[Article type] Original Article

[Title]
Work and family characteristics as socioeconomic determinants in long sickness absence: the Japanese civil servants study

[Authors] 1Saori NOSE, 1Michikazu SEKINE, 1Takashi TATSUSE and 1Masaaki YAMADA

[Affiliation] 1Department of Epidemiology and Health Policy, School of Medicine, University of Toyama, Japan

Tel: 076-434-7270 / Fax: 076-434-5022

[Email address] snose.3055@gmail.com

[Short running title] SOCIOECONOMIC DIFFERENCE IN LONG SICKNESS ABSENCE
Long sickness absence is more common among low socioeconomic status (SES) groups than high SES groups. This study aimed to evaluate whether work and family characteristics contribute to SES and sex differences in long sickness absence (7 days or more). The participants were 3080 civil servants working for a local Japanese government. In both sexes, low-grade employees were likely to take long sickness absence, with a statistically significant association for men (age-adjusted OR of lowest-grade employees for long sickness absence: 2.30 (95% Confidence Interval (CI): 1.32–4.02)). After adjusting for all variables, SES differences in long sickness absence in men decreased to OR 1.98 (CI 1.10–3.55) but remained significant; in men, being without a spouse was significantly associated with long sickness absence. Employees working long hours had lower OR for long sickness absence after adjusting for all variables in both sexes. Conversely, poor sleep quality and longstanding illness significantly increased OR for long sickness absence. In conclusion, SES differences in sickness absence were explained partly by work and family characteristics, longstanding illness, and poor sleep quality; however, other factors that were not evaluated in this study may also be associated with SES differences.
[Key words] Sickness absence, Socioeconomic status, Grade of employment, Job stress, Family characteristics, The JACS study.
Introduction

Sickness absence is an important occupational problem. Approximately 2,400 people per 100,000 population among Japanese civil servants have been taking long sickness absence since 2006, and the number has increased to more than 2,500 people per 100,000 population in 2018\(^1\). A study conducted in 2011 showed that economic loss resulting from sickness or injury amounted to 3.3 trillion yen (approximately 29.7 billion US dollars), and economic loss resulting from absenteeism another 2.9 trillion yen (approximately 26.1 billion US dollars) while presenteeism accounted for 0.5 trillion yen (approximately 4.5 billion US dollars)\(^2\). In 2015, sickness absence caused an economic loss of 3.8% of gross domestic product (GDP) in Japan, which is expected to rise to 4.1% in 2030\(^3\). In this way, sickness absence has serious effects on both individuals and society at large.

There have been many studies on employees’ sickness absence. For example, older employees tend to take longer sickness absence than do younger ones\(^4\). Employees with sleep problems had a higher risk for sickness absence than did those without\(^5\)\(^-\)\(^6\). As for work characteristics, having high job stress, low job satisfaction, and long working hours were associated with higher rates of sickness absence\(^7\)\(^-\)\(^12\). As for family characteristics, single men and women were more likely to have poor mental health than those who were married\(^13\), and
fatigue from stress is associated with an increased risk of long-term sickness absence\(^6\).

The problem of sickness absence is due to sex differences, suggesting that women are more likely to take sickness absence than men\(^4\). Especially for women, there is a glass ceiling phenomenon in salary increase and promotion\(^5\), which is thought to lead to sickness absence and gender gap. The gender gap is very low in Japan, ranking at 120\(^{th}\) out of 156 countries in the world in 2021\(^6\). A previous study showed differences in sex and socioeconomic status (SES) regarding work environment\(^{13}\).

While SES is an important determinant of occupational and individual health. In a previous study\(^{13}\), the low SES of male employees was found to be associated with poor physical and mental health. SES differences are known risk factors for the leading causes of sickness absence such as cardiovascular diseases, low back pain, and depression\(^{10\text{--}12}\).

Although there have been previous studies on the association of SES with sickness absence, and the associations of work and family characteristics with sickness absence, whether SES differences in sickness absence are explained by work and family characteristics has not been comprehensively evaluated. Moreover, although work and family characteristics and SES differences in sickness absence may differ between men and women, very few studies have focused on sex differences\(^{17}\). Thus, this study aimed to evaluate whether work and family characteristics contribute to SES differences in sickness absence and whether the associations
Methods

Study and Questionnaire

The Japanese civil servants study (the JACS study)\textsuperscript{13,18–19} was an international joint study with the Whitehall II Study (British civil servants study) and the Helsinki Health Study (HHS). Most questionnaire items in our study were selected from the Whitehall II study\textsuperscript{4,7,17,20}. These items were translated into Japanese; thereafter, they were back-translated into English by someone who did not know the original questionnaire. The accuracy of the back-translated questionnaire was confirmed by researchers in the Whitehall II study.

Participants

The study was conducted between January and February 2003. The participants of this study were all civil servants aged 20–65 years at the time of the survey, who were working in a local government, approximately in the center of Japan’s main island. A postal questionnaire was sent to participants. Once filled out, they returned it to the researchers in sealed envelopes. The Ethical Committee of the University of Toyama approved the study. The subjects gave informed consent and participated voluntarily in this study.
Altogether, 4,272 participants responded to the questionnaire (response rate 79.2%). Participants who did not answer questions on age, sex, family status, longstanding illness, sleep status, Karasek’s job strain model, grade of employment, shift work, job satisfaction, and work hours were excluded from the analysis. Finally, data on 3080 participants (2,091 men and 989 women, with gender ratios of 67.9% men and 32.1% women, and analysis rates of 76.3% men and 70.3% women, respectively) were analyzed. The mean ages of the participants were 44.2 ± 9.7 years for men and 40.6 ± 10.8 years for women.

