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Abstract

The purpose of the present study was to assess the association between job strain and smoking cessation among Japanese male employees. In 1997, a baseline questionnaire was given to 2,625 (2,113 males and 512 females) employees of an electronics firm in Gifu Prefecture, Japan. The self-administered questionnaire was a set of questions on smoking habits and consisted of items on socio-demographic variables and smoking habits, including the Japanese version of the Job Content Questionnaire (JCQ). The JCQ consists of scales of job control, job demand, supervisory support, coworker support, job insecurity, physical demands, and isometric load. A total of 733 male smokers were then followed for 2 years, with 446 completing a follow-up questionnaire in 1999 (follow-up rate, 61%). Logistic regression analyses were performed to examine associations between job strain and smoking cessation. Among the 446 participants, 38 had quit smoking. After adjusting for age ((odds ratio: OR) = 0.38, 95% (confidence interval: CI) = 0.15-0.94), men with a high level of physical demands at baseline showed a lower smoking cessation rate at follow-up than did those with a low level. However, when adjustments were made for age and other socio-demographic variables, the odds ratio of smoking cessation showed marginal significance (OR = 0.45, 95% CI = 0.16-1.29). There was no significant association between other job strain variables and smoking cessation at the 2-year follow-up. No significant association was found between job strain and change in the number of smoked cigarettes per day. The present study did not support the hypothesis that higher levels of job stressors are associated with a lower rate of smoking cessation among men.

KEYWORDS: job strain, smoking, worksite support, physical demands, prospective cohort study

Original Article

Job Strain and Smoking Cessation among Japanese Male Employees: A Two-year Follow-up Study

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The purpose of the present study was to assess the association between job strain and smoking cessation among Japanese male employees. In 1997, a baseline questionnaire was given to 2,625 (2,113 males and 512 females) employees of an electronics firm in Gifu Prefecture, Japan. The self-administered questionnaire was a set of questions on smoking habits and consisted of items on socio-demographic variables and smoking habits, including the Japanese version of the Job Content Questionnaire (JCQ). The JCQ consists of scales of job control, job demand, supervisory support, coworker support, job insecurity, physical demands, and isometric load. A total of 733 male smokers were then followed for 2 years, with 446 completing a follow-up questionnaire in 1999 (follow-up rate, 61%). Logistic regression analyses were performed to examine associations between job strain and smoking cessation. Among the 446 participants, 38 had quit smoking. After adjusting for age ((odds ratio: OR) = 0.38, 95% (confidence interval: CI) = 0.15-0.94), men with a high level of physical demands at baseline showed a lower smoking cessation rate at follow-up than did those with a low level. However, when adjustments were made for age and other socio-demographic variables, the odds ratio of smoking cessation showed marginal significance (OR = 0.45, 95% CI = 0.16-1.29). There was no significant association between other job strain variables and smoking cessation at the 2-year follow-up. No significant association was found between job strain and change in the number of smoked cigarettes per day. The present study did not support the hypothesis that higher levels of job stressors are associated with a lower rate of smoking cessation among men.

Key words: job strain, smoking, worksite support, physical demands, prospective cohort study

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The work environment is one of the predictors of smoking habits among employed persons [1, 2]. Previous findings show that lower socioeconomic classes have larger proportions of smokers [3-5] and that blue-collar workers have larger proportions of

heavy smokers [6, 7] than their wealthier or white-collar counterparts. Furthermore, smoking has adverse effects on health and is a predictor of early retirement [8] and sickness absence [9]. In many developed countries, workplaces have started to prohibit smoking or at least introduce smoking ordinances in association with smoking cessation programs. As a result of these efforts, smoking prevalence rates have been reduced in many developed countries [10]. However, smoking is still an important issue for the working population. Many other factors, such as psychological stress, might also contribute to changes in smoking status and smoking habits. For example, financial events have been found to be associated with continued smoking, whereas health events have been found to be associated with increased likelihood of quitting [11]. Persons who had failed to quit were more likely to have experienced a negative financial event and less likely to have experienced an adverse health event [11]. These findings suggest that psychological stress plays an important role in the dynamics of cigarette smoking, such as difficulty in quitting smoking [12]. Based on this body of research, stressors and mental stress reactions are generally male employees considered to make the cessation of smoking difficult.

