

# Overtime Work, Cigarette Consumption, and Addiction to Cigarette among Workers Subject to Mild Smoking Restrictions

Tetsuya MIZOUE<sup>1\*</sup>, Yoshihisa FUJINO<sup>2</sup>, Hiroshi YAMATO<sup>2</sup>,  
Shoji TOKUNAGA<sup>1</sup>, Tatsuhiko KUBO<sup>2</sup> and Kari REIJULA<sup>3</sup>

<sup>1</sup>Department of Preventive Medicine, Graduate School of Medical Sciences, Kyushu University, 3-1-1 Maidashi, Higashiku, Fukuoka 812-8582, Japan

<sup>2</sup>Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, 1-1 Iseigaoka, Yahatanishiku, Kitakyushu 807-8555, Japan

<sup>3</sup>Uusimaa Regional Institute, Institute of Occupational Health, Arinatie 3 A, FIN-00370 Helsinki, Finland

*Received April 4, 2005 and accepted December 9, 2005*

**Abstract:** The goal of the present study was to investigate the relation of hours of overtime work to cigarette consumption and addiction to cigarette, which was measured by the heaviness of smoking index. The subjects were 571 male daily smokers who responded to a cross-sectional survey of municipal employees of a Japanese city office, in which smoking was permitted in designated areas. Those who engaged in moderate overtime work (10–29 h per month) consumed less number of cigarettes per day and had lower levels of heaviness of smoking index, compared with those who worked either shorter or longer hours of overtime, although the differences were not statistically significant. In the workplace, men who worked 50 h or longer overtime last month consumed, on average, 4 cigarettes more than men who worked less than 30 h of overtime. Home cigarette consumption decreased as hours of overtime work increased. In stratified analysis, there was a significant difference in daily cigarette consumption according to hours of overtime work among smokers in staff position or under low psychological work stress; showing reduced consumption associated with medium levels of overtime work, compared to either no overtime work or extended overtime hours. The U-shaped relations of hours of overtime work to overall cigarette consumption and addiction to smoking deserve further investigations.

**Key words:** Addiction, Cross-sectional studies, Office employee, Overtime work, Smoking behavior

## Introduction

Health problems arising from long working hours represent an important issue in occupational settings<sup>1</sup>. In Japan, where working long hour is a social norm, additional hours of work have been linked to a wide range of adverse health effects, including sudden death<sup>2</sup>, acute myocardial infarction<sup>3, 4</sup>, diabetes mellitus<sup>5</sup>, and sick building syndrome<sup>6</sup>. Moreover, the number of workers officially recognized as suffering from mental disorders as the result of overwork is increasing<sup>7</sup>.

Long overtime hours result in physiological dysfunc-

tions<sup>8</sup>, which may in turn trigger serious diseases. Long working hours may also contribute indirectly to the occurrence of disease by deteriorating health-related behaviors, including smoking<sup>1</sup>. If smokers who work long overtime hours consume more cigarettes as a mechanism for coping with stress, these overtime hours would intensify smoking habits, and in turn, increase the rate of smoking-related pathogenesis. However, there is a paucity of evidence for an association between work hours and smoking intensity<sup>1</sup>. The present study sought to investigate cigarette consumption and addiction to cigarette in relation to overtime hours worked, using survey data of municipal employees in Kitakyushu, Japan.

\*To whom correspondence should be addressed.

## Materials and Methods

### Survey

Two questionnaire surveys were conducted as part of a smoking control program in a city office in Japan. Details of the first survey in 1998 have been described elsewhere<sup>6</sup>. The present 2001 survey was undertaken 6 months after the tightening of workplace restrictions on smoking. The amended workplace restrictions prohibit smoking except in designated smoking areas located on each building floor. Employees were allowed to take short breaks for smoking unrestrictedly during office hours. The conduct of the survey has been approved by the safety and health committee of the city office.

The targets of the present survey were permanent workers in office buildings of the city office. Workers in small branch offices or in offices attached to specific facilities such as waste incinerator plants were excluded, leaving approximately 5,000 workers in 13 large office buildings. Of these, nearly half ( $n = 2,568$ ) workers were randomly selected using the last digit of worker identification number and asked to respond to an anonymous questionnaire. The questionnaires were distributed and returned using internal mailing system of the office. The questionnaire included queries concerning the work environment and health, including smoking habits, smoking restrictions, overtime work, and psychological work stress. The response rate was 84% ( $n = 2,161$ ).