Measures for sickness absence

The participants were asked to provide information on the total number of days of sickness absence in the previous year. We defined short-term sickness absence as periods less than 7 days and long-term sickness absence as 7 days or more in the previous year\(^{(19)}\). Previous studies showed that short-term sickness absence (less than 7 days) was mainly attributable to minor symptoms, while long-term was attributable to more serious diseases such as cardiovascular diseases\(^{(21, 22)}\). Furthermore, the previous Whitehall II studies chose 7 days as the cut-off for long-term sickness absence because it required a medical certificate\(^{(4, 7)}\). Therefore, we also took 7 days or more as long-term sickness absence in this study.
Measures for SES

Our study used grade of employment to investigate SES. We asked “Which of the following is your position in the workplace?”, and we got an answer classified into 3 grades. According to our previous studies\(^{13,18}\), grade of employment was classified into 3 grades: the highest grade (grade 1) includes senior administrative workers (e.g., Head of Bureau, Head of Department, Deputy Head of Department, and Head of Section); the intermediate grade (grade 2), administrative workers (e.g., Assistant Head of Section and Subsection Chief); and the lowest grade (grade 3), clerical workers.

Measures for the working environments

The participant’s working environment was evaluated using work hours, job satisfaction, shift work and Karasek’s job strain model\(^{20,23}\).

Work hours per day were classified into four periods: less than 7 hours, from 7 to 9 hours, from 9 to 11 hours, 11 hours or more.

Regarding job satisfaction, we asked “How satisfied are you with your job as a whole, taking everything into consideration?” Items on job satisfaction had four response categories: very satisfied, satisfied, unsatisfied, very unsatisfied about their job. We created two categories: “satisfied” (very satisfied and satisfied) and “unsatisfied” (unsatisfied and very unsatisfied). A previous study showed that the reliability of the single-item measurement of job satisfaction is
Regarding shift work, we asked “Does your job have shift work?” Shift work was classified in two response categories: “shift workers” or “no shift workers”.

A job strain (demand-control-support) model\(^{23}\) was used to evaluate psychosocial work characteristics, consisting of 25 self-reported items, including 15 items for job control, 4 items for job demand, and 6 items for social support at work\(^{20}\). Response categories ranged from 0 (often) to 3 (never). After all items were re-coded in the same direction, scores for each scale were calculated by summing item scores. Participants were divided into tertiles according to scores. A high score in each scale indicates high control, high demand, or high support at work, respectively. The reliability coefficient (Cronbach’s alpha\(^{25}\)) was 0.78 for control, 0.69 for demand, and 0.83 for social support in this study population.

**Measures for family characteristics**

Participants were asked, “Who are you living with?” There were 9 response categories to this question: alone, with a spouse, with children under 5 years old, with children 5–15 years old, with children 15 years old or more, with father, with mother, with father-in-law, and with mother-in-law. Responses were classified into three categories: “spouse status” (living with a spouse), “children status” (living with children under 5 years old, with children 5–15 years old,
with children 15 years old or more) and “parents status” (living with father, mother, father-in-law, or mother-in-law).

**Measures for sleep time and quality**

This study used data on sleep time and quality. We asked regarding sleep time, “What is the actual average sleep time last month?” and regarding sleep quality, “How do you evaluate your sleep quality last month?” The item on sleep quality consisted of four response categories: very good, good, poor, very poor. Responses were classified into two categories: “good” (very good and good) and “poor” (poor and very poor). Participants were asked to provide sleep hours as average sleeping time in the previous month. Regarding sleep time, a previous study showed that the association of sleep hours and physical and mental health formed a U-shaped curve and that people who slept from 6 to 8 hours were mostly healthy. Therefore, we divided sleep time into the following categories: 6 hours or less, from 6 to 8 hours, and more than 8 hours.

**Statistical analyses**

We performed $\chi^2$ tests to evaluate whether there were sex differences in work and family characteristics and longstanding illnesses. Logistic regression analyses were performed to examine whether there were employment-grade differences in sickness absence and whether
such SES differences are explained by work and family characteristics and longstanding illnesses. Odds ratio (OR) and 95% confidence intervals (95%CI) were calculated. Statistical analysis was performed using SPSS (22.0). A two-tailed P-value of less than 0.05 was considered significant.

Results

Table 1 shows the participants’ characteristics according to sex. Women were relatively young and more likely to be unmarried than men. More women belonged to lower grades of employment. Further, women had lower control and higher demands at work, worked longer, and were more often shift workers. However, men were likely to sleep longer and have better sleep quality than women, and men had more longstanding illnesses than women.

Table 2 shows SES differences in sickness absence before and after adjusting for work and family characteristics in men. In the age-adjusted model (model 1), low-grade employees had significantly higher OR for long sickness absence (OR=2.30(95%CI:1.32–4.02)). After adjustment for work characteristics (model 2), the association between grade of employment and long sickness absence was lower (OR=2.01(1.12–3.56)). After adjusting for family characteristics (model 3) and all covariates (model 4), the SES differences in long sickness absence decreased slightly (ORs=1.97(1.10–3.52) and 1.98(1.10–3.55), respectively). Men
working 11 hours or more had lower OR for sickness absence (OR=0.48(0.23–0.99)). Men without a spouse had significantly higher OR for long sickness absence (OR= 2.07(1.30–3.28)). Additionally, poor sleep quality and longstanding illness were associated with long sickness absence (ORs=1.92(1.38–2.68) and 2.18(1.57–3.03), respectively). Employees with low control, low support, and unsatisfied with their job were relatively more likely to take long sickness absence. However, these associations were not statistically significant.