The influence of job stress on smoking habits has been addressed in several studies. As for the assessment of work stress, the job strain model [13, 14] is the dominant work stress theory. According to this model, health risks arise from high job demands and low job control, and their combination is referred to as job strain. Previous empirical research, which has predominantly covered male populations [15–19], has produced mixed results on the association between job strain components and smoking. Several studies have shown prevalence or intensity of smoking to be associated with high job demands [20–24], low job control [15, 17, 19, 21], or job strain [16, 23, 25]. Gender differences in the associations between work stress and smoking have also been noted; according to Kouvonen [26], the intensity of smoking was positively associated with low control for both men and women, and an increased number of cigarettes smoked per day was found for women with high strain. However, many other studies have shown no association of smoking with job demands [15, 18, 19, 27], job control [18, 24, 28], or job strain [15, 18, 27,

29, 30]. Furthermore, in one study [20] low job control was associated with a smaller quantity of cigarettes smoked [22] and high job strain was associated with a lower prevalence of smoking.

Although there have been numerous studies on the association between job strain and intensity of smoking, there have been far fewer studies on the association between job strain and smoking cessation [31]. Among the studies that have been performed on this subject, several show that women with high strain [26, 32, 33] are less likely to stop smoking. On the other hand, no such association was observed for men in a cross-sectional study [26] and in a cohort study [15]. In a recent cohort study [34], high demands were unexpectedly associated with an increased likelihood of smoking cessation in a 5-year follow-up. Thus, the associations between job strain and smoking cessation among men are still uncertain.

According to a recent systematic review [31], only 2 of 11 studies showed a positive association between worksite social support and smoking cessation; 8 showed a null association and 1 study showed a negative association. Two of 5 previous studies showed that worksite social support was associated with an increased amount of smoking, while the other 3 studies showed a null association [31]. Worksite social support may have fewer clear effects on smoking cessation. However, since all of these studies were conducted in Western countries, the effects of worksite social support on smoking cessation should be re-examined among workers in non-Western countries, such as Japan, a country that is more collectivity-oriented [35].

The present study was a prospective male cohort study aimed at determining the associations of job stress, including job strain and worksite social support, with smoking cessation and change in the number of cigarettes consumed. We hypothesized that males with high job strain would have less of a tendency to stop smoking or reduce the number of cigarettes smoked per day during a 2-year follow-up period.

Subjects and Methods

Subjects. In 1997, a baseline questionnaire was given to 2,625 (2,113 males and 512 females) employees of an electronics firm in Gifu Prefecture, Japan, who ranged in age from 18 to 60 years. A

total of 2,369 (90.2%) employees (1,902 males and 467 females) returned the baseline questionnaire. Of these, 2,098 (1,734 males and 364 females) completed all of the relevant questions in the baseline questionnaire. A total of 772 employees (733 males and 39 females) were current smokers. We limited further analyses only to men because of the low number of female current smokers at baseline. In 1999, a follow-up survey was conducted on these male smokers. A total of 446 males completed the follow-up questionnaire (follow-up rate, 61.0%). Among them, 408 were still current smokers (91.5%) and 38 were not (8.5%). The characteristics of the male subjects are shown in Table 1.

Measures. Self-administered questionnaires were used for the data collection in 1997 and 1999. The baseline questionnaire was used to obtain information on socio-demographic variables, occupation, health-related behaviors and sick leave, and it included a Japanese version of the Job Content

Questionnaire (JCQ).

