9
Age-group (years)					
17-29	3542 (8)	79.1	10.9	8.8	1.2
30-39	10 179 (22)	80.8	8.7	8.5	2.0
40-49	15 891(34)	80.3	8.1	8.8	2.8
50-59	15312 (33)	85.6	5.3	6.5	2.6
60-65	1240 (3)	90.8	3.7	3.7	1.8
Basic education					
Common school	10 034 (22)	79.1	6.6	10.3	4.0
Comprehensive/middle school	13 153 (29)	76.1	9.3	11.4	3.2
High school	22 181 (49)	87.5	6.5	4.6	1.3
Marital status					
Married/living with a partner	34 735 (76)	84.4	6.9	6.8	1.9
Other	11 008 (24)	76.1	8.9	11.0	4.0
Occupational status					
Manual	6863 (15)	72.8	7.7	13.2	6.3
Lower grade non-manual	25 709 (58)	82.4	8.0	7.9	1.7
Higher grade non-manual	12 259 (27)	88.1	5.9	4.5	1.5
Type of employment					
Permanent	36 710 (82)	82.6	6.9	7.9	2.6
Temporary	8251 (18)	81.3	9.5	7.8	1.5

Note: $p < 0.001$ in cases (χ^2 test).

Work stress and smoking status

Table 2 shows the results from binary logistic regression analyses on the associations between the two work stress models and smoking. Effort-reward imbalance was associated with prevalent smoking. Odds of being a smoker were 1.28-fold higher among women and 1.13-fold higher among men with high effort-reward imbalance compared with female and male employees with low effort-reward imbalance, respectively. Of the components of the effort-reward imbalance model, low rewards were associated with an increased likelihood of being a smoker. Moreover, lower effort was associated with a decreased likelihood of smoking in women. Neither job strain nor any of its components was significantly associated with smoking status.

Simultaneous adjustment for job strain and effort-reward imbalance did not attenuate the odds ratios of smoking among employees with high effort-reward imbalance: ORs were 1.29 (95% CI = 1.19 to 1.40) for women and 1.13 (95% CI = 0.98 to 1.30) for men. Besides, active jobs were associated with a decreased likelihood of smoking in men (OR = 0.85, 95% CI = 0.73 to 1.00) (data not shown).

The interaction between sex and effort was statistically significant ($p = 0.019$), whereas other interactions between sex and job strain and effort-reward imbalance measures were not (see table 2). In addition, the interactions between occupational status and job control, job strain, effort and effort-reward imbalance were significant (all p -values < 0.01). Further analysis showed that between occupational status groups, the main differences were between higher grade non-manual employees and others. High effort-reward imbalance and lower rewards were associated with an increased likelihood of smoking only among lower grade non-manual and manual employees. Low control and low effort were related to a higher likelihood of smoking among higher grade non-manual employees. In contrast, low

job control among lower grade non-manual employees, and low effort among manual and lower grade non-manual employees were associated with a decreased likelihood of smoking.

Table 2 The relationship of smoking status with job strain and effort-reward imbalance: adjusted odds ratios (ORs) and their 95 percent confidence intervals (CIs).

	Women			Men			<i>p</i> for sex interaction
	<i>n</i>	OR*	(95% CI)	<i>n</i>	OR*	(95% CI)	
Job control (component of job strain)							0.776
High job control	11 033	1.00		2739	1.00		
Intermediate job control	12 428	0.94	(0.87 to 1.01)	2925	0.98	(0.86 to 1.11)	
Low job control	11 454	0.96	(0.89 to 1.04)	2490	1.01	(0.88 to 1.17)	
Job demands (component of job strain)							0.616
Low job demands	8547	1.00		2403	1.00		
Intermediate job demands	13 825	0.92	(0.85 to 0.99)	3431	0.97	(0.86 to 1.10)	
High job demands	12 452	1.01	(0.94 to 1.09)	2310	0.99	(0.87 to 1.14)	
Job strain							0.083
Low strain	8316	1.00		2173	1.00		
Active jobs	10 284	1.00	(0.92 to 1.09)	2398	0.87	(0.76 to 1.01)	
Passive jobs	7387	1.02	(0.93 to 1.11)	2021	0.88	(0.75 to 1.02)	
High strain	8792	1.04	(0.96 to 1.13)	1548	1.00	(0.86 to 1.17)	
Effort (component of effort-reward imbalance)							0.019
High effort	12 908	1.00		2169	1.00		
Intermediate effort	18 037	0.88	(0.83 to 0.94)	4363	1.09	(0.96 to 1.24)	
Low effort	3860	0.83	(0.75 to 0.92)	1605	0.95	(0.81 to 1.11)	
Rewards (component of effort-reward imbalance)							0.292
High rewards	10 236	1.00		2405	1.00		
Intermediate rewards	10 379	1.03	(0.96 to 1.11)	2355	1.05	(0.91 to 1.21)	
Low rewards	8534	1.20	(1.11 to 1.30)	2501	1.15	(1.00 to 1.33)	
Effort-reward imbalance							0.129
Low imbalance	9044	1.00		2652	1.00		
Intermediate imbalance	11 156	1.13	(1.05 to 1.22)	2441	1.01	(0.88 to 1.15)	
High imbalance	8831	1.28	(1.19 to 1.39)	2152	1.13	(0.98 to 1.29)	