Table 3 shows SES differences in sickness absence before and after adjusting for work and family characteristics in women. Because of the few highest-grade employees, the highest and intermediate-grade employees were combined in the analysis. Lower-grade employees were likely to take long sickness absence; however, the association was not statistically significant (aged-adjusted OR for long sickness absence=1.40(0.71–2.76)). The SES difference decreased further after adjusting for work characteristics (OR=1.23(0.59–2.55)). In the fully adjusted model (model 4), women working from 9 hours to 11 hours and those working 11 hours or more had a significantly lower OR for long sickness absence (ORs=0.32(0.16–0.60) and 0.24(0.07–0.84), respectively). In women, sickness absence was not significantly associated with family characteristics. However, women without children were more likely to take long sickness absence than those living with children (OR=1.36(0.83–2.24)). Poor sleep quality and longstanding illness had significantly higher OR for long sickness absence (ORs=2.30(1.43–
In contrast to the results obtained for men, in women, job stress and job dissatisfaction were not associated with long sickness absence.

**Discussion**

This study showed that SES differences in sickness absence were, in part, explained by work and family characteristics. Notably, after making adjustments for work characteristics (job satisfaction and shift work, work hours, job stress), the SES differences in long sickness absence in men decreased. In women, SES differences in sickness absence were not statistically significant; moreover, they slightly decreased after adjusting for work and family characteristics.

A previous study showed that low-grade employees were more likely to have poor physical and mental functioning than high-grade employees. SES differences in physical and mental functioning decreased and were no longer significant after adjustments for work and family characteristics. Stressful work characteristics were more common among low-grade employees, which may have led to health inequalities. In other studies, employees with physical and mental dysfunction tended to be absent from work. This study showed that low-grade male employees were twice more likely to take long sickness absence. The results from this study are, therefore, similar to previous findings.
In women, the association of long sickness absence and grade of employment was not statistically significant; moreover, the strength of the association decreased after correcting for work and family characteristics. Previous studies showed that male managers and supervisors with high credentials showed better self-reported health than those in other class positions (most notably semi-skilled and unskilled workers). In female employees, the association between social class and self-reported health status was less evident than that among men (lower adjusted OR in logistic models than men)\textsuperscript{27}). And the association between SES and health in women is not as strong when women are categorized by their occupation compared to the head of household\textsuperscript{28}). This is why that social class inequality in health has been a problem among men; women’s health is possibly more influenced by other factors, such as household role and the occupation of the head of household\textsuperscript{27,28}). Therefore, the results on SES differences in long sickness absence in women were not significant, and SES differences in men were more pronounced than those in women in this study.

As for working hours, in both sexes, employees working long hours (men worked 11 hours or more and women worked 9 hours or more) had lower ORs for sickness absence, associations that remained significant in the fully adjusted model. Long hospital shifts have not been associated with either short or long sickness absence, probably because it is difficult for employees working long hours to take sickness absences\textsuperscript{29–30}). However, other studies showed
the opposite\textsuperscript{31, 32}. As our study is a cross-sectional study, employees working long hours who took long sickness absence might not have participated in this study, considering we required employees not to be absent during the research period.

In contrast, women working less than 7 hours took less long sickness absence than those who worked from 7 to 9 hours. However, the association was not significant after adjustments for sleep quality and longstanding illness, which may mean that employees working short hours do so because of illnesses. Additionally, women who raise young children and care for the elderly may have poor sleep time and quality and be included in the group working less than 7 hours\textsuperscript{33, 34}.

As for family characteristics, men without a spouse were associated with long sickness absence, as were women without children. A previous study showed that men with a spouse (regardless of having children or not) had lower OR for poor sleep and mental dysfunction than men without a spouse\textsuperscript{13, 18}. Therefore, men with a spouse had lower OR for long sickness absences than those without a spouse. Meanwhile, among women, sickness absence is more common in those with children than among those without\textsuperscript{35}. However, in this study, women with children did not take more long sickness absence. In Japan, women with children may have more motivation to work than those without children because they have made a deliberate choice to continue working after they had their children\textsuperscript{36, 37}. This may make them less prone to
taking long sickness absence.

The strengths of this study are the comprehensive investigation of the work and family characteristics as determinants of SES difference in long sickness absence, and the influence of sex on these characteristics and differences. In Japan, studies on this last topic are rare. Despite the Whitehall II study showing that grade of employment was associated with disease in long and short sickness absence\(^{17}\), comprehensive investigations on these relationships are scarce. In the Japanese civil servants study\(^{13, 18, 19, 33}\), grade differences were associated with work and family characteristics, sleep, quality of life, and, in turn, physical and mental health. Therefore, grade differences were possibly associated with long sickness absence in this study.