The JCQ is designed to measure work environment characteristics based on the demand-control-support model [36]. The Japanese version of the JCQ has been validated and tested for reliability [37]. The questionnaire consists of scales of job control (9 items), job demand (5 items), supervisory support (4 items), coworker support (4 items), job insecurity (3 items), physical demands (3 items), and isometric load (2 items). Likert-scale response options from 1 (completely disagree) to 4 (completely agree) are used. Each of these job-stressor scale scores is calculated by summing the scores according to the JCQ guidelines <<http://www.jcqcenter.org/>>. As an indicator of job strain in this study, the ratio of job demand to job control was also calculated. Cronbach's alpha coefficients among the study subjects were 0.84 for job control, 0.64 for job demand, 0.87 for supervisor support, 0.73 for coworker support, 0.36 for job insecurity, 0.81 for physical demands, and 0.88 for isometric load. Subjects were then classified into separate tertiles for each of the 7 job stressor scores (job control, job demand, supervisory support, coworker support, job insecurity, physical demands, and isometric load) as well as for the job strain score.

At baseline, the subjects were asked to answer a set of questions on their smoking habits: (1) Have you ever smoked at least 1 cigarette per day over a period of 1 month or longer? (2) How many cigarettes did you smoke when you smoked? (3) In total, how long did you smoke cigarettes in your lifetime? (4) Do you smoke? Those who responded affirmatively to both questions 1 and 4 were defined as current smokers at baseline.

At follow-up, the subjects were asked 1 question on their smoking habits: How many cigarettes do you smoke per day? The subjects were classified as non-smokers if they smoked no cigarettes per day and were classified as current smokers if they smoked 1 or more cigarettes per day.

Among subjects who were current smokers at baseline, those who were non-smokers at follow-up were classified as those who stopped smoking (*i.e.*, quitters) and those who were current smokers at follow-up were classified as those who did not stop smoking (*i.e.*, non-quitters).

We also calculated the change in number of cigarettes smoked per day by subtracting the value obtained at baseline from that obtained at follow-up

Table 1 Baseline characteristics of male smokers (n = 446) employed in a manufacturing factory

Variable	n	(%)	Average	(SD)
Age (years)				
18-34	307	69		
35-44	65	14		
45-60	74	17		
Education (years)				
12 years or less	294	65.8		
More than 12 years	152	34.2		
Occupation				
Manager	44	10		
White-collar	178	40		
Blue-collar	224	50		
Shift work				
Day work	263	59		
Rotating shift	183	41		
Smoking at 2-year follow-up				
Ex-smokers	38	8		
Smokers	408	92		
Job stressors				
Job control			66.4	11.8
Job demands			33.3	5.0
Supervisor support			10.7	2.2
Coworker support			11.2	1.6
Job insecurity			6.4	1.4
Physical demands			5.9	2.0
Isometric load			3.6	1.3

among non-quitters in order to examine the effects of job stressors on smoking.

Other covariates consisted of sex, age, education, occupation, and shift work. Age was classified into 3 groups: 18–34 years old, 35–44 years old, and 45 years of age or older. Education was classified into 2 groups: low (6–12 years) and high (13 years or more). Occupation was classified into 3 groups: manager, white collar, and blue collar. Shift work was classified into 2 groups: day work and rotating shift.

Statistical analysis. In order to examine the association between baseline levels of job stressors and smoking cessation, the proportion of quitters at follow-up was compared among the 3 groups classified on the basis of scores for each job stressor (low, med, and high) in the sample of current smokers at baseline (chi-square test). The odds ratio of becoming a quitter was estimated according to the baseline levels of each of the job stressors after adjusting for age and all demographic variables by using multiple logistic regressions. The linear trend was also tested. In order to examine differential changes in the number of cigarettes smoked per day among the tertile groups for each job stressors among the groups classified on the basis of a job stressor, the average numbers (standard deviations, SDs) were calculated at baseline and at follow-up only among those who smoked at baseline and at follow-up. Differences in changes among the groups were examined by testing a time \times group interaction using analysis of variance (ANOVA) after adjusting for age and all demographic variables.

These analyses were conducted using the statistical package SPSS 11.0 J.