### Overtime and smoking habits

In the present office, the scheduled weekly working hours for permanent workers is 40 h (8 h per working day). Subjects were asked to give one of five possible responses for number of total overtime hours worked during the preceding one-month period: none, fewer than 10 h, 10 to 29 h, 30 to 49 h, and 50 h or more. Current smokers were asked to indicate the number of cigarettes smoked daily, the number consumed at the workplace, and the number consumed at home over a typical work day. Cigarette consumption in places other than workplace and home was not asked. We calculated the heaviness of smoking index<sup>9</sup> as a measure of addiction to cigarette by summing the scores of the following two items: cigarette consumption per day (1 to 10 cigarettes = 0 point, 11 to 20 cigarettes = 1 point, 21 to 30 cigarettes = 2 points, 31 cigarettes or more = 3 points) and time to first cigarette of the day (within 5 min = 3 points, 6 to 30 min = 2 points, 31 to 60 min = 1 point, more than 60 min = 0 point). The range of scores was from 0 to 6, with higher values indicating stronger addiction. The Pearson correlation coefficients with the heaviness of smoking index were 0.81 and 0.88 for score of cigarette consumption and that of time to first cigarette of the day,

respectively. The correlation between cigarette consumption and time to first cigarette of the day was moderate (Pearson correlation coefficient = 0.44).

### Potential confounders

Age, workplace smoking restriction, occupational position, and psychological work stress were considered as potential confounders in analysis. In selecting these variables, we referred either to our previous analysis<sup>10</sup> (age and smoking restriction) or to other literatures (occupational position<sup>11</sup>) and psychological work stress<sup>12, 13</sup>). Our questionnaire included four queries about psychological work stress: interest in work ("Do you regard your work as interesting and stimulating?"), perceived work overload ("Do you have too much work to do?"), control over work ("Do you have any opportunity of influence your working conditions?"), support from colleague ("Do your fellow workers help you with problems you may have in your work?"), together with four response options (often, sometimes, seldom, never) for each question. These questions on work stress were derived from MM040EA<sup>14</sup>, a questionnaire for indoor environment and health.

### Statistical analysis

Since few female subjects smoked, all the subjects analysed were men. Of 642 current male smokers, we excluded 38 less-than-daily smokers and 33 subjects who provided incomplete or inconsistent responses with respect to smoking habits, overtime hours worked, or confounding variables. This left 571 daily smokers for analysis.

Differences for categorical variables were tested using the chi-square test. Analysis of covariance was used to calculate means of daily cigarette consumption, consumption at the workplace, consumption at home, and heaviness of smoking index for each category of overtime hours worked, while adjusting for age (< 30, 30–39, 40–49, 50 + yr), occupational position (staff, section chief or higher), type of workplace smoking restriction (work area ban or milder, workroom ban or stricter), interest in work (never or seldom, others), work overload (often, others), control over work (never or seldom, others), support from colleagues (never or seldom, others). Interaction was assessed by including a cross-product term of hours of overtime work and each potential confounding variable in a separate model. If the interaction was significant, stratified analysis was conducted according to the variable.

We tested overall difference in means across categories of overtime work. If  $P$  value for the overall difference was less than 0.05, we made pairwise comparisons using Tukey method<sup>15</sup>. Trend associations were tested by

assigning ordinal scores to the categories for hours of overtime worked. All analyses were done with PROC GLM on Statistical Analysis System (SAS) software<sup>16</sup>.

## Results

The proportions of subjects aged < 30, 30–39, 40–49, and 50 yr were 9%, 31%, 30%, and 30% respectively. As shown in Table 1, subjects who had worked longer hours of overtime during the past one-month period were more likely to be young. The absence of overtime work was associated with low levels of interest in work. Hours of overtime work was positively associated with perceived work overload.

As shown in Table 2, there was no significant overall difference in mean daily consumption of cigarettes and heaviness of smoking index according to overtime hours worked. Adjustment for potential confounding variables

did not materially alter the results. However, smokers who worked 10 to 29 overtime hours demonstrated decreased daily cigarette consumption and heaviness of smoking index, compared with smokers who did not work any overtime and with smokers who worked 50 hours or more overtime. In the workplace, smokers who worked 50 or more overtime hours consumed, on average, 4 cigarettes more than those who worked fewer than 30 overtime hours. Workplace cigarette consumption did not differ materially among groups of subjects who worked fewer than 30 overtime hours. In contrast, home cigarette consumption was inversely related to overtime hours worked in a monotonic manner.