This study has several limitations. First, this study was cross-sectional, and it cannot, therefore, determine causal associations between sickness absence and work and family characteristics. Moreover, this study was conducted from January to February 2003, and employees who took long sickness absence during that period may have been excluded from this study. A longitudinal investigation would be needed to reveal those associations and investigate employees who took sickness absences. Second the findings of this study are based on data from 2003 which raises the question whether these findings are still relevant. However, as the sickness absence rate has been increasing from 2006 and continues to remain at a high level\(^{11}\), presently the associations may be even stronger than the ones we found. Third, a
previous study showed that working conditions found in female-dominated occupations contribute to lower sickness absence, and the working conditions found in male-dominated occupations contribute to higher sickness absence after adjusting the selection effect\textsuperscript{14). This underlines the need to proceed with research which incorporates perspectives on individual occupational selection and characteristics of the group to which employees belong.

Fourth, in our study, SES differences for long sickness absence decreased in both sexes, but remained significant until final models in men and not significantly from first models in women. Other factors, like self-efficacy and other personal characteristics, were not investigated in this study. A previous study suggested that high work-related self-efficacy is important for early return to work, which may contribute to shorter sickness absence\textsuperscript{38). Therefore, further research that involves these factors is needed. Fifth, because the participants were working civil servants, we cannot generalize the results to the Japanese adult working population. Compared to the general adult population, civil servants comprise more regular employees, who are relatively young and mostly white-collar workers. In Japan, the absence rate was high in non-regular employment, old, and blue-collar workers (for example, agriculture, forestry, and fishery industry workers and those involved in construction and cleaning)\textsuperscript{39). Therefore, the association of sickness absence and working environmental factors which we found may be an underestimation.
In conclusion, this study showed SES differences in long sickness absence in Japanese civil servants. There were SES differences in long sickness absence among men; the differences were attenuated when adjusted for work and family characteristics. Contrastingly, SES differences in sickness absence slightly decreased after adjusting for work and family characteristics among women; however, they were not statistically significant. Work and family characteristics and longstanding illness, including sleep problems, could partially explain the SES and sex differences; however other contributing factors may also underlie this effect. A better understanding of how factors related to SES and work and family characteristics influence sickness absence may help to improve working conditions for workers and at the same time prevent a further increase of long sickness absence.

Acknowledgments

We are indebted to all the civil servants in the local government department for participating in this study. This study was in part funded by the Ministry of Health, Labour and Welfare of Japan, Japanese Society for the Promotion of Science, Occupational Health Promotion Foundation, the Universe Foundation (98.04.017), Daiwa Anglo-Japanese Foundation (03/2059), Great Britain Sasakawa Foundation (2551). The funding sources were not involved in the study design, the collection and analysis and interpretation of data, the
writing of the report, and the decision to submit the paper for publication.

References

1) Japan Local Government Employee Safety & Health Association. The Current Health Status of Local Japanese Civil Servants. http://www.jalsha.or.jp/tyosa/result (in Japanese). Accessed June 28, 2020.

2) The American Chamber of Commerce in Japan. Financial loss resulting from sickness or injury. (Press Release)

https://www.accj.or.jp/uploads/4/9/3/4/49349571/pr_health_j.pdf (in Japanese). Accessed December 20, 2019.

3) U.S. Chamber of Commerce. Health and The Economy-The Impact of Wellness on Workforce Productivity in Global Markets.

https://www.uschamber.com/sites/default/files/documents/files/global_initiative_on_health_and_the_economy__report.pdf. Accessed March 31, 2021.

4) Ferrie J, Head J, Shipley M, Vahtera J, Marmot M, Kivimäki M (2007) BMI, obesity, and sickness absence in the Whitehall II study. Obesity 15, 1554–64.

5) Rahkonen O, Lallukka T, Kronholm E, Vahtera J, Lahelma E, Laaksonen M (2012) Sleep
problems and sickness absence among middle-aged employees. Scand J Work Environ Health \textbf{38}, 47–55.

6) Åkerstedt T, Kecklund G, Alfredsson L, Selen J (2007) Predicting long-term sickness absence from sleep and fatigue. J Sleep Res \textbf{16}, 341–5.

7) North F, Syme L, Feeney A, Shipley M., Marmot M (1996) Psychosocial work environment and sickness absence among British civil servants: The Whitehall II study. Am J Public Health \textbf{86}, 332–40.

8) Nakata A, Takahashi M, Irie M, Ray T, Swanson N (2011) Job satisfaction, common cold, and sickness absence among White-collar employees: a cross-sectional survey. Ind Health \textbf{49}, 116–21.

9) Tatsuse T, Sekine M, Yamada M (2019) The contributions made by job satisfaction and psychosocial stress to the development and persistence of depressive symptoms. a 1-year prospective study. J Occup Environ Med \textbf{61}, 190–6.

10) Kivimäki M, Nyberg S T, Batty G. D, Kawachi I, Jokela M, Alfredsson L, Bjorner B, Borritz M, Burr H, Dragano N, Fransson I, Heikkilä K, Knutsson A, Koskenvuo M, Kumari M, Madsen H, Nielsen L, Nordin M, Oksanen T, Peijtersen H, Pentti J, Rugulies R, Salo P, Shipley J, Suominen S, Theorell T, Vahtera J, Westerholm P, Westerlund H, Steptoe A, Singh-Manoux A, Hamer M, Ferrie E, Virtanen M, Tabak G, IPD-Work consortium (2017)
Long working hours as a risk factor for atrial fibrillation: a multi-cohort study. Eur Heart J 38, 2621–8.

11) Sumanen H, Pietiläinen O, Lahelma E, Rahkonen O (2017) Short sickness absence and subsequent sickness absence due to mental disorders - a follow-up study among municipal employees. BMC Public Health 17, 15.

