Type of Manuscript: Original article

Relations of Occupational Stress to Occupational Class in Japanese Civil Servants －Analysis by Two Occupational Stress Models

Mariko KAWAHARADA[1], Yasuaki SAIJO[2], Eiji YOSHIOKA[1], Tetsuro SATO[1], Hirokazu SATO[3] and Reiko KISHI[1]

[1] Department of Public Heath, Graduate School of Medicine, Hokkaido University

[2]Department of Health Science, Asahikawa Medical College

[3]Health Administration Department, Sapporo Railway Hospital, Japan

Correspondence:

Mariko KAWAHARADA

Department of Heath Sciences, School of Medicine, Hokkaido University

Kita 12, Nishi 5, Kita-ku, Sapporo 060-0812, Japan

Tel: 81 11 706 3324; Fax: 81 11 706 3324

E-mail: mariko@med.hokudai.ac.jp

Running title

Relations of Occupational Stress to Occupational Class

Abstract

The aim of the present study was to identify relations between occupational stress and occupational class in Japanese civil servants, using two occupational stress models – the Effort-Reward Imbalance (ERI) Model and the Job Demand-Control (JDC) Model. The subjects were employees of three local public organizations. We distributed self-administered questionnaires and assessed occupational stress by ERI and JDC. We used seven occupational categories based on the Standard Occupational Classification for Japan. The data of 6,423 male and 1,606 female subjects were analyzed by logistic regression analysis to obtain odds ratios (OR) for relations between occupational stress and occupational class. In JDC, male clerical workers, transport/communication workers and protective service workers showed a significantly higher OR of being in the high occupational stress group, compared to managers. In ERI, male professionals/technicians, transport/communication workers, clerical workers and protective service workers showed a significantly higher prevalence OR, compared to managers, the two models giving different results. In ERI, female production workers/laborers and clerical workers had a significantly lower prevalence OR, compared to managers. The results of this study showed that occupational stress differed by occupational class and the two occupational stress models gave different results for occupational classes with high

occupational stress.

Key words: Occupational stress, Effort-Reward Imbalance Model, Job Demand-Control Model, Occupational class, Civil servants

Introduction

In the recent years, the impact of job-related stress on health has become a problem of great concern in Japan[1] .The Effort-Reward Imbalance (ERI) Model and the Job Demand-Control (JDC) Model have demonstrated relationships between occupational stress and physical and mental disorders[2-5]. JDC is the most influential theoretical occupational stress model nowadays. It states that workers exposed to high job demands and low job control are at a risk to develop health problems[6] . ERI claims that imbalance between high efforts spent and low reward received elicits stress at work. Developed in the 90s, ERI has been drawing attention as a model that assesses simultaneously occupational environment and individual factors and gives a comprehensive picture of job-related stress[6,7]. Numerous studies have reported relations of occupational stress due to effort-reward imbalance to coronary heart disease[8-10], depression[11-13] and well-being[14]. Overcommitment, as an individual factor within effort-reward imbalance, is also considered to be possibly related to coronary heart disease[2,10]

and mental disorders[4].

Differences in health and illness by occupational class have been examined by several studies. A study of British civil servants reported low-grade occupations to be related to poor health, i.e. ischemic heart disease detected by electrocardiograms, chronic bronchitis symptoms, etc [15]. Another study examined citizens in seven European countries and found differences in morbidity by occupational class[16]. Previous studies of civil servants have shown that health conditions differed by employment grade[17-19] and there were significant grade-differences in life-style and annual health check-up data[17]. There have been a number of studies exploring relations of women's health to occupational stress and occupational class [18,20,21] .

Sociopsychological environment is considered to be one of the factors that may cause differences in health conditions of workers by occupation, a number of studies having found connections between occupations and occupational stress [17,20,22]. The Whitehall II study in the United Kingdom has suggested that low-grade occupations are at high risk of exposure to low job control and low job demand[15]. The Swedish study by Peter *et al.* reported higher effort-reward imbalance in white-collar workers, compared to blue-collar workers [23]. The study also focused on overcommitment, reporting that the immersion levels in women and

white-color workers were higher than in their counterparts[23].

Research on occupational class and exposure to job stressors is limited in Japan. As a result of a study based on JDC, Kawakami et al. have found connections between nine occupational categories and job stressors among Japanese employed men and women, also reporting that low-grade occupations such as laborers and machine operators are highly exposed to low job control and high job strain[24]. Sekine *et al.* have reported that job stress differs according to employment grade, high grades being characterized by high job control and high job demands[19] .These results coincide with the findings of prospective studies in Europe[15]. The number of Japanese studies on occupational stress and occupational class based on ERI is still rather limited[25]. ERI and JDC are considered to assess occupational stress from different positions and to detect health risks independently of each other[26]. Therefore, it is essential to clarify relations between occupations and occupational stress using both ERI and JDC.

The objective of this study was to identify relations between occupational stress and occupational class in a large sample of Japanese civil servants, using both occupational stress models.