Interaction with hours of overtime work was significant for occupational position ( $P = 0.049$ ) and perceived work overload ( $P < 0.01$ ). The results of stratified analysis for these variables were shown in Table 3. Employees in staff position exhibited significant difference in mean of

**Table 1. Work characteristics of study subjects according to overtime hours worked**

	Overtime hours worked during the previous month					<i>P</i> *
	No	<10	10–29	30–49	50+	
	n=160	n=219	n=112	n=48	n=32	
Age (40 yr or older)	72	61	54	38	38	<0.01
Position (section chief or higher)	39	45	33	29	31	0.11
Workroom ban on smoking	73	82	77	88	84	0.11
Perceived work stress						
Interest in work (never/seldom)	39	21	21	21	22	<0.01
Work overload (often)	5	9	18	19	50	<0.01
Control over work (never/seldom)	23	17	20	23	19	0.70
Work support (never/seldom)	15	10	9	8	19	0.23

\*Chi-square test.

Values in the table are proportions given as percent, unless stated otherwise.

**Table 2. Cigarette consumption and heaviness of smoking index in relation to overtime hours worked**

	Overtime hours worked during the previous month					Overall <i>P</i>	<i>P</i> for trend
	No	<10	10–29	30–49	50+		
	n=160	n=219	n=112	n=48	n=32		
Cigarettes consumption							
Overall	21.8 (0.8)	21.4 (0.7)	19.4 (0.9)	20.4 (1.4)	23.3 (1.7)	0.16	0.55
Workplace	22.4 (1.2)	22.0 (1.0)	20.0 (1.2)	21.2 (1.6)	23.6 (1.8)	0.19	0.55
Home	12.6 (0.5)	12.5 (0.4)	12.2 (0.6)	13.6 (0.9)	16.6 (1.0)		
Heaviness of Smoking Index*	13.0 (0.7)	12.7 (0.7)	12.4 (0.7)	13.8 (1.0)	16.6 (1.1)		
	9.0 (0.5)	8.3 (0.4)	7.1 (0.5)	6.9 (0.8)	6.4 (1.0)		
	9.4 (0.7)	8.9 (0.6)	7.6 (0.7)	7.5 (0.9)	6.8 (1.0)		
	3.2 (0.1)	3.0 (0.1)	2.8 (0.1)	3.0 (0.2)	3.2 (0.3)	0.21	0.38
	3.3 (0.2)	3.1 (0.2)	2.9 (0.2)	3.1 (0.2)	3.3 (0.3)	0.30	0.47

\* Index of addiction to cigarette; calculated based on daily cigarette consumption and time to first cigarette of the day.

Values in the table are means (SE) adjusted for age only (upper) and those additionally adjusted for occupational position, type of workplace smoking restriction, interest in work, perceived work overload, control over work, work support (lower), unless stated otherwise.

**Table 3. Daily cigarette consumption and overtime hours worked according to occupational position and perceived work overload**

	Overtime hours worked during the previous month					Overall <i>P</i>
	No	<10	10–29	30–49	50+	
Occupational position						
Staff (n=350)	24.0 (1.3)*	21.0 (1.2)	19.9 (1.3)	19.6 (1.7)	23.4 (2.0)	0.02
Section chief or higher (n=221)	21.8 (2.1)	24.8 (2.0)	22.2 (2.4)	26.4 (3.2)	26.1 (3.5)	0.25
Perceived work overload						
Never, seldom, sometimes (n=498)	22.5 (1.1)	21.8 (1.0)	20.5 (1.2)	22.2 (1.7)	28.9 (2.4) <sup>†</sup>	0.02
Often (n=73)	25.2 (4.2)	24.1 (2.9)	18.0 (3.1)	16.8 (3.6)	17.8 (3.0)	0.10

\*  $P < 0.05$ , compared to the category of 10–29 h of overtime work by Tukey method.

<sup>†</sup>  $P < 0.05$ , compared to the category of <10 or 10–29 h of overtime work by Tukey method.

Values in the table are means (SE) adjusted for age, type of workplace smoking restriction, interest in work, control over work, work support, and either perceived work overload or occupational position, unless stated otherwise.

overall cigarette consumption according to overtime hours worked ( $P = 0.02$ ), having reduced consumption associated with moderate overtime hours ( $P < 0.05$ , compared to no overtime work). Mean daily cigarette consumption across categories of overtime hours differed significantly among employees who did not perceive themselves to be frequently overworked ( $P = 0.02$ ); smoker who worked 50 overtime hours or more consumed daily 8 cigarettes more than those who worked 10–29 overtime hours ( $P < 0.05$ ). The type of workplace smoking restriction did not influence the association between overtime work and workplace cigarette consumption (data not shown).