12) Kivimäki M, Head J, Ferrie E, Hemingway H, Shipley J, Vahtera J, Marmot M (2005) Working while ill as a risk factor for serious coronary events: the Whitehall II study. Am J Public Health 95, 98–102.

13) 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, 430–45.

14) Melsom A M, Mastekaasa A (2018) Gender, occupational gender segregation and sickness absence: longitudinal evidence. Acta Sociol 61, 227–45.

15) Johns M L (2013) Breaking the glass ceiling: structural, cultural, and organizational barriers preventing women from achieving senior and executive positions. Perspect Health Inf Manag 10, 1e.

16) World Economic Forum. Global Gender Gap Report 2021 Insight Report.

http://www3.weforum.org/docs/WEF_GGGR_2021.pdf. Accessed April 1, 2021.
17) Feeney A, North F, Head J, Canner R, Marmot M (1998) Socioeconomic and sex differentials in reason for sickness absence from the Whitehall II study. Occup Environ Med 55, 91–8.

18) Sekine M, Chandola T, Martikainen P, Marmot M, Kagamimori S (2010) Sex differences in physical and mental functioning of Japanese civil servants: explanations from work and family characteristics. Soc Sci Med 71, 2091–9.

19) Sekine M, Nasermoaddeli A, Wang H, Kanayama H, Kagamimori S (2006) Spa resort use and health-related quality of life, sleep, sickness absence and hospital admission: the Japanese civil servants study. Complement Ther Med 14, 133–43.

20) Bosma H, Marmot M, Hemingway H, Nicholson A, Brunner E, Stansfeld S (1997) Low job control and risk of coronary heart disease in Whitehall II (prospective cohort) study. BMJ 314, 558–65.

21) Kivimäki M, Ferrie J, Shipley M, Vahtera J, Singh-Manoux A, Marmot M, Head J (2008) Low medically certified sickness absence among employees with poor health status predicts future health improvement: the Whitehall II study. Occup Environ Med 65, 208–10.

22) Head J, Ferrie J, Alexanderson K, Westerlund H, Vahtera J, Kivimäki M (2008) Diagnosis-specific sickness absence as a predictor of mortality: the Whitehall II prospective cohort study. BMJ 337, a1469.
23) Karasek, R A (1979). Job demands, job decision latitude and mental strain: implications for job design. Adm Sci Quart 24, 285–308.

24) Wanous J P, Reichers A E, Hudy M J (1997) Overall job satisfaction: how good are single-item measures? J Appl Psychol. 82, 247–52.

25) Cronbach L J (1951). Coefficient alpha and the internal structure of tests. Psychometrika 16, 297–334.

26) Sekine M, Tatsuse T, Cable N, Chandola T, Marmot M (2014) U-shaped associations between time in bed and the physical and mental functioning of Japanese civil servants: the roles of work, family, behavioral and sleep quality characteristics. Sleep Med 15, 1122–31.

27) Borrell C, Muntaner C, Benach J, Artazcoz L (2004) Social class and self-reported health status among men and women: what is the role of work organisation, household material standards and household labour? Soc Sci Med 58, 1869–87.

28) Chandola T (1998) Social inequality in coronary heart disease: a comparison of occupational classifications. Soc Sci Med 47, 525–33.

29) Koura U, Sekine M, Yamada M, Tatsuse T (2017) Work, family, and personal characteristics explain occupational and gender differences in work-family conflict among Japanese civil servants. Public Health 153, 78–90.

30) Bernstrom V (2018) Long working hours and sickness absence – a fixed effects design.
BMC Public Health 18, 578.

31) Ropponen A, Koskinen A, Puttonen S, Härmä M (2019) Exposure to working-hour characteristics and short sickness absence in hospital workers: a case-crossover study using objective data. Int J Nurs Stud 91, 14–21.

32) Larsen A D, Ropponen A, Hansen J, Hansen Å M, Kolstad H A, Koskinen A, Härmä M I, Garde A H (2020) Working time characteristics and long-term sickness absence among Danish and Finnish nurses: a register-based study. Int J Nurs Stud 112, 103639

33) Fujimura Y, Sekine M, Tatsuse T (2014) Sex differences in factors contributing to family-to-work and work-to-family conflict in Japanese civil servants. J Occup Health 56, 485–97.

34) Gao C, Chapagain Y, Scullin K (2019) Sleep duration and sleep quality in caregivers of patients with dementia: a systematic review and meta-analysis. JAMA Netw Open. 2, e199891.

35) Floderus B, Hagman M, Aronsson G, Marklund S, Wikma A (2011) Medically certified sickness absence with insurance benefits in women with and without children. Eur J Public Health 22, 85–92.

36) Gender Equality Bureau Cabinet Office. White Paper on Gender Equality 2017.

http://www.gender.go.jp/about_danjo/whitepaper/h29/gaiyou/index.html#honpen (in
Japanese). Accessed June 20, 2020.

37) Ministry of Health, Labour and Welfare. Director-General for Statistics and Information Policy. White Paper on Labor Economy 2017.

https://www.mhlw.go.jp/wp/hakusyo/roudou/17/dl/17-1.pdf (in Japanese). Accessed October 30, 2020.

38) Lagerveld S E, Blonk R W B, Brenninkmeijer V, Schaufeli W B (2010) Return to work among employees with mental health problems: Development and validation of a self-efficacy questionnaire. Work & Stress, 24, 359–75.