Results

Table 1 shows the baseline characteristics of the male smokers. Their average age (standard deviation, SD) was 33.3 (8.3) years. Among them, 10% were managers, 40% white-collar workers and 50% blue-collar workers. At follow-up, 38 (8.5%) of the smokers at baseline had quit smoking.

When adjusted for age, those who had a high level of physical demands at baseline had a significantly lower chance of being a quitter at follow-up than those who had a low level of physical demands ($p < 0.05$) (Table 2). While the age- and demographic-adjusted odds ratio of being a quitter was still lower (0.45) in

the former group, the difference in the adjusted odds ratio was not significant ($p > 0.05$). Those who had high levels of job strain at baseline had a marginally significantly lower chance of being quitters at follow-up than did those who had low levels of job strain ($p = 0.054$), although this difference was no longer significant after the odds ratio was adjusted for age and demographic variables ($p > 0.05$). No significant difference in the chance of being a quitter at follow-up was observed among the groups classified on the basis of any other job stressor, either after adjusting for age or after adjusting for age and demographic variables ($p > 0.05$).

While groups with a higher level of demands or lower level of job insecurity tended to smoke more at follow-up, no clear difference in the change in number of cigarettes smoked per day was observed during follow-up (Table 3). Furthermore, no significant time \times group interaction was observed for any job stressor in terms of the change in number of cigarettes smoked per day during the follow-up.

Discussion

The present prospective study revealed that there was no significant association between any of the examined job stressors and smoking cessation in a 2-year follow-up of Japanese men. In addition, no significant association was found between any job stressor and the 2-year change in number of cigarettes smoked per day among men who continued to smoke at the time of follow-up.

The present findings are consistent with the results of previous studies that showed no association between job strain (job demands or job control) or worksite support and smoking cessation among men [15, 26, 34]. One previous cohort study of a sample of male smokers [34] unexpectedly showed that high job demands were associated with an increased likelihood of smoking cessation. However, that study also showed an interesting age difference: the positive association was observed for workers under 40 years of age, while job demands were negatively associated with smoking cessation among older workers (over 50 years of age) [34]. The present study showed that job strain and job demands were associated with a non-significant but slightly lower probability of quitting smoking in a relatively younger sample of male work-

Table 2 Association between job stressors at baseline and the probability of being an ex-smokers at the 2-year follow-up (in 446 male smokers)

	N	Ex-smokers at follow-up		Odds ratio for being ex-smokers at follow-up*			
		n	(%)	Age-adjusted		Age and demographic-adjusted**	
				Odds ratio	(95% CI)	Odds ratio	(95% CI)
Job control							
Low	155	11	7.1	1.00		1.00	
Medium	149	11	7.4	1.04	(0.43–2.48)	0.81	(0.31–2.13)
High	142	16	11.3	1.59	(0.67–3.73)	0.72	(0.30–1.72)
		$p = 0.363$ (df = 2)		p for trend = 0.258		p for trend = 0.666	
Job demands							
Low	153	14	9.2	1.00		1.00	
Medium	126	10	7.9	0.86	(0.37–2.02)	0.89	(0.37–2.12)
High	167	14	8.4	0.90	(0.42–1.97)	0.83	(0.38–1.85)
		$p = 0.934$ (df = 2)		p for trend = 0.827		p for trend = 0.663	
Supervisor support							
Low	169	11	6.5	1.00		1.00	
Medium	65	7	10.8	1.71	(0.63–4.64)	1.65	(0.59–4.59)
High	212	20	9.4	1.48	(0.69–3.19)	1.39	(0.63–3.05)
		$p = 0.466$ (df = 2)		p for trend = 0.323		p for trend = 0.491	
Coworker support							
Low	110	9	8.2	1.00		1.00	
Medium	118	8	6.8	0.81	(0.30–2.18)	0.66	(0.24–1.83)
High	218	21	9.6	1.18	(0.52–2.68)	1.14	(0.49–2.63)
		$p = 0.663$ (df = 2)		p for trend = 0.605		p for trend = 0.719	
Job insecurity							
Low	133	10	7.5	1.00		1.00	
Medium	143	12	8.4	1.09	(0.45–2.63)	1.06	(0.43–2.60)
High	170	16	9.4	1.26	(0.55–2.88)	1.26	(0.54–2.92)
		$p = 0.840$ (df = 2)		p for trend = 0.575		p for trend = 0.524	
Physical demands							
Low	140	17	12.1	1.00		1.00	
Medium	143	13	9.1	0.73	(0.34–1.57)	0.83	(0.37–1.85)
High	163	8	4.9	0.38	(0.15–0.94)	0.45	(0.16–1.29)
		$p = 0.076$ (df = 2)		p for trend = 0.032		p for trend = 0.147	
Isometric load							
Low	166	18	10.8	1.00		1.00	
Medium	201	15	7.5	0.68	(0.33–1.41)	0.70	(0.33–1.48)
High	79	5	6.3	0.58	(0.20–1.65)	0.74	(0.25–2.21)
		$p = 0.382$ (df = 2)		p for trend = 0.226		p for trend = 0.433	
Job strain †							
Low	155	19	12.3	1.00		1.00	
Medium	130	9	6.9	0.54	(0.23–1.23)	0.54	(0.23–1.25)
High	149	9	6.0	0.46	(0.20–1.08)	0.51	(0.21–1.24)
		$p = 0.112$ (df = 2)		p for trend = 0.054		p for trend = 0.105	