Subjects and Methods

Subjects and Data Collection

The subjects were employees of three local public organizations in Hokkaido aged 21 to 64 years old. We distributed self-administered questionnaires to 23,628 subjects in advance of an annual health checkup during the period from April 2003 through March 2004 and collected them during the checkup. Questionnaire responses and written consents on the health-checkup data to be used in the study were obtained from 8,635 persons (6,782 males, 1,853 females;response rate: 36.5%) , with 8,263 valid responses (active response rate: 95.7%).The number of participants was 5,013 in public organization A (males/females: 3,962/1,051; response rate: 47.5%/47.6%), 219 in public organization B (123/96; 46.1%/45.5%), and 3,403 in public organization C (2,697/706; 27.4%/25.6%).

Occupational Stress Assessment

Occupational stress was assessed using the Job Demand-Control Questionnaire (JDCQ) and the Effort-Reward Imbalance Questionnaire (ERIQ). The Japanese version of JDCQ consists of 5 questions on psychological demands and 6 questions on job control [27]. Each question has 4 frequency-based response categories ranging from “never” to “always”. We calculated separately the scores for demand and control and then divided them into tertils to indicate low, medium, and high levels for each scale. After that, subjects who were assessed as low for control and high for demand were categorized as having high stress. In this study, scores for job

control ranged from 6 to 20, with the score of 15 and less indicating low control. Scores for job demand ranged from 5 to 20, with the score of 13 and more indicating high job demand. Cronbach's alpha coefficients were 0.66 in males and 0.63 in females for job control, and 0.76 in males and 0.7 5 in females for job demand.

The Japanese version of ERIQ consists of 6 questions on efforts spent and 11 questions on rewards received[25,28]. The subjects were asked to rate their jobs' severity from "not at all distressed" (1 point) to "very distressed" (4 points). We calculated the Effort-Reward ratio and defined the upper tertile as the high stress group. Overcommitment was rated using 6 questions. We defined the upper tertile of acquired scores as the high stress group. In this study, the Effort-Reward ratio ranged from 0.20 to 3.67、the ratio for the high stress group being 0.44 and higher. Scores for overcommitment ranged from 6 to 24, the high stress group scoring 14 and more.

In this study, Cronbach's alpha coefficients were 0.80 in males and 0.81 in females for effort, 0.83 in males and 0.82 in females for reward, and 0.77 in males and 0.78 in females for overcommitment. Scores of 5 job stress measures differed significantly in males and females ($P<0.001$). Scores of job demands and control had significant differences in male and female clerical workers (job demands: $P<0.05$, control: $P<0.001$). However scores of 3 measures of ERI model showed no

gender difference. Scores of job stress measures in clerical workers had less gender differences than other occupational groups.

Classification of occupations

The subjects were asked to choose their jobs from the list of job names used in their work places. The answers were then classified based on the Standard Occupational Classification for Japan[29]. In this study, we employed seven occupation categories; managers (department directors, division directors, deputy division directors), professionals/technicians(technicians, teachers, and hospital workers), clerical workers, protective service workers (firefighters), service workers (cooks at schools and hospitals, transportation/communication workers(drivers, conductors, and station attendants), production workers/laborers(maintenance workers, garbage collectors, and orderlies). Sales workers were excluded due to the small number of respondents (n=17). 217 part time workers were also excluded from the analyses. As a result, data from 6,423 male and 1,606 female subjects were analyzed.

Other covariates

Other covariates were age, marital status, educational attainment, and presence/absence of shift work. Marital status was divided into “married” and “unmarried”. Educational attainment was divided into “high school or lower” and “higher than high school”. Presence/ absence of shift work was divided into “yes”

and “no”.

Statistical Analysis

All analyses were performed separately for males and females. First, the χ^2 test, or the Student’s unpaired t test, was conducted to examine significant differences of baseline characteristics by gender. Second, logistic regression analysis was conducted to obtain odds ratios (OR) and 95% confidence intervals (95% CI) of each stress model for each occupational category before and after adjustment for potential confounders. Possible confounding factors included in the logistic-regression models as independent variables were age (continuous variable), marital status, educational attainment, presence or absence of shift work, and workplace. The estimated prevalence odd ratio of high job strain group and its 95% confidence intervals were calculated taking managers as a reference group. Third, the high stress group in ERI and the high stress group in JDC were combined, and the odd ratio of the combined ERI&JDC high stress group was calculated for each occupational class. Next, a correlation matrix was calculated to assess the independence (or interdependence) of the 5 job stress measures entering the analysis (table 4).

Male service workers, female protective service workers, and female transportation/communication workers were excluded from the analysis due to the

small number of the subjects. Two-tailed values of less than 0.05 were considered statistically significant. All analyses were conducted using the SPSS software Version 12 for Windows.

Ethical Approval

The Ethics Committee of Medicine for Hokkaido University, Japan, approved the recruitment, consent, and field procedures prior to the survey. Written consents were acquired from the subjects on explaining the purposes of this study.

Results

Information on characteristics of the subjects is presented in Table 1. There were significant differences between males and females in age, marital status, educational attainment, and shift work ($P<0.001$).