39) Ohta S (2018) Absence from work and leave of absence in Japan: understanding through official statistics. The Japanese Journal of Labour Studies 695, 4–18 (in Japanese).
Table 1. Participant characteristics by sex

|                          | Men(n=2091) | Women(n=989) | χ²-test | p-value |
|--------------------------|-------------|--------------|---------|---------|
|                          | n (%)       | n (%)        |         |         |
| **Age**                  |             |              |         |         |
| 20–29                    | 192 9.2     | 232 23.5     |         |         |
| 30–39                    | 636 30.4    | 288 29.1     |         |         |
| 40–49                    | 620 29.7    | 261 26.4     |         |         |
| 50–65                    | 643 30.7    | 208 21.0     | <0.001  |         |
| **Grade of employment**  |             |              |         |         |
| Grade1                   | 298 14.2    | 15 1.5       |         |         |
| Grade2                   | 422 20.2    | 123 12.4     |         |         |
| Grade3                   | 1,371 65.6  | 851 86.0     | <0.001  |         |
| **Job satisfaction**     |             |              |         |         |
| satisfied                | 1,417 67.8  | 602 60.9     |         |         |
| not satisfied            | 674 32.2    | 387 39.1     | <0.001  |         |
| **Shift work**           |             |              |         |         |
| Yes                      | 165 7.9     | 441 44.6     |         |         |
| No                       | 1,926 92.1  | 548 55.4     | <0.001  |         |
| **Work hours**           |             |              |         |         |
| <7h                      | 175 8.4     | 45 4.6       |         |         |
| 7–9h                     | 1,314 62.8  | 573 57.9     |         |         |
| 9–11h                    | 430 20.6    | 297 30.0     |         |         |
| ≥11h                     | 172 8.2     | 74 7.5       | <0.001  |         |
| **Job stress**           |             |              |         |         |
| control                  |             |              |         |         |
| low                      | 567 27.1    | 359 36.3     |         |         |
| middle                   | 839 40.1    | 416 42.1     |         |         |
| high                     | 685 32.8    | 214 21.6     | <0.001  |         |
| demand                   |             |              |         |         |
| high                     | 496 23.7    | 339 34.3     |         |         |
| middle                   | 570 27.3    | 277 28.0     |         |         |
| low                      | 1,025 49.0  | 373 37.7     | <0.001  |         |
| support                  |             |              |         |         |
| low                      | 746 35.7    | 328 33.2     |         |         |
| middle                   | 744 35.6    | 334 33.8     |         |         |
| Living with family |                |                |                |                |                |
|-------------------|----------------|----------------|----------------|----------------|----------------|
|                   | high           | 601            | 28.7           | 327            | 33.1           | <0.05          |
| parent            |                |                |                |                |                |                |
| with              | 1,041          | 49.8           | 437            | 44.2           |                |                |
| without           | 1,050          | 50.2           | 552            | 55.8           | <0.005         |                |
| spouse            |                |                |                |                |                |                |
| with              | 391            | 18.7           | 338            | 34.2           |                |                |
| without           | 1,700          | 81.3           | 651            | 65.8           | <0.001         |                |
| children          |                |                |                |                |                |                |
| with              | 951            | 45.5           | 533            | 53.9           |                |                |
| without           | 1,140          | 54.5           | 456            | 46.1           | <0.001         |                |

| Sleep             |                |                |                |                |                |
| time              |                |                |                |                |                |
| ≤6h               | 611            | 29.2           | 457            | 46.2           |                |                |
| 6h–8h             | 1,403          | 67.1           | 519            | 52.5           |                |                |
| >8h               | 77             | 3.7            | 13             | 1.3            | <0.001         |                |
| Subjective        |                |                |                |                |                |                |
| good              | 1,605          | 76.8           | 719            | 72.7           | <0.001         |                |
| sleep quality     |                |                |                |                |                |                |
| poor              | 486            | 23.2           | 270            | 27.3           | <0.05          |                |

| Longstanding illness |                |                |                |                |                |
| Yes                | 753            | 36.0           | 281            | 28.4           |                |                |
| No                 | 1,338          | 64.0           | 708            | 71.6           | <0.001         |                |

Note: Grade1: the highest grade employees; Grade2: intermediate grade employees; Grade3: the lowest grade employees.
Table 2. Socioeconomic differences in sickness absence before and after adjustment for work and family characteristics in men

