International Archives of Occupational and Environmental Health (2019) 92:661–672
https://doi.org/10.1007/s00420-019-01401-y

ORIGINAL ARTICLE

Long working hours and depressive symptoms: moderating effects of gender, socioeconomic status, and job resources

Kanami Tsuno[1,2] · Ichiro Kawachi[1] · Akiomi Inoue[3] · Saki Nakai[2] · Takumi Tanigaki[2] · Hikaru Nagatomi[2] · Norito Kawakami[4] · JSTRESS Group

Received: 23 February 2018 / Accepted: 13 January 2019 / Published online: 12 March 2019
© Springer-Verlag GmbH Germany, part of Springer Nature 2019

Abstract

Purpose Systematic reviews and meta-analyses have found inconsistent associations between working hours and depressive symptoms. The purpose of this study was to investigate the possible moderators of this association, using data from a large-scale cross-sectional survey.

Methods A total of 16,136 Japanese employees (men 83.5%; women 16.5%) responded to a self-administered questionnaire inquiring about overtime working hours during the previous month and depressive symptoms (Center for Epidemiologic Studies Depression scale), as well as moderating factors including gender, age, marital status, socioeconomic status, commuting time, sleeping hours per day, job control and worksite social support (Job Content Questionnaire), neuroticism (Eysenck's Personality Questionnaire Revised), and social desirability (Social Desirability Scale) (response rate, 85%). We conducted sequential regression analyses to investigate the main effects and interaction effects of all moderating variables.

Results The association between overtime working hours and depressive symptoms was significantly moderated by gender (interaction effect: $\beta = 0.03$), age ($\beta = -0.02$), manager ($\beta = 0.03$), sleeping hours ($\beta = -0.02$), job control ($\beta = -0.03$), and neuroticism ($\beta = 0.02$). Among workers engaged in 80 + hours of overtime, higher depressive symptoms were reported by women, younger employees, non-managers, employees with low job control, low worksite social support, and high neuroticism. A significant main effect of long overtime working hours on depressive symptoms was also observed even after controlling for all independent variables ($\beta = 0.02$).

Conclusions Long overtime working hours is associated with depressive symptoms. We also found significant heterogeneity in the association according to employee characteristics, which may explain the inconsistent findings in previous literature.

Keywords Depression · Japan · Overwork Mental Health · Workplace

Introduction

Long working hours exceeding regular working hours (40 h/week) remain a persistent problem in Japan, despite recent attention in the mass media to issues such as "karoshi" (death from over-work). Although average total working hours have been declining, daily working hours are actually on the rise among certain groups such as full-time male workers (Kuroda 2010).

Epidemiologic research indicates that long working hours are a cause of various physical health problems. For example, two systematic reviews (Bannai and Tamakoshi 2014; Kivimäki et al. 2015) showed that long working hours (≥ 41 h/week or ≥ 55 h/week) are associated with high blood pressure, cardiovascular diseases, and all-cause mortality. In contrast, several systematic reviews or meta-analyses

The members of JSTRESS Group are listed in "Acknowledgements".

✉ Kanami Tsuno
ktsuno-tky@umin.ac.jp

[1] Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, 677 Huntington Ave, Boston, MA 02115, USA

[2] Department of Hygiene, School of Medicine, Wakayama Medical University, 811-1 Kimiidera, Wakayama, Wakayama 641-8509, Japan

[3] Department of Public Health, Kitasato University School of Medicine, 1-15-1 Kitasato, Minami-ku, Sagamihara, Kanagawa 252-0374, Japan

[4] Department of Mental Health, Graduate School of Medicine, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

have reported inconsistent findings for the association between working hours and mental health problems such as depression (Bannai and Tamakoshi 2014; Fujino et al. 2006; Sparks et al. 1997; Van der Hulst 2003; Virtanen et al. 2018; Watanabe et al. 2016). Specifically, although Bannai and Tamakoshi (2014), Sparks et al. (1997), and Watanabe et al. (2016) found a positive association between working hours and depression, Fujino et al. (2006) and Van der Hulst (2003) found inconsistent results. However, the most recent systematic review and meta-analysis (Virtanen et al. 2018) found an association between long working hours and the onset of depressive symptoms. Additionally, they found a stronger association in Asia than in European countries and no association in North America and Australia. However, this study did not reveal the reason for this regional difference nor what moderating factors affect this association.