*Adjusted for age, basic education, occupational status, type of employment and marital status.

Work stress and smoking intensity

Adjusted ORs (95 CI%) from multinomial logistic regression models are presented in table 3. There was a relationship between the two work stress models and intensity of smoking. In women, passive jobs, high job strain and active jobs were significantly associated with an increased likelihood of smoking 20 or more cigarettes per day and high effort-reward imbalance with an increased likelihood of smoking 10-19 cigarettes per day. Of the components of the work stress models, low job control, low effort and low rewards were associated with a higher likelihood of more intensive smoking among women. In men, low rewards were significantly associated with an increased likelihood of smoking 20 or more cigarettes per day. In addition, low control, passive jobs, high job strain, low effort and high effort-reward imbalance showed similar associations with smoking intensity than those in women but probably due to a smaller sample size they did not reach statistical significance.

When job strain and effort-reward imbalance were concurrently adjusted for, the significant association between high effort-reward imbalance and smoking 10-19 cigarettes per day persisted (OR = 1.19, 95% CI = 1.01 to 1.39) among women. Moreover, the associations between high job strain and an increased likelihood of smoking 20 or more cigarettes per day (OR = 1.42, 95% CI = 1.02 to 1.96) and between passive jobs and an increased likelihood of smoking 20 or more cigarettes per day (OR = 1.52, 95% CI = 1.10 to 2.10) remained significant (data not shown).

None of the interaction terms between sex and work stress variables were significant (see table 3).

Table 3 The relationship of smoking intensity with job strain and effort-reward imbalance among smokers: adjusted odds ratios (ORs) and their 95% confidence intervals (CIs).

	Women				Men				<i>p</i> for sex interaction
	10-19 cigarettes		20+ cigarettes		10-19 cigarettes		20+ cigarettes		
	OR*	(95% CI)	OR*	(95% CI)	OR*	(95% CI)	OR*	(95% CI)	
Job control (component of job strain)									0.356
High job control	1.00		1.00		1.00		1.00		
Intermediate job control	1.05	(0.91 to 1.21)	1.13	(0.87 to 1.48)	1.20	(0.91 to 1.59)	1.22	(0.88 to 1.70)	
Low job control	1.19	(1.03 to 1.38)	1.49	(1.15 to 1.94)	1.28	(0.93 to 1.75)	1.42	(0.99 to 2.03)	
Job demands (component of job strain)									0.841
Low job demands	1.00		1.00		1.00		1.00		
Intermediate job demands	0.99	(0.99 to 1.14)	1.14	(0.89 to 1.48)	0.92	(0.70 to 1.21)	1.04	(0.76 to 1.42)	
High job demands	0.97	(0.86 to 1.11)	1.07	(0.83 to 1.39)	0.90	(0.67 to 1.22)	0.92	(0.65 to 1.30)	
Job strain									0.114
Low strain	1.00		1.00		1.00		1.00		
Active jobs	1.01	(0.86 to 1.19)	1.37	(1.01 to 1.87)	1.06	(0.78 to 1.45)	0.91	(0.63 to 1.32)	
Passive jobs	1.15	(0.97 to 1.35)	1.61	(1.18 to 2.20)	1.23	(0.88 to 1.72)	1.38	(0.95 to 2.01)	
High strain	1.16	(0.99 to 1.36)	1.55	(1.14 to 2.10)	1.11	(0.78 to 1.58)	1.19	(0.80 to 1.77)	
Effort (component of effort-reward imbalance)									0.633
High effort	1.00		1.00		1.00		1.00		
Intermediate effort	1.01	(0.90 to 1.14)	1.03	(0.83 to 1.28)	0.88	(0.67 to 1.17)	0.96	(0.69 to 1.33)	
Low effort	1.31	(1.08 to 1.59)	1.66	(1.21 to 2.27)	0.88	(0.61 to 1.27)	1.12	(0.74 to 1.68)	
Rewards (component of effort-reward imbalance)									0.711
High rewards	1.00		1.00		1.00		1.00		
Intermediate rewards	1.24	(1.07 to 1.44)	1.20	(0.92 to 1.57)	1.09	(0.80 to 1.49)	1.11	(0.77 to 1.59)	
Low rewards	1.26	(1.08 to 1.46)	1.58	(1.22 to 2.04)	1.26	(0.92 to 1.73)	1.61	(1.13 to 2.30)	
Effort-reward imbalance									0.521
Low imbalance	1.00		1.00		1.00		1.00		
Intermediate imbalance	1.15	(1.00 to 1.34)	1.03	(0.79 to 1.34)	1.01	(0.75 to 1.35)	0.75	(0.53 to 1.05)	
High imbalance	1.19	(1.03 to 1.39)	1.28	(0.98 to 1.66)	1.20	(0.88 to 1.63)	1.23	(0.88 to 1.73)	