|                    | The rate of sickness absence 7 days or more(%) | model1 OR (95%CI) | model2 OR (95%CI) | model3 OR (95%CI) | model4 OR (95%CI) |
|--------------------|-----------------------------------------------|-------------------|-------------------|-------------------|-------------------|
| **Grade of employment** |                                              |                   |                   |                   |                   |
| Grade 1            | 6.4                                           | 1.00              | 1.00              | 1.00              | 1.00              |
| Grade 2            | 9.5                                           | 1.66[0.93–2.96]   | 1.61[0.90–2.88]   | 1.62[0.90–2.92]   | 1.52[0.84–2.74]   |
| Grade 3            | 9.9                                           | 2.30[1.32–4.02]   | 2.01[1.12–3.56]   | 1.97[1.10–3.52]   | 1.98[1.10–3.55]   |
| **Age**            |                                              |                   |                   |                   |                   |
| 20–29              | 6.8                                           | 1.00              | 1.00              | 1.00              | 1.00              |
| 30–39              | 8.8                                           | 1.34[0.72–2.51]   | 1.29[0.69–2.42]   | 1.50[0.78–2.88]   | 1.41[0.73–2.72]   |
| 40–49              | 9.7                                           | 1.72[0.91–3.25]   | 1.50[0.78–2.86]   | 1.83[0.92–3.64]   | 1.47[0.73–2.96]   |
| 50–65              | 10.3                                          | 2.28[1.18–4.42]   | 2.02[1.03–3.99]   | 2.64[1.29–5.42]   | 1.91[0.91–4.00]   |
| **Job satisfaction** |                                              |                   |                   |                   |                   |
| satisfied          | 8.3                                           | 1.00              | 1.00              | 1.00              | 1.00              |
| not satisfied      | 11.6                                          | 1.34[0.97–1.87]   | 1.34[0.97–1.87]   | 1.21[0.86–1.71]   |
| **Shift work**     |                                              |                   |                   |                   |                   |
| Yes                | 10.9                                          | 1.10[0.65–1.85]   | 1.10[0.65–1.85]   | 1.04[0.61–1.78]   |
| No                 | 9.2                                           | 1.00              | 1.00              | 1.00              |
| **Work hours**     |                                              |                   |                   |                   |                   |
| Time  | Value 1 | Value 2       | Value 3       | Value 4       |
|-------|---------|---------------|---------------|---------------|
| <7h   | 10.3    | 0.95[0.56–1.61] | 0.96[0.57–1.64] | 0.95[0.56–1.62] |
| 7–9h  | 10.0    | 1.00          | 1.00          | 1.00          |
| 9–11h | 8.6     | 0.85[0.57–1.27] | 0.87[0.58–1.31] | 0.87[0.58–1.31] |
| ≥11h  | 5.2     | 0.49[0.24–0.99] | 0.47[0.23–0.97] | 0.48[0.23–0.99] |

**Job stress**

| Control   | Value 1 | Value 2       | Value 3       | Value 4       |
|-----------|---------|---------------|---------------|---------------|
| low       | 12.7    | 1.33[0.88–2.03] | 1.31[0.86–1.99] | 1.22[0.80–1.87] |
| middle    | 8.1     | 0.92[0.62–1.35] | 0.90[0.61–1.33] | 0.86[0.58–1.27] |
| high      | 8.0     | 1.00          | 1.00          | 1.00          |
| Demand    |         | 0.97[0.67–1.42] | 0.97[0.66–1.41] | 0.97[0.66–1.42] |
| high      | 9.1     | 1.08[0.73–1.61] | 1.08[0.73–1.61] | 1.04[0.69–1.55] |
| middle    | 8.6     | 1.00          | 1.00          | 1.00          |
| Low       | 9.8     | 0.94[0.63–1.39] | 0.94[0.63–1.40] | 0.90[0.60–1.34] |
| Support   |         | 0.82[0.55–1.21] | 0.82[0.55–1.21] | 0.78[0.53–1.17] |
| low       | 10.7    | 1.00          | 1.00          | 1.00          |
| middle    | 8.2     | 0.95[0.70–1.30] | 0.96[0.70–1.30] |               |
| High      | 9.0     | 1.00          | 1.00          | 1.00          |

**Living with family**

| Parent   | Value 1 | Value 2       | Value 3       | Value 4       |
|----------|---------|---------------|---------------|---------------|
| Without  | 8.6     | 0.75[0.52–1.07] | 0.76[0.53–1.09] |               |
| With     | 10.0    | 1.00          | 1.00          |               |
| Spouse   |         | 1.98[1.26–3.11] | 2.07[1.30–3.28] |               |
| Without  | 11.8    | 1.00          | 1.00          |               |
| With     | 8.8     | 1.00          | 1.00          |               |
| Children |         | 0.75[0.52–1.07] | 0.76[0.53–1.09] |               |
| Without  | 8.9     | 1.00          | 1.00          |               |
| With     | 9.6     | 1.00          | 1.00          |               |
### Sleep

| Sleep time | OR   | 95% CI          |
|------------|------|-----------------|
| ≤6h        | 0.83 | [0.58–1.19]     |
| 6h–8h      | 1.00 |                 |
| >8h        | 1.18 | [0.54–2.58]     |

| Subjective sleep quality | OR   | 95% CI          |
|--------------------------|------|-----------------|
| good                     | 1.00 |                 |
| poor                     | 1.92 | [1.38–2.68]     |

### Longstanding illness

| Longstanding illness | OR   | 95% CI          |
|----------------------|------|-----------------|
| Yes                  | 2.18 | [1.57–3.03]     |
| No                   | 1.00 |                 |

Abbreviations: Odds Ratios: OR; 95% Confidence Intervals: 95%CI; Grade1: the highest grade employees; Grade2: intermediate grade employees; Grade3: the lowest grade employees.

Model1 is adjusted for age.

Model2 is adjusted for age and work characteristics (job satisfaction, shift work, work hours, and job stress (control, demand and support)).