In this study, scores of job stress in JDC, job demands and control were rather low in males and rather high in females, compared to previous studies of Japanese employees[5]. In ERI, effort and overcommitment were rather low, and reward was rather high, comparing to the previous research by Takaki *et al.* [30]. The subjects of this study whose Effort-Reward ratio was 1 and higher comprised 2.4%(males: 1.9%, females: 4.4%), the percentage being low compared to the results of the previous research of Japanese employees.

The relations between occupational class and occupational stress are presented

in Table 2 for males and Table 3 for females. In JDC, male clerical workers, transport/communication workers and protective service workers showed a significantly higher prevalence OR of being in the high occupational stress group, compared to managers. Female service workers had the highest OR of having high occupational stress.

In ERI, male professionals/technicians, transport/communication workers, clerical workers and protective service workers showed a significantly higher prevalence OR of being in the high occupational stress group, compared to managers. Female production workers/laborers and clerical workers had a significantly high prevalence OR of having high occupational stress. In ERI, male professionals/technicians, clerical workers and protective service workers showed a significantly higher prevalence OR of being in the high occupational stress group for overcommitment, compared to managers. Female production workers/laborers and service workers had a significantly high prevalence OR of being in the high occupational stress group for overcommitment.

Table 4 presents a correlation matrix of the 5 job stress measures. All the stress measures had significant correlations with each other（P value<0.001）, job demands and effort showing the highest correlation coefficient.

Adjusted OR for high stress groups in ERI and JDC in males were as follows;

clerical workers: 5.18(95%CI 2.23;12.01,P<0.001), transport/communication workers: 3.05(95%CI 1.15;8.12,P=0.025), protective service workers: 2.71(95%CI 1.02;7.19,P=0.045), professionals/technicians: 2.47(95%CI 1.04;5.86,P=0.041), production workers/laborers: 1.86(95%CI 0.72;4.79,P=0.201), as compared to managers. Adjusted OR in females were as follows; service workers: 4.36(95%CI 0.56;34.04,P=0.161), clerical workers: 2.38(95%CI 0.31;18.32,P=0.406), professionals/technicians: 1.98(95%CI 0.26;15.13,P=0.510), production workers/laborers: 0.69(95%CI 0.07;6.76,P=0.752).

Discussion

This study was the first to examine relations between occupational stress and occupational class in a large sample of civil servants, using two occupational stress models (JDC and ERI). The analysis showed that the two models gave different results for occupational class with high stress levels.

Male managers showed a low prevalence OR of being in the high occupational stress group in JDC stress (high demands, low decision latitude), which coincides with the results by Kawakami *et al.* [24]. However, production workers/laborers showed a lower prevalence OR of being in the high occupational stress group, compared to managers. Besides, male clerical workers had the highest prevalence OR. This differs from the results by Kawakami et al[24] , that claimed that both male

and female workers in low occupational grades had a higher OR for being in the high stress group in JDC. The difference in the results could be caused by the fact that the subjects of this study were civil servants. Production workers/laborers in public sector might have fewer stress factors related to mass production than the same jobs in private sector[31]. On the other hand, civil servants are now faced with stress factors related to changes in the quality and quantity of work and changes in human relations due to computerization. The administrative reform promoting efficiency increase has also generated numerous stress factors. All this might have resulted in the growing burden of clerical workers[32].

Male professionals/technicians did not show a significantly higher prevalence OR of being in the high occupational stress group in JDC, compared to managers, but had a significantly high prevalence OR in ERI. Different results given by ERI and JDC for professionals/technicians also need consideration. Among the 5 measures of job stress, there were high correlations between job demand and effort, which coincided with the results by Tsutsumi *et al.*[13]. On the other hand, rather weak correlations between job control and reward were found. In males, the combined ERI & JDC high stress group had higher OR for high stress as compared to the high stress groups in both models taken separately. The two models identify different aspects of job stress with independent health effects [33]. Niedhammer *et*

al. [34] and Ota *et al.*[35] have reported that ERI and JDC play complementary roles in predicting health effects of psychological characteristics of a job. In this study as well, the two models showed different results for the relations between occupational stress and occupational class, which lets us suppose that the complementary use of both models can help in developing efficient stress measures.

In the case of overcommitment - an inherent factor within effort-reward imbalance – male professionals/technicians, clerical workers and protective service workers showed a significantly higher OR than that of managers. Overcommitment, considered to be an individual factor, has been reported to be higher among managers[25] and white-collar workers[23], compared to subordinates and blue-collar workers correspondently. In this study, male managers appeared not to have a significantly high level of overcommitment.

Next, it is necessary to discuss the relation of high stress to occupational categories in women. In JDC, no occupational class demonstrated a significantly higher prevalence OR of being in the high occupational stress group than that of managers. However, female service workers showed the highest, though not significant OR, which is close to the results by Kawakami *et al.* [24]. In ERI, female managers had the highest OR, showing a significant difference with production workers/laborers and clerical workers.