Inconsistencies in the relation between long work hours and depression may stem from the potential heterogeneity of the association according to employee characteristics. For example, one possible modifier of the association between long working hours and mental illness is gender. Several studies reported that the association between overtime work and depressive disorder for women was greater than in men (Artazcoz and Gutiérrez 2012; Shields 1999). Among workers reporting the same working hours, it is likely that female workers—especially married women—are also engaged in more domestic labor compared to male workers, as captured by the concept of the "double shift" (Milner et al. 2015; Spurgeon et al. 1997). In Japan, gender differences in the division of household labor are even more marked than in many western societies. For example, working married women perform domestic chores for 5 h, while the average working married men report less than 1 h even if they have children under 6 years old (Ministry of Internal Affairs and Communications 2016).

Since there are only 24 h in a day, long work hours will be inversely correlated with sleeping time. Insufficient sleep could potentiate the adverse effects of long working hours by increasing negative affect (Kahn-Greene et al. 2007). Indeed, Nakata (2011) reported that combination of long work and short sleep posed the strongest risk for depressive symptoms among full-time employees. A similar argument applies to commuting time. Hence, sleep or commute time is a potential moderator of long working hours and depression.

Another possible reason for inconsistent results is the buffering role of job resources. According to the job demands–control model by Karasek (1979), the combination of high job demands and low job control generates the highest levels of worker stress. This situation which is called job strain was reported in a systematic review as a strong and consistent predictor for onset of clinical depression (Madsen et al. 2017). Thus, job control is critical when considering the impact of overwork on depressive symptoms (Hino et al. 2015). Additionally, as suggested by the iso-strain model (Johnson and Hall 1988), worksite social support (supervisor support and coworker support) may also buffer the association between long working hours and depressive symptoms. Thus, the effect of longer working hours on mental health is likely to be moderated by the availability of these job resources (Bannai and Tamakoshi 2014).

Socioeconomic status (SES), which is defined by educational status, income, or occupational status, is also robustly lined with health outcomes such as mortality or depression and anxiety (Glymour et al. 2014). Although there is no clear gradient in the association between SES and long work hours, a census-based longitudinal study revealed that the adverse effect of long working hours on mortality from cardiovascular disease was more marked in individuals engaged in low SES occupations (O'reilly and Rosato 2013). Thus, the adverse impact of long working hours on depressive symptoms might be observed among low SES workers, possibly because of low job control.

Finally, the association between long working hours and depressive symptoms might be moderated by the worker's personality characteristics. Neuroticism is strongly associated with depressive and anxiety symptoms, while introversion is moderately associated with depressive symptoms (Jylhä and Isometsä 2006). On the other hand, social desirability has been negatively correlated with depression (Cole 1988).

In summary, the purpose of this study was to investigate a comprehensive range of possible moderators, i.e., gender, age, marital status, socioeconomic status (SES), commuting time, sleeping hours per a day, job control, worksite social support, neuroticism, and social desirability, of the association between overtime working hours and depressive symptoms, using data from the large-scale cross-sectional survey (Kawakami et al. 2004). We hypothesized that women, younger employees, lower SES employees, as well as workers with longer commuting time, shorter sleeping hours, fewer workplace resources (e.g., job control or social support), higher neuroticism, and lower social desirability are more likely to report depressive symptoms than men, older employees, higher SES employees, as well as workers with shorter commuting time, longer sleeping hours, larger workplace resources, lower neuroticism, and higher social desirability in situations involving severe overtime working hours.

Methods

Participants

The present study was conducted using the baseline survey of the Japan Work Stress and Health Cohort Study

(JSTRESS Study) which was conducted from April 1996 until May 1998 and recruitment strategies were as previously described (Kawakami et al. 2004). A questionnaire was distributed to 29,471 workers at nine manufacturing companies and factories, and a total of 22,770 questionnaires were returned (average response rate, 85.2%). After excluding participants with at least one missing response for variables relevant to the study, data from 16,136 respondents (13,467 men and 2669 women) were analyzed in this study. The study procedure was reviewed and approved by the Human Research Ethics Committee of Gifu University Graduate School of Medicine, before the surveys were conducted.