Model3 is adjusted for age, work characteristics, and family characteristics (living with spouse, child, and parents)

Model4 is adjusted for age, work and family characteristics, sleep time and quality, and longstanding illness.
Table 3. Socioeconomic differences in sickness absence before and after adjustment for work and family characteristics in women

|                                | The rate of sickness | model1     | model2     | model3     | model4     |
|--------------------------------|----------------------|------------|------------|------------|------------|
|                                | absence 7 days or    | OR (95%CI) | OR (95%CI) | OR (95%CI) | OR (95%CI) |
|                                | more (%)             |            |            |            |            |
| **Grade of employment**        |                      |            |            |            |            |
| Grade1+2                       | 8.7                  | 1.00       | 1.00       | 1.00       | 1.00       |
| Grade3                         | 10.0                 | 1.40 [0.71–2.76] | 1.23 [0.59–2.55] | 1.28 [0.79–2.09] | 1.29 [0.61–2.72] |
| **Age**                        |                      |            |            |            |            |
| 20–29                          | 6.9                  | 1.00       | 1.00       | 1.00       | 1.00       |
| 30–39                          | 11.1                 | 1.70 [0.91–3.18] | 1.65 [0.87–3.15] | 1.55 [0.77–3.13] | 1.59 [0.78–3.25] |
| 40–49                          | 8.8                  | 1.39 [0.71–2.73] | 1.32 [0.66–2.65] | 1.08 [0.49–2.39] | 1.19 [0.54–2.64] |
| 50–65                          | 12.5                 | **2.15 [1.08–4.25]** | 1.91 [0.92–3.93] | 1.40 [0.63–3.14] | 1.47 [0.65–3.32] |
| **Job satisfaction**           |                      |            |            |            |            |
| satisfied                      | 10.1                 | 1.00       | 1.00       | 1.00       | 1.00       |
| not satisfied                  | 9.3                  | 1.03 [0.64–1.65] | 1.02 [0.63–1.65] | 0.90 [0.55–1.48] |           |
| **Shift work**                 |                      |            |            |            |            |
| Yes                            | 8.2                  | 0.89 [0.55–1.44] | 0.91 [0.56–1.48] | 0.86 [0.53–1.42] |           |
| No                             | 11.1                 | 1.00       | 1.00       | 1.00       | 1.00       |
| **Work hours**                 |                      |            |            |            |            |
|                | <7h | 7–9h | 9–11h | ≥11h |
|----------------|-----|------|-------|------|
|                | 24.4| 12.0 | 4.7   | 4.1  |
| **Job stress** |     |      |       |      |
| control        |     |      |       |      |
| low            | 10.6| 1.00 | 0.93[0.50–1.73] | 0.95[0.51–1.78] | 0.88[0.46–1.67] |
| middle         | 8.7 | 0.34[0.18–0.65] | 0.34[0.18–0.64] | 0.32[0.16–0.60] |
| high           | 10.7| 0.34[0.18–0.65] | 0.34[0.18–0.64] | 0.32[0.16–0.60] |
| demand         |     |      |       |      |
| high           | 8.6 | 1.46[0.86–2.49] | 1.40[0.82–2.40] | 1.46[0.85–2.51] |
| middle         | 11.2| 1.50[0.82–2.71] | 1.48[0.81–2.71] | 1.48[0.80–2.75] |
| low            | 9.9 | 1.46[0.86–2.49] | 1.40[0.82–2.40] | 1.46[0.85–2.51] |
| support        |     |      |       |      |
| low            | 8.8 | 0.80[0.45–1.44] | 0.80[0.44–1.44] | 0.78[0.43–1.43] |
| middle         | 11.1| 1.13[0.67–1.92] | 1.13[0.66–1.92] | 1.11[0.65–1.90] |
| high           | 9.5 | 1.13[0.67–1.92] | 1.13[0.66–1.92] | 1.11[0.65–1.90] |
| **Living with family** |     |      |       |      |
| parent         |     |      |       |      |
| without        | 9.6 | 0.86[0.55–1.35] | 0.85[0.54–1.35] | 0.82[0.52–1.33] |
| with           | 10.0| 1.00 | 1.00  | 1.00 |
| spouse         |     |      |       |      |
| without        | 7.4 | 0.73[0.40–1.32] | 0.72[0.39–1.31] | 0.70[0.38–1.28] |
| with           | 11.1| 1.00 | 1.00  | 1.00 |
| children       |     |      |       |      |
| without        | 9.6 | 1.29[0.79–2.09] | 1.36[0.83–2.24] | 1.37[0.84–2.26] |
| with           | 10.1| 1.29[0.79–2.09] | 1.36[0.83–2.24] | 1.37[0.84–2.26] |
Sleep

| Subject                  | Odds Ratio (95%CI) | Model Adjusted  |
|--------------------------|--------------------|-----------------|
| Sleep time               |                    |                 |
| ≤6h                      | 0.96[0.60–1.53]    | Model1: adjusted for age |
| 6h–8h                    | 1.00               | Model2: adjusted for age and work characteristics (job satisfaction, shift work, work hours, and job stress (control, demand and support)) |
| >8h                      | 1.15[0.22–5.90]    | Model3: adjusted for age, work and family characteristics (living with spouse, child, and parents) |
| Subjective sleep quality |                    | Model4: adjusted for age, work and family characteristics, sleep time and quality, and longstanding illness |
| good                     | 1.00               |                 |
| poor                     | 2.30[1.43–3.70]    |                 |

Longstanding illness

| Yes | 14.6 | 1.88[1.18–3.01] |
|-----|------|-----------------|
| No  | 7.9  | 1.00            |

Abbreviations: Odds Ratios: OR; 95% Confidence Intervals: 95%CI; Grade1: the highest grade employees; Grade2: intermediate grade employees; Grade3: the lowest grade employees.