Female and male managers had different results, females showing a higher OR in ERI. In female managers, the job demands score in JDC and the effort score in ERI were rather high. Sekine *et al.* found that female employees of higher grade were exposed to higher job demands, compared to male employees. Besides, female employees of higher grade also worked long hours and had a high rate of work-to-family conflict[19]. In this study, the number of female subjects was smaller than that of male subjects, and they had different characteristics. However, our results demonstrated the existence of some kind of difference in the relations between occupational class and occupational stress by gender. This study showed that female managers were in the high stress group in ERI. Until recently, female managers in Japan have been an extremely small group and the problems of their health have drawn little attention. From now on this serious issue needs thorough examination.

A number of previous studies have examined stress factors typical for medical workers[36], software industry workers[32], clerical workers[37], production workers[31]. Further research is necessary to examine specific factors that cause differences in occupational stress by occupational class. Development of effective interventional measures for stress reduction[36] in accordance with occupational class and gender differences, as well as the possibility of individual approach to the issue of

overcommitment[7] also needs examination.

Several limitations of this study must be discussed. First, we have to point out the problem of selection bias. The subjects of this study were the employees of public organizations. As public and private organizations have different environments, assessment and competition systems, etc., research of private organizations is also necessary. The study was limited to north Japan, and the characteristics of the region might have influenced the results.

Since the present study was cross-sectional, it is probable that workers with severe mental and/or physical health problems had left or moved to another workplace with lower stress. That could have led to the underestimation of occupational stress prevalence. The response rate of this study was rather low, with those who perceived much stress probably being unable to take part in the survey. On the other hand, those who perceived very low stress might have had no interest in the stress questionnaire. However, this study was conducted as part of a survey of lifestyle-related diseases prevention, so the subjects' attitude to occupational stress might have had little influence on their incentive to answer this questionnaire. We had difficulties comparing the characteristics of the respondents and non-respondents. Though we made efforts to reduce bias, the non-response bias was to some extent unavoidable. Thus the results of this study

need to be interpreted carefully.

The subjects of the study were asked to choose their jobs from the list of job names used in their work places. Afterwards, the chosen jobs were classified into job categories according to the Standard Occupational Classification for Japan. Differential misclassification bias might occur at this stage. However, each workplace had a carefully subdivided job list, so the possibility of differential misclassification is considered to be low.

This study did not assess support by superiors and co-workers[4,38]. However, this and other confounding variables that could have influenced the results must be also taken into consideration.

This research was based on a large sample of subjects. However, the number of male service workers, female protective service workers, and female transportation and communication workers was small. Another research based on a larger sample of subjects or focused on these occupational categories is necessary.

In this study, we classified the jobs of the subjects using the Standard Occupational Classification for Japan. The Standard Occupational Classification for Japan differs from the International Standard Classification of Occupations, which divides occupations into high-grade and low-grade according to the level of knowledge and skills each occupation demands. Considering these differences in

classification standards, we should be very careful when comparing the results of this study to the results of the previous studies.

Conclusion

In this research, we identified relations between high stress indicated by two occupational stress models－JDC and ERI－and occupational class.

Male clerical workers, transport/communication workers and protective service workers showed a significantly higher prevalence OR of being in the high occupational stress group in JDC, compared to clerical workers. Male professionals/technicians showed a significantly high prevalence OR in ERI, the two models giving different results. Female managers had the highest OR in ERI, the result being different from male managers.

There exists a wide range of occupational stress factors, which may as well differ by occupational class. For protection of mental health of workers, it is necessary to promote anti-stress policies developed with thorough understanding of occupational and gender differences.

Acknowledgements

We thank Mr. Manabu Shojiguchi, Mr. Hiroyuki Arizuka, Ms. Toyoko Enomoto, Mr. Takanori Mogi, Mr. Naoto Sasaki, Mr. Takeshi Tsuda, Ms. Tomoko Arihara, Mr. Chizuko Sato, Dr. Takehito Nakabayashi, Mr. Masahiro Odajima, Ms. Tomoko

Hinoda, Ms. Mutumi Homma, and Ms. Mineko Muranaka for their valuable assistance in the data collection. We also thank Ms. Akemi Onodera, Ms. Maki Fukushima, and Ms. Aki Yasuike for their assistance in checking the data.

This work was supported in part by the Grant-in-Aid for Young Scientists of the Ministry of Education, Culture, Sports, Science and Technology of Japan and the Grant-in-Aid for Scientific Research of the Ministry of Health, Labour and Welfare of Japan.

References

1. Japanese Ministry of Health, Labor and Welfare (2000) Guideline for promoting mental health of workers at enterprises. Japanese Ministry of Health, Labor and Welfare, Tokyo.

2. Hellerstedt WL, Jeffery RW (1997) The association of job strain and health behaviours in men and women. Int J Epidemiol **26**,575-583.

3. Alterman T, Shekelle RB, Vernon SW, KD Burau SW (1994) Decision latitude, psychological demand, job strain, and coronary heart disease in the Western Electric Study. Am J Epidemiol **139**,620-627.