Measures

Overtime working hours per month

All study participants were full-time workers and their scheduled working hours were 40 h/week. Overtime working hours exceeding scheduled working hours were measured by asking participants average overtime working hours per month. First, we used overtime working hours as a continuous variable, but we also classified them into three groups (< 45 h, 45–79 h, and ≥ 80 h/month) to compare depressive symptoms scores among sub categories. This classification is generally used in the Japanese society and research, and equal to < 51.25 h, 51.25–59.75 h, ≥ 60 h/week (e.g., Hino et al. 2015).

Depressive symptoms

Depressive symptoms were measured by Japanese version of the Center for Epidemiologic Studies Depression (CES-D) scale (Radloff 1977; Shima et al. 1985). This scale consists of 20 items asking participants to rate how often they experienced symptoms associated with depression over the past week. The response options were from 0 ("rarely" or "never") to 3 ("most" or "almost all of the time"). The Japanese version of the CES-D has a good reliability and validity (Shima et al. 1985). In this study, Cronbach's alpha coefficient for internal consistency was 0.82.

SES and demographic characteristics

Gender, age, marital status, and SES variables (education and occupation) were assessed in the questionnaire. Marital status was classified into currently married and unmarried, which consists of never married, divorced, or widowed. Education was dichotomized into under high school graduates and higher education. Occupation was classified into manager, white-collar, and blue-collar.

Commuting and sleeping time

One-way commuting time and average sleeping hours per a day were assessed in the questionnaire. One-way commuting time was classified into two groups with median time of the participants: short (≤ 40 min) and long (> 40 min). Average sleeping hours per a day during previous 1 year were grouped into short (≤ 6 h) and long (≥ 7 h) because the median daily sleeping hours in this sample are 7 h.

Job control and worksite social support

Job control and worksite social support were measured using the Japanese version of the Job Content Questionnaire (JCQ) (Karasek 1985; Kawakami et al. 1995). Job control consists of skill discretion (six items) and decision authority (three items) (total Cronbach alpha for nine items = 0.79). Social support consists of supervisor support (four items) and coworker support (four items) (total Cronbach alpha for eight items = 0.84). Response options ranged from 1 ("strongly disagree") to 4 ("strongly agree").

Neuroticism

Neuroticism was measured using scales from the short version of Eysenck's Personality Questionnaire Revised (SEPQ-R) (Eysenck et al. 1985). This scale consists of 12 items with a yes/no response yielding a total score 0–12: a high score reflects the degree of nervousness or anxiety experienced by the respondent for neuroticism or the degree of participation and interaction with others in social situations for extroversion. The Japanese version of SEPQ-R was proven to be reliable and valid (Hosokawa and Ohyama 1993). Respondents were classified into two groups: low score (0.0–5.0) and high score (5.1–12.0). In this study, Cronbach's alpha coefficient for internal consistency was 0.77.

Social desirability

Social desirability was measured using the Japanese version of the Social Desirability Scale (Crowne and Marlowe 1960; Kitamura and Suzuki 1986). This scale consists of ten items with a yes/no response. A high score reflects the high degree of social desirability. In this study, Cronbach's alpha coefficient for internal consistency was 0.53.

Statistical analyses

We conducted sequential regression analyses to investigate the association of long overtime working hours on depressive symptoms. All continuous variables were grand-mean centered to avoid multicollinearity when entering interaction effects into the model. In Step 1, we first entered long

overtime working hours, demographic characteristics, SES, commuting time, and sleeping hours (Model 1). In Step 2, job resources and personality traits were additionally entered (Model 2). Finally, interaction terms (gender, age, marital status, education, manager, blue-collar, commuting time, sleeping hours, job control, worksite social support, neuroticism, social desirability × working hours) were additionally entered into the model (Model 3). Subsequently, two-way ANCOVA and post hoc test (Bonferroni) were also conducted on the significant interaction effects to see the score differences of depressive symptoms. The level of significance was 0.05 (two tailed). The statistical analyses were conducted using IBM SPSS 23.0J for Windows.