*Odds ratios and their 95% confidence intervals (CIs) were estimated using multiple logistic regression.

**Adjusted for age, education, occupation, and shift work.

† Job strain was calculated as a ratio of job demands to job control.

ers. The difference between the results of the previous study and the present study, however, can not be attributable to age difference alone. The effect of job strain and job demands on smoking cessation may depend on other situational factors as well, such as psychological rewards at work [38]. It has also been reported that the association between high job strain

and difficulty in smoking cessation was more clearly observed among women [26, 32, 33]. A previous study showed that non-work stressors (life events) were associated with difficulty in smoking cessation more among women than men [11]. Women may be more vulnerable to stressors in both work and non-work domains in terms of ability to quit smoking. It is

Table 3 Association between job stressors at baseline and changes in the number of cigarettes smoked per day during the 2-year follow-up among male continuous smokers (in 408 male smokers) †

	N	Number of cigarettes smoked per day				Time × group interaction*	
		At baseline		At follow-up		Age-adjust	Age and demographic-adjusted**
		Average	(SD)	Average	(SD)	<i>p</i>	<i>p</i>
Job control							
Low	144	17.3	6.5	18.1	6.6	0.640	0.231
Medium	138	18.4	6.8	19.2	7.2		
High	126	18.7	9.2	19.7	10.2		
Job demands							
Low	139	18.1	7.1	18.9	7.4	0.321	0.323
Medium	116	18.1	7.3	18.5	8.2		
High	153	18.2	8.1	19.3	8.6		
Supervisor support							
Low	158	18.3	6.8	19.1	7.6	0.916	0.818
Medium	58	19.2	7.5	20.2	8.8		
High	192	17.6	8.0	18.4	8.2		
Coworker support							
Low	101	18.6	7.2	19.5	8.3	0.770	0.857
Medium	110	17.6	6.1	18.6	6.6		
High	197	18.2	8.4	18.8	8.7		
Job insecurity							
Low	123	18.2	8.3	19.5	9.0	0.261	0.199
Medium	131	18.2	7.5	19.0	8.1		
High	154	18.0	6.9	18.4	7.2		
Physical demands							
Low	123	19.8	10.0	20.4	10.6	0.666	0.868
Medium	130	17.6	6.2	18.2	6.8		
High	155	17.3	6.0	18.4	6.4		
Isometric load							
Low	148	18.7	8.5	19.4	8.8	0.830	0.810
Medium	186	18.4	7.3	19.3	8.1		
High	74	16.4	5.6	17.0	5.9		
Job strain ‡							
Low	136	17.7	7.2	18.2	8.2	0.248	0.256
Medium	121	20.1	9.2	21.5	9.2		
High	140	16.6	5.9	17.5	6.5		

† Excluding 38 who quit smoking at follow-up.