## Discussion

In a cross-sectional study of male smokers, both short and long hours of overtime work were associated with increased overall cigarette consumption and addition to cigarette, compared with medium levels of overtime work. The association was evident among those who were in low occupational position or subject to low levels of perceived work stress.

The results of separate analysis for smoking in the workplace and at home revealed that in the workplace, smokers who worked extended overtime hours (50 h or more) consumed more cigarettes than other groups. Prolonged time spent at the office is a plausible but not the only explanation for this increase; stronger desire to smoke to alleviate work stress<sup>17)</sup> may also account for the increased workplace cigarette consumption associated with such long overtime hours. A small decrease in cigarette consumption at home for this group did not fully compensate the large increase in cigarette consumption at work, leading to increased overall cigarette consumption.

An increase in overall cigarette consumption among smokers who did not work overtime was unexpected. These smokers consumed similar amount of cigarettes in the workplace as those who worked moderate hours of

overtime (10–29 h per month), where as the former consumed greater number of cigarettes at home than the latter. If the amount of workplace cigarette consumption per hour is constant, those who did not work overtime should consume less number of cigarettes at work than those who did. We have no plausible explanation for the lack of reduction in workplace cigarette consumption among those who worked no overtime. As shown in Table 1, smokers who did not engage in any overtime work tended to have low interest in work. We thus infer that smokers having no overtime work may take smoking breaks more often or longer than those who engaged in moderate overtime work.

Stratified analysis showed that the association between overtime work and cigarette consumption is more marked among employees in staff position or in employees subject to low levels of work-related psychological stress. In contrast, the association was not clear among those who are in management positions or subject to high levels of work stress. This finding suggests that overtime work may significantly influence smoking behaviours in the absence of occupational factors strongly associated with smoking.

We expected that under strict smoking restriction, workplace cigarette consumption may be reduced. However, the type of workplace smoking restriction did not significantly affect the association between hours of overtime work and workplace cigarette consumption. A plausible explanation is that there was no material difference for smokers in taking smoking breaks under either policy. It is possible that stricter rules on smoking including total ban may significantly reduce cigarette consumption at work.

In a previous cross-sectional study, long working hours were associated with increased cigarette consumption<sup>12)</sup>. Steptoe *et al.*<sup>18)</sup> found that female smokers but not male smokers consumed more cigarettes during periods of long work hours, based on repeated observations. Shields<sup>19)</sup>

reported an increase in cigarette consumption after a transition from standard to long work hours. The present study adds evidence to support the hypothesis that working long hours is related to greater cigarette consumption. To our knowledge, no study has reported greater cigarette consumption among smokers who did not work any overtime than among those who worked moderate overtime hours.

In general, the association of hours of overtime hours with the heaviness of smoking index was similar to that with overall cigarette consumption. Daily cigarette consumption was incorporated into the index and thus these indicators of smoking were not independent each other. Nevertheless, the heaviness of smoking index represents addictive levels of smoking, which may be useful for behavioural studies. Our study indicates that both short and extended hours of overtime work are related to higher levels of addition to cigarette, a status making it more difficult to quit smoking.

The present study had the following limitations. First, the inherent nature of cross-sectional studies does not permit the conclusion that overtime causes increased cigarette consumption at work. Nevertheless, subjects were selected from among workers of similar occupational background — i.e., from municipal office employees in permanent positions. In addition, these employees are on average relocated every three years without consideration of smoking habits. This makes it less likely that heavy smokers are more likely to work no or extended overtime hours than light smokers. Second, both smoking habits and overtime hours worked were self-reported. Nevertheless, since the questionnaires were anonymous, systematic errors in the responses to these questions may be minimal. Third, since the subjects were daytime office employees subject to smoking restrictions, caution needs to be exercised in generalizing the result to shift workers, non-office workers, or to individuals who worked in totally smoke-free environments. Fourth, the number of men who worked overtime of 50 hours or more was small and thus our study was underpowered to detect a statistically significant difference for this category. We were unable to assess the effects of extremely long working hours, i.e., overtime work of 100 hr or more per month.