4. Stansfeld SA, Fuhrer R, Shipley MJ, Marmot MG (1999) Work characteristics predict psychiatric disorder; prospective results from the Whitehall Ⅱ study. Occup

Environ Med **56**, 302-307.

5. Tsutsumi A, Kayaba K, Tsutsumi K , Igarashi M (2001) Jichi Medical School Cohort Study Group. Association between job strain and prevalence of hypertension: a cross sectional analysis in a Japanese working population with a wide range of occupations: the Jichi Medical School cohort study. Occup Environ Med **58**, 367-373.

6. Karasek R (1979) Job demand, job decision latitude, and mental strain; Implications for job redesign. Adm Sci Quart **24**, 285-308.

7. Tsutsumi A (2004) Applicability of the effort-reward imbalance questionnaire to individual-focused stress reduction. Occup Mental Health**12**,20-24.

8. Bosma H, Peter R, Siegrist J, Marmot M (1998) Two alternative occupational stress models and the risk of coronary heart disease. Am J Public Health**88**,68-74.

9. Peter R, Siegrist J, Hallqvist J, Reuterwall C, Theorell T (2002) The SHEEP Study Group. Psychosocial work environment and myocardial infarction; improving risk estimation by combining two complementary occupational stress models in the SHEEP Study. J Epidemiol Community Health **56**, 294-300.

10. Kuper H, Singh-Manoux A, Siegrist J, Marmot M (2002) When reciprocity hails; effort-reward imbalance in relation to coronary heart disease and health functioning within the Whitehall Ⅱ study. Occup Environ Med **59**, 777-784.

11. Pikhart H, Bobak M , Pajak A, Malyutona S , Kubinova R, Topor R, Sebakova H, Nikitin Y, Marmot M (2004) Psychosocial factors at work and depression in three countries of Central and Eastern Europe. Soc Sci Med **58**, 1475-1482.

12. Knesebeck O, Siegrist J (2003) Reported nonreciprocity of social exchange and depressive symptoms. Extending the model of effort-reward imbalance beyond work, J. Psychosomatic Research **55**, 209-214.

13. Tsutsumi A, Kayaba K, Theorell T, Siegrist J (2001) Association between job stress and depression among Japanese employees threatened by job loss in a comparison between two complementary job-stress models, Scand J Work Environ Health **27**,146-153.

14. Jonge J, Bosma H, Peter R, Siegrist J (2000) Job strain, effort-reward imbalance and employee well-being: a large-scale cross-sectional study. Soc Sci Med **50**, 1317-1327.

15. 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**, 1387-1393.

16. Cavelaars AE, Kunst AE, Geurts JJ, Helmert U, Lunberg O, Matheson J, Mizrahi A, Rasmussen N, Spuhler T, Mackenbach JP (1998) Morbidity differences by occupational class among men in seven European countries: an application of

the Erikson-Goldthorpe social class scheme. Int J Epidemiol **27**, 222-230.

17.Nishi N, Makino K, Fukuda H, Tatara K (2004) Effects of socioeconomic indicators on coronary risk factors, self-rated health and psychological well-being among urban Japanese civil servants. Soc Sci Med **58**, 1159-1170.

18. Martikainen P, Lahelma E, Marmot M, Sekine M, Nishi N , Kagamimori S (2004) A comparison of socioeconomic differences in physical functioning and perceived health among male and female employees in Britain, Finland and Japan. Soc Sci Med **59**, 1287-1295.

19.Sekine M, Chandola T, Martikainen P, Marmot M, Kagamimori S (2006) Socioeconomic inequalities in physical and mental functioning of Japanese civil servants: Explanations from work and family characteristics. Soc Sci Med **63**, 430-445.

20. Wamara SP, Mittleman MA, Horsten M, Schenck-Gustafsson K, Orth-Gomer K (2000) Job stress and the occupational gradient in coronary heart risk in women, The Stockholm Female Coronary Risk study. Soc Sci Med **51**, 491-499.

21. Miura K, Morikawa Y, Ishizaki M, Kido T, Naruse M, Nakagawa H (2003) Association between occupational factors and long-term hypertension. Occup Health J **26**,53-58.

22. Kagamimori S (2003) Summary of the 2001 survey research of occupational

medicine ” Work strain due to quality and quantity of work and its impact on health in tertiary Occupational Mental industry”. J Occup Health **26**,28－39.

23. Peter R, Alfredsson L, Hammar N, Siegrist J, Theorell T, Westerholm P (1998) High effort, low reward, and cardiovascular risk in employed Swedish men and women: baseline results from the WOLF study. J Epidemiol Community Health **52**, 540-547.

24. Kawakami N, Haratani T, Kobayashi F, Ishizaki M, Hayashi T, Fujita O, Aizawa Y, Miyazaki S, Hiro H, Masumoto T, Hashimoto S, Araki S (2004) Occupational Class and Exposure to Job Stressors among Employed Men and Women in Japan. J Epidemiol **14**, 204-211.