* Analysis of variance (ANOVA).

** Adjusted for age, education, occupation, and shift work.

‡ Job strain was calculated as a ratio of job demands to job control.

thus suggested that psychological job stressors, such as job demands and job control, may not be as influential on smoking cessation among men, if at all. Further investigations are needed to determine which other factors are responsible for these observed gender- and age-related differences.

In the present study, men with a high level of physical demands showed a lower smoking cessation rate than did men with a low level of physical demands. This trend was non-significant after controlling for education level, occupation, and shift work, suggesting that part of the association is attributable to occupational class differences. This result supported a previous cohort study [34] in which physical demands were associated with difficulty in smoking cessation (odds ratio = 0.53 for the highest tertile) even after controlling for social class [34]. Thus, physical demands may be a factor interfering with smoking cessation. Another possible explanation is that a norm (*i.e.*, atmosphere or peer pressure) favorable for smoking at such a workplace with a high level of physical demands may prevent workers from successful smoking cessation. Further research should be conducted to clarify the association using a larger sample.

No significant association was found between worksite support and smoking cessation in the present study. This is consistent with previous findings of a null association between worksite support and smoking cessation in Western countries [31]. The present study confirms that worksite social support is not strongly associated with smoking cessation in a non-Western country. A previous study using university students as subjects [39] indicated a moderating effect of social support: women under high stress increased smoking when they had a low level of support and reduced smoking when they had a high level of support. In future studies, a moderating effect of worksite support for other psychosocial and work-related factors on smoking cessation should be considered.

Many previous studies have shown that job stressors, including job strain, were associated with an increased number of cigarettes smoked per day [16, 20, 25, 26, 28]. However, most of these studies were cross-sectional. Only 1 previous prospective study addressed this topic, showing that job strain did not significantly predict changes in the amount of smoking [40]. On the other hand, it was also found in

the same study that an increase in work hours was associated with an increased amount of smoking [40]. As summarized in a review by Albertsen *et al.* [31], other previous studies also showed that the amount of smoking changed in response to the temporal elevation of working hours. Another previous study showed that an increase in job decision latitude (a subscale of job control) over 3 years was associated with a decrease in cigarette smoking [15]. This type of association was not tested in the present study. Thus the baseline measurement of job stressors used in the present study may not have been sufficiently sensitive to predict changes in the amount of smoking over time. Changes in job stressors should also be considered in future studies.

In addition to the limitations mentioned above, several other limitations should be noted. This study included only male workers in a large manufacturing company in Japan, and therefore participants were not representative of the general Japanese working population. Furthermore, 2 years was a shorter follow-up period than that used in the cohort study of Albertsen *et al.* [34]. Ideally, the follow-up period should be longer than 2 years. Moreover, during the follow-up period, about 40% of the participants were excluded due to their failure to respond to the follow-up survey, and this group included both retired and transferred individuals (no data on these percentages are available). In addition, there might have been some problems in our measurement of smoking cessation. We defined quitters based on their answer to a single question in the follow-up survey—*i.e.*, whether or not they had quit smoking—and did not ask about the duration of the cessation. This may have caused a misclassification in which some transient quitters were included as quitters at follow-up. Finally, medical history, which may have an effect on smoking cessation, should also have been included in the analyses.

In conclusion, the present study indicated that there were weak associations between job strain or worksite social support and smoking cessation in male workers. Furthermore, physical demands were shown to be an important factor that should be considered in smoking cessation programs, which could provide strategies for coping with high levels of physical demands and for improving workplaces to make them less physically demanding. Although further studies on the associations among psychosocial stress, work

environments and smoking are necessary, the findings of this study will be useful for establishing worksite measures to encourage smoking cessation.

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