In conclusion, the present study suggests that, in offices adopting mild smoking restrictions, both short and long hours of overtime work may be associated with increased overall cigarette consumption, compared with moderate overtime hours, especially among smokers who are under low psychological work stress. The U-shaped relation needs to be confirmed by studies including a larger number of smokers who work extended hours of overtime. Moreover, further studies are required to explore the effects of workplace smoke-free policy on the association

between working hours and smoking behaviors.

## Acknowledgements

We thank the staff of the safety and health section of the Kitakyushu city office and Yoko Wada for their help in conducting the survey. This study was supported by a Grant-in-Aid for Scientific Research, Japanese Ministry of Education, Science, Sports and Culture Fund (12670377, 13670402) and the Third Term Comprehensive 10-yr Strategy for Cancer Control from the Ministry of Health, Labour and Welfare, Japan.

## References

- 1) Spurgeon A, Harrington JM, Cooper CL (1997) Health and safety problems associated with long working hours: a review of the current position. *Occup Environ Med* **54**, 367–75.
- 2) Uehata T (1991) Long working hours and occupational stress-related cardiovascular attacks among middle-aged workers in Japan. *J Human Ergol* **20**, 147–53.
- 3) Sokejima S, Kagamimori S (1998) Working hours as a risk factor for acute myocardial infarction in Japan: case-control study. *BMJ* **317**, 775–80.
- 4) Liu Y, Tanaka H (2002) Overtime work, insufficient sleep, and risk of non-fatal acute myocardial infarction in Japanese men. *Occup Environ Med* **59**, 447–51.
- 5) Kawakami N, Araki S, Takatsuka N, Shimizu H, Ishibashi H (1999) Overtime, psychosocial working conditions, and occurrence of non-insulin dependent diabetes mellitus in Japanese men. *J Epidemiol Community Health* **53**, 359–63.
- 6) Mizoue T, Reijula K, Andersson K (2001) Environmental tobacco smoke exposure and overtime work as risk factors for sick building syndrome in Japan. *Am J Epidemiol* **154**, 803–8.
- 7) Ministry of Health, Welfare, and Labour (2003) Trends of compensation for mental disorders by occupational psychological overloads. Available at <http://www.mhlw.go.jp/houdou/2003/06/h0610-4c.html> (accessed Mar, 2006)
- 8) Kageyama T, Nishikido N, Kobayashi T, Kurokawa Y, Kabuto M (1997) Commuting, overtime, and cardiac autonomic activity in Tokyo. *Lancet* **350**, 639 (letter).
- 9) Heatherton TF, Kozlowski L, Frecker RC, Rickert W, Robinson J (1989) Measuring the heaviness of smoking using self-reported time to first cigarette of the day and number of cigarettes smoked per day. *Br J Addict* **84**, 791–800.
- 10) Mizoue T, Reijula K, Heloma A, Yamato H, Fujino Y (2000) Impact of workplace smoking restrictions on smoking behavior and attitude toward quitting. *Tobacco Control* **9**, 435 (letter).
- 11) Marmot MG, Smith GD, Stansfeld S, Patel C, North F, Head J, White I, Brunner E, Feeney A (1991) Health

- inequalities among British civil servants: the Whitehall II study. *Lancet* **337**, 1387–93.
- 12) Westman M, Eden D, Shirom A (1985) Job stress, cigarette smoking and cessation: the conditioning effects of peer support. *Soc Sci Med* **20**, 637–44.
  - 13) Green KL, Johnson JV (1990) The effects of psychological work organization on patterns of cigarette smoking among male chemical plant employees. *Am J Public Health* **80**, 1368–71.
  - 14) Andersson K (1998) Epidemiological approach to indoor air problems. *Indoor Air* **8**(Suppl 4), 32–9.
  - 15) Tukey JW (1949) Comparing individual means in the analysis of variance. *Biometrics* **5**, 99–114.
  - 16) SAS Institute, Inc. (1989) SAS/STAT user's guide, version 6. SAS Institute, Inc., Cary, NC.
  - 17) Perkins KA, Grobe JE (1992) Increased desire to smoke during acute stress. *Br J Addict* **87**, 1037–40.
  - 18) Steptoe A, Wardle J, Lipsey Z, Mills R, Oliver G, Jarvis M, Kirschbaum C (1998) A longitudinal study of work load and variations in psychological well-being, cortisol, smoking, and alcohol consumption. *Ann Behav Med* **20**, 84–91.
  - 19) Shields M (1999) Long working hours and health. *Health Rep* **11**, 33–48.