25. Tsutsumi A, Kayaba K, Nagami M, Miki A, Kawano Y, Ohya Y, Odagiri Y, Shimomitsu T (2002) The Effort-reward Imbalance Model: Experience in Japanese Working Population. J Occup Health **44**, 398-407.

26. Tsutsumi A, Kayaba K, Theorell T, Siegrist J (2001) Association between job stress and depression among Japanese employees threatened by job loss in a comparison between two complementary job-stress models. Scand J work Environ Health **27**,146-153.

27. Kawakami N, Kobayashi F, Araki S, Haratani T, Furui H (1995) Assessment of job stress dimensions based on the Job Demands-Control model of employees of

telecommunication and electric power companies in Japan: reliability and validity of the Japanese version of Job Content Questionnaire. Int J Behavior Med **2**, 358-375.

28. Tsutsumi A, Ishitake T, Siegrist J, Matoba T (2001) The Japanese version of the Effort-Reward Imbalance Questionnaire: a study in dental technicians. Work & Stress **15**, 86-96.

29. Ministry of Internal Affairs and Communications, Statistics Bureau, Statistical Standards Department (1998) Standard Occupational Classification for Japan. National Federation of Statistical Organizations, Tokyo.

30. Takaki J, Nakao M, Karita K, Nishikitani M, Yano (2006) Relationships between Effort-Reward Imbalance, Over-Commitment, and Fatigue in Japanese Information-Technology Workers. J Occup Health **48**, 62-64.

31.Watanabe M (2003) Stress Management in manufacturing industry. Sangyo Eiseigaku Zasshi **45**,1-6.

32.Asakura T (2002) Stressor and stress reduction strategies for computer software engineers. Sangyo Eiseigaku Zasshi **44**,117-124.

33. Tsutsumi A (2005) Psychosocial Factors and Health: Community and Workplace Study. J Epid **15**, 65-69.

34.Niedhammer I, Chastang JF, David S, Barouhiel L, Barrandon G (2006)

Psychosocial work environment and mental health: Job-strain and effort-reward imbalance models in a context of major organizational change. Int J Occup Environ Health **12**, 111-119.

35.Ota A, Masue T, Yasuda N, Tsutsumi A, Mino Y, Ohara H (2005) Association between psychosocial job characteristics and insomnia: an investigation using two stress models-the demand-control-supprt(DCS) model and the effort-reward imbalance(ERI) model. Sleep Med **6**, 353-358.

36. Miki A (2002) Stress management in hospitals. Sangyo Eiseigaku Zasshi **44**, 219－223.

37. Hayashi T (2002) Stress management for clerical workers. Sangyo Eiseigaku Zasshi **44**,175-179.

38.Johnson J V, Hall E M (1998) Job strain, work place social support, and cardiovascular Disease; A cross-sectional study of a random sample of the Swedish Working Population. Am J Public Health **78**, 1336-1342.