Note: Light smokers (1-9 cigarettes per day) formed the reference category within the smoking intensity indicator.

*Adjusted for age, basic education, occupational status, type of employment and marital status.

Work stress and ex-smoking

Table 4 depicts the results from binary logistic regression analyses on the associations between the two work stress models and ex-smoking among former and current smokers. Among women, high job demands, high job strain and high effort-reward imbalance were significantly associated with an increased likelihood of being a current smoker whereas lower effort was associated with an increased likelihood of being an ex-smoker. In men, these work stress measures showed similar associations with ex-smoking intensity than those in women but again probably due to a smaller sample size they did not reach statistical significance.

After simultaneous adjustment for job strain and effort-reward imbalance, the relationship between high job strain and a lower likelihood of ex-smoking among women remained significant (OR = 0.87, 95% CI = 0.77 to 0.99) (data not shown).

The interactions between sex and work stress measures were not statistically significant (see table 4), but the interactions between occupational status and job control, job strain and effort were significant (all *p*-values < 0.01). Between occupational status groups, again, the main differences were between higher grade non-manual employees and others. Low control was associated with an increased likelihood of current smoking among higher grade non-manual employees. Low effort was associated with a higher and high effort-reward imbalance with a lower likelihood of ex-smoking among lower grade non-manual and manual employees. High job demands and high job strain were additionally related to an increased likelihood of current smoking among manual workers (data not shown).

Table 4 The relationship of ex-smoking with job strain and effort-reward imbalance among former and current smokers: adjusted odds ratios (ORs) and their 95 percent confidence intervals (CIs).

	Women			Men			<i>p</i> for sex interaction
	<i>n</i>	OR*	(95% CI)	<i>n</i>	OR*	(95% CI)	
Job control (component of job strain)							0.594
High job control	3429	1.00		1199	1.00		
Intermediate job control	3975	1.01	(0.92 to 1.11)	1310	0.90	(0.77 to 1.07)	
Low job control	4004	0.98	(0.89 to 1.08)	1245	0.87	(0.73 to 1.04)	
Job demands (component of job strain)							0.760
Low job demands	2978	1.00		1186	1.00		
Intermediate job demands	4387	0.99	(0.90 to 1.09)	1582	0.97	(0.83 to 1.13)	
High job demands	4010	0.90	(0.82 to 0.99)	983	0.85	(0.71 to 1.01)	
Job strain							0.206
Low strain	2635	1.00		1024	1.00		
Active jobs	3127	0.96	(0.86 to 1.07)	976	0.98	(0.82 to 1.18)	
Passive jobs	2607	0.95	(0.85 to 1.06)	1012	1.07	(0.88 to 1.28)	
High strain	2994	0.88	(0.79 to 0.99)	737	0.83	(0.68 to 1.01)	
Effort (component of effort-reward imbalance)							0.315
High effort	4132	1.00		915	1.00		
Intermediate effort	5918	1.18	(1.08 to 1.28)	2069	1.03	(0.88 to 1.21)	
Low effort	1326	1.27	(1.12 to 1.44)	772	1.15	(0.93 to 1.41)	
Rewards (component of effort-reward imbalance)							0.729
High rewards	3102	1.00		1038	1.00		
Intermediate rewards	3388	1.03	(0.93 to 1.14)	1078	0.95	(0.79 to 1.13)	
Low rewards	3117	0.93	(0.84 to 1.04)	1265	0.88	(0.74 to 1.06)	
Effort-reward imbalance							0.590
Low imbalance	2791	1.00		1200	1.00		
Intermediate imbalance	3587	0.92	(0.83 to 1.02)	1096	0.96	(0.81 to 1.14)	
High imbalance	3194	0.88	(0.79 to 0.98)	1080	0.93	(0.78 to 1.10)	

*Adjusted for age, basic education, occupational status, type of employment and marital status.