Table1-Characteristics of male subjects

	Managers	Production workers/labourers	Professionals/technicians	Protective service workers	Transport/communication workers	Clerical workers	Service workers	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
					Males			
	(n=601)	(n=727)	(n=1983)	(n=509)	(n=392)	(n=2202)	(n=9)	(n=6423)
Age mean (±SD)	53.3 (±4.3)	49.4 (±6.5)	46.5 (±6.5)	45.7 (±7.3)	49.5 (±7.5)	46.3 (±6.7)	49.4 (±6.5)	47.5 (±6.9)
Marital status								
Married	580 (91.5)	677 (87.5)	1852 (87.6)	469 (90.5)	383 (85.5)	1891 (82.9)	38 (95.0)	5890 (85.6)
Unmarried	54 (8.5)	97 (12.5)	263 (12.4)	49 (9.5)	65 (14.5)	391 (17.1)	2 (5.0)	921 (13.5)
Educational attainment								
High school or lower	134 (21.1)	616 (79.6)	738 (34.9)	411 (79.3)	394 (87.9)	918 (40.2)	35 (87.5)	3246 (47.7)
Higher than high school	500 (78.9)	158 (20.4)	1377 (65.1)	107 (20.7)	54 (12.1)	1364 (59.8)	5 (12.5)	3565 (52.3)
Presence/absence of shift work								
Yes	16 (2.5)	209 (27.0)	126 (6.0)	414 (79.9)	280 (62.5)	86 (3.8)	20 (50.0)	1151 (16.9)
No	618 (97.5)	565 (73.0)	1989 (94.0)	104 (20.1)	168 (37.5)	2196 (96.2)	20 (50.0)	5660 (83.1)
Workplace								
A	404 (67.2)	651 (89.5)	728 (36.7)	479 (94.1)	380 (96.9)	1110 (50.4)	1 (11.1)	3753 (58.4)
B	1 (0.2)	0 (0.0)	9 (0.5)	29 (5.7)	0 (0.0)	37 (1.7)	4 (44.4)	80 (1.2)
C	196 (32.6)	76 (2.9)	1246 (62.8)	1 (0.2)	12 (3.1)	1055 (47.9)	4 (44.4)	2590 (40.3)
Stress score average(±SD)								
Demand	11.4 (±2.2)	10.5 (±2.4)	12.1 (±2.4)	12.2 (±2.2)	9.8 (±2.5)	11.5 (±2.4)	12.3 (±2.6)	11.5 (±2.5)
Control	17.1 (±2.2)	15.5 (±2.6)	17.2 (±2.4)	16.7 (±2.0)	12.0 (±2.6)	15.9 (±2.3)	15.3 (±2.5)	16.2 (±2.7)
Effort	9.3 (±2.8)	8.9 (±3.2)	10.9 (±4.0)	11.0 (±3.6)	10.6 (±4.2)	10.2 (±4.0)	10.3 (±3.2)	10.3 (±3.9)
Reward	51.1 (±4.6)	49.4 (±5.5)	49.2 (±5.7)	51.2 (±4.4)	49.3 (±6.0)	49.4 (±5.6)	46.0 (±8.2)	49.6 (±5.5)
Overcommitment	13.1 (±2.4)	12.2 (±3.0)	13.7 (±2.8)	12.8 (±2.9)	12.1 (±3.1)	13.4 (±2.9)	14.1 (±2.2)	13.2 (±2.9)
					Females			
	(n=34)	(n=88)	(n=847)	(n=4)	(n=6)	(n=406)	(n=221)	(n=1606)
Age mean (±SD)	52.8 (±5.1)	49.4 (±6.3)	44.3 (±7.1)	34.0 (±8.0)	51.0 (±6.9)	45.0 (±7.1)	50.0 (±7.0)	45.7 (±7.4)
Marital status								
Married	20 (58.8)	64 (72.7)	542 (63.8)	1 (25.0)	5 (62.5)	243 (59.9)	115 (52.0)	990 (61.5)
Unmarried	14 (41.2)	24 (27.3)	307 (36.2)	3 (75.0)	3 (37.5)	163 (40.1)	106 (48.0)	620 (38.5)
Educational attainment								
High school or lower	3 (8.8)	69 (78.4)	63 (7.4)	0 (0.0)	8 (100)	202 (49.8)	198 (89.6)	545 (33.9)
Higher than high school	31 (91.2)	19 (21.6)	786 (92.6)	4 (100)	0 (0.0)	204 (50.2)	23 (10.4)	1065 (66.1)
Presence/absence of shift work								
Yes	1 (2.9)	2 (2.3)	349 (41.1)	1 (25.0)	3 (37.5)	7 (1.7)	6 (2.7)	369 (22.9)
No	33 (97.1)	86 (97.7)	500 (58.9)	3 (75.0)	5 (62.5)	399 (98.3)	215 (97.3)	1241 (77.1)
Workplace								
A	24 (70.6)	84 (95.5)	419 (49.5)	3 (75.0)	4 (66.7)	230 (56.7)	218 (98.6)	982 (61.0)
B	1 (2.9)	0 (0.0)	31 (3.7)	1 (25.0)	0 (0.0)	10 (2.5)	0 (0.0)	43 (2.7)
C	9 (26.5)	4 (4.5)	397 (46.9)	0 (0.0)	2 (33.3)	166 (40.9)	3 (1.4)	581 (36.2)
Stress score average(±SD)								
Demand	13.1 (±2.2)	10.1 (±2.2)	13.0 (±2.2)	11.0 (±1.2)	9.5 (±3.2)	11.2 (±2.4)	11.8 (±2.6)	12.2 (±2.5)
Control	18.2 (±1.8)	14.1 (±2.9)	17.1 (±2.2)	18.3 (±0.5)	12.5 (±2.7)	15.0 (±2.5)	13.3 (±2.1)	15.9 (±2.8)
Effort	13.1 (±4.7)	9.4 (±3.1)	14.1 (±4.7)	10.3 (±1.0)	8.0 (±3.0)	10.4 (±4.0)	12.1 (±3.5)	12.6 (±4.6)
Reward	50.4 (±5.5)	49.0 (±5.8)	47.9 (±6.4)	51.2 (±2.9)	46.3 (±9.5)	49.7 (±5.1)	48.7 (±5.9)	48.6 (±6.0)
Overcommitment	14.8 (±3.0)	12.7 (±2.8)	14.5 (±2.9)	13.5 (±4.1)	13.6 (±3.4)	13.4 (±3.2)	13.3 (±3.0)	14.0 (±3.1)

Table2. Association between occupational categories and occupational stress models in males

Stress model	Occupational category	n	High job stress							
			n	(%)	Unadjusted OR	(95%CI)	P-value	Adjusted OR	(95%CI)	P-value
Job Demand-Control										
	Managers	601	15	(2.5)	1.00			1.00		
	Production workers/laborers	727	40	(9.7)	2.28	(1.24-4.16)	0.008	1.49	(0.79-2.81)	0.223
	Professionals/technicians	1983	86	(4.3)	1.77	(1.02-3.09)	0.044	1.55	(0.87-2.76)	0.134
	Protective service workers	509	45	(8.8)	3.79	(2.09-6.89)	<.0001	2.01	(1.02-3.97)	0.044
	Transport/communication workers	392	37	(9.4)	4.07	(2.20-7.53)	<.0001	2.15	(1.09-4.25)	0.027
	Clerical workers	2202	189	(8.6)	3.67	(2.15-6.26)	<.0001	3.14	(1.81-5.45)	<.0001
Effort-Reward Imbalance										
	Managers	601	96	(16.0)	1.00			1.00		
	Production workers/laborers	727	131	(18.0)	1.16	(0.87-1.54)	0.324	1.12	(0.82-1.53)	0.468
	Professionals/technicians	1983	689	(34.7)	2.80	(2.21-3.55)	<.0001	2.35	(1.83-3.01)	<.0001
	Protective service workers	509	155	(30.5)	2.30	(1.73-3.07)	<.0001	1.61	(1.14-2.28)	0.007
	Transport/communication workers	392	119	(30.4)	2.29	(1.69-3.12)	<.0001	2.02	(1.42-2.87)	<.0001
	Clerical workers	2202	615	(27.9)	2.04	(1.61-2.58)	<.0001	1.77	(1.38-2.28)	<.0001
ERI overcommitment										
	Managers	597	149	(25.0)	1.00			1.00		
	Production workers/laborers	718	136	(18.9)	0.70	(0.54-0.91)	0.009	0.82	(0.62-1.09)	0.173
	Professionals/technicians	1967	697	(35.4)	1.65	(1.34-2.03)	<.0001	1.52	(1.22-1.90)	<.0001
	Protective service workers	508	134	(26.4)	1.08	(0.82-1.41)	0.590	1.42	(1.02-1.98)	0.038
	Transport/communication workers	387	76	(19.6)	0.74	(1.00-0.05)	0.123	0.96	(0.68-1.37)	0.835
	Clerical workers	2188	723	(33.0)	1.48	(1.21-1.82)	<.0001	1.43	(1.15-1.78)	0.001

Adjusted by age, marital status, educational attainment, workplace and presence/absence of shiftwork.

JDC high job stress; combination of low control and high demand.

ERI high job stress ; the upper tertile of Effort-Reward ratios.

Table3. Association between occupational categories and occupational stress models in females

Stress model	Occupational category	n	High job stress						
			n(%)		Unadjusted OR(95%CI)		P-value	Adjusted OR(95%CI)		P-value
Job Demand-Control										
	Managers	34	2	(5.9)	1.00			1.00		
	Production workers/laborers	88	9	(10.2)	1.82	(0.37-8.91)	0.458	1.04	(0.20-5.36)	0.959
	Professionals/technicians	847	88	(10.4)	1.86	(0.44-7.87)	0.402	1.28	(0.29-5.60)	0.744
	Clerical workers	406	54	(13.3)	2.46	(0.57-10.54)	0.227	1.86	(0.42-8.19)	0.414
	Service workers	221	65	(29.4)	6.67	(1.55-28.64)	0.011	4.00	(0.89-17.92)	0.070
Effort-Reward Imbalance										
	Managers	34	20	(58.8)	1.00			1.00		
	Production workers/laborers	88	20	(22.7)	0.21	(0.09-0.48)	<.0001	0.20	(0.08-0.47)	<.0001
	Professionals/technicians	847	543	(64.1)	1.25	(0.62-2.51)	0.530	0.86	(0.41-1.76)	0.671
	Clerical workers	406	129	(31.8)	0.33	(0.16-0.67)	0.002	0.28	(0.13-0.59)	<.0001
	Service workers	221	108	(48.9)	0.67	(0.32-1.39)	0.282	0.63	(0.29-1.36)	0.240
ERI overcommitment										
	Managers	34	17	(50.0)	1.00			1.00		
	Production workers/laborers	88	23	(26.1)	0.35	(0.16-0.81)	0.013	0.33	(0.14-0.77)	0.011
	Professionals/technicians	844	410	(48.6)	0.95	(0.48-1.88)	0.871	0.88	(0.43-1.79)	0.723
	Clerical workers	404	144	(35.6)	0.55	(0.27-1.12)	0.099	0.52	(0.25-1.08)	0.078
	Service workers	219	68	(31.1)	0.45	(0.03-3.53)	0.362	0.41	(0.19-0.88)	0.023

Adjusted by age, marital status, educational attainment, workplace and presence/absence of shiftwork.

JDC high job stress; combination of low control and high demand.

ERI high job stress ; the upper tertile of Effort-Reward ratios.

Table4. Correlation matrix for job stress measures

	Job Demands-Control Mode		Effort-Reward Imbalance Model		
	Demand	Control	Effort	Reward	Overcommitment
Males					
Demand		0.430	0.641	-0.209	0.445
Control			0.186	0.053	0.180
Effort				-0.390	0.483
Reward					-0.318
Overcommitment					
Females					
Demand		0.357	0.674	-0.303	0.409
Control			0.234	0.008	0.147
Effort				-0.458	0.504
Reward					-0.357
Overcommitment					

p value is 0.001 and less for all items.