DISCUSSION

Our findings on 46 190 employees showed that work stress defined as job strain and effort-reward imbalance was associated with smoking. After the effects of age, basic education, occupational status, type of employment and marital status were accounted for, employees with high stress were found more often to be smokers than their colleagues with low stress. Among smokers higher work stress was associated with greater smoking intensity. Furthermore, in current and ex-smokers, higher stress was associated with a higher likelihood of being a current smoker. The independent associations between both work stress models and smoking indicate that both stress models provide supplementary information on important stressors in the psychosocial work environment.

The magnitude of the relationships between work stress variables and smoking status were not great. This may be due to the fact that smoking is usually initiated before entering into full-time labour force and maintained by other cultural and social factors.¹⁵ Nevertheless, smoking intensity can vary during adulthood and smoking can be quit at any point of life. Based on our findings, it seems likely that workplace stress influences in particular the number of cigarettes smoked and the maintenance of the smoking habit rather than the smoking status per se.²⁴ In accordance with this hypothesis, there is more evidence for an association between job strain and smoking intensity than for job strain and smoking status.²⁸

In general, our findings are consistent with studies suggesting an association of job strain²⁵ and effort-reward imbalance³¹ with smoking, although these previous studies are on male populations. However, other studies have reported no association between job strain and smoking.^{15 18 26 28-29} Potential reasons for these inconsistencies include relatively small sample sizes in many earlier studies possibly decreasing the likelihood of detecting

significant associations; that some of the previous studies did not include smoking intensity; and that many of the studies were limited to male populations only.

As stressful job characteristics are potentially modifiable, it is important to consider practical implications for promoting health among employees. Our findings suggest that reducing stress by increasing job control, decreasing job strain,^{see 15 25-26} as well as by finding a better balance between personal efforts and rewards gained from work might help the smoking cessation efforts. Studies of smoking interventions combined with stress management interventions would be a step forward in testing this hypothesis. These studies should also take into account that the aspects of work stress related to smoking seem to vary between occupational status groups.

We recognize the need for caution in interpreting the present findings owing to some limitations. First, the reliance on cross-sectional self-reported data in this study may have inflated our results through common-method bias. Second, self-report data on substance use are often subject to underreporting and self-reporting may be additionally influenced by recall bias. These may lead to underestimation rather than overestimation of the actual associations. In the future, longitudinal studies using both self-reported and objective indicators of work stress would provide an interesting comparison to the present findings.

Third, the fact that non-respondents were more often men, i.e., those with a higher prevalence and intensity of smoking, may have reduced the likelihood of finding significant associations between work stress indicators and smoking in men.

Fourth, applications of smoking restrictions may have slightly varied between different workplaces. While some employers may have imposed a total ban of smoking others may have allowed smoking in designated smoking rooms or areas. There is evidence showing an association between workplace smoking restriction policy and employees'

smoking behaviour.⁴⁰ Variation in workplace smoking policies may thus have had an effect on the observed relationships between work stress measures and smoking.

Finally, although several possible confounding factors were controlled in the analyses, there are other important factors which we were not able to take into account in this study. For example, many work-related factors such as smoking behaviour among colleagues can also have an effect on the relationship between work stress and smoking.

Conclusions

The present data extend knowledge on the potential indirect pathways through which work stress may affect health. Our findings lend some support to the notion that work stress defined as job strain and effort-reward imbalance, is related to cigarette smoking, the largest preventable risk factor for morbidity and mortality in developed countries.¹² Moreover, by concurrently controlling for both work stress models, this study found independent relationships between the both leading work stress models and smoking.

Key points:

- Employees with high stress were more likely to be smokers than their colleagues with low stress; independent of age, basic education, occupational status, type of employment and marital status.
- Higher work stress was associated with greater smoking intensity among smokers.
- Among ex- and current smokers, higher work stress was associated with an increased likelihood of being a current smoker.
- Both stress models provide supplementary information on important stressors in the psychosocial work environment.

Policy implications:

- Reducing work stress by increasing job control, decreasing job strain and by finding a better balance between personal efforts and rewards gained from work might help the smoking cessation efforts.

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