Results

Characteristics of participants

Table 1 shows the demographic and occupational characteristics, overtime working hours, job resources, personality traits, and depressive symptoms scores of respondents in this study. Most of them were men (83.5%), married (77.6%), high school graduates (52.9%), and blue-collar workers (47.2%). The average overtime working time was 27.9 h. The prevalence of depressive symptoms when using cut-off point of 16 + was 24.0% in this study.

Main effects of overtime working hours and characteristics on depression

A significant main effect of long overtime working hours on depression was observed after adjusting for gender, age, marital status, education, occupational status, commuting time, and sleeping hours in Model 1 (Table 2). In Model 2, the main effect of long overtime working hours on depression remained significant, while main effects were also found for all other variables including job resources and personality traits.

Interaction effects of long overtime working hours and depressive symptoms

Significant interaction effects of overtime hours and age, woman, manager, sleeping hours, job control, and neuroticism were observed for depressive symptoms (Table 3). On the other hand, we did not find significant interaction effects of overtime hours and unmarried ($p = 0.417$), no college ($p = 0.960$), blue-collar ($p = 0.257$), long commuting time ($p = 0.877$), worksite social support ($p = 0.633$), or social desirability ($p = 0.808$).

Table 4 and Figs. 1, 2, 3, 4, 5 and 6 show score differences of CES-D among the groups which showed significant interaction effects. We found that women, younger workers (30–49 years), workers in non-managerial white-collar occupations, and employees reporting low job control were more likely to report depressive symptoms when experiencing ≥ 80 h overtime working hours. Employees with high neuroticism were also more likely to experience depressive symptoms under conditions of long working hours. On the other hand, short-sleepers were more likely to have depressive symptoms regardless of how many hours they had worked overtime.

Discussion

In this large-scale cross-sectional study, we found a significant main effect of long work hours on depressive symptoms. However, we also found significant heterogeneity in the relation according to gender, age, occupational status, sleeping hours, job control, and neuroticism. Women, younger employees, non-managers, employees with low control or high neuroticism are more likely to have depressive symptoms when they suffer from heavy overwork, compared to men, older employees, managers, employees with high control or low neuroticism, respectively. In other words, if an employee is a man, ≥ 50 years old, manager, having high job control, and having low neuroticism, he/she is less likely to have depressive symptoms even though working ≥ 80 h overtime per a month. The results of the current study revealed that the effect of severe overtime working time is heterogeneous, which helps to understand why some existing literature had inconsistent results on the association between working hours and depression. The result differences highly depend on the characteristics of participants.

In the current study, long overtime working hours themselves were one of the predictors of depressive symptoms. This is consistent with the systematic reviews or meta-analyses, which reported a positive association between long working hours and depression (Bannai and Tamakoshi 2014; Sparks et al. 1997; Virtanen et al. 2018; Watanabe et al. 2016). Additionally, the severity of depressive symptoms was obvious in working overtime 80 + h in the current study. This is also in line with the studies which showed that risk of psychiatric morbidity predominated in longest working hour group such as ≥ 60 h/week (Kato et al. 2014), 49–100 h/week (Kleppa et al. 2008), or ≥ 280 h/month (Nagashima et al. 2007). Working overtime ≥ 80 h means employees work at least 60 h/week or 12 h/day. Sleeping, bathing, or eating time are part of employees' free time so that if they work longer their free time will be reduced, resulting in less time to relax or recover efficiently.

Both men and women who work overtime ≥ 80 h had significantly higher depressive symptoms compared with those working less hours; however, women had much higher

Table 1 Demographic and occupational characteristics, over time working hours per month, job resources, personality traits, and depressive symptoms among Japanese employees ($N = 16,136$)

Variables	Average (SD)	*n*	%
Demographic characteristics			
Gender			
Men		13,467	83.5
Women		2669	16.5
Age (years)	40.1 (9.2)		
Marital status			
Married		12,528	77.6
Unmarried		3608	22.4
SES			
Educational status			
Junior high school/high school graduate		10,395	64.4
College/university/graduate school graduate		5741	35.6
Occupational status			
Manager		2208	13.7
White-collar		6346	39.3
Profession		2250	13.9
Engineer		2238	13.9
Clerical job		1858	11.5
Blue-collar		7582	47.0
Service worker		178	1.1
Craft worker		1848	11.5
Machinery operator		3340	20.7
Physical worker		1406	8.7
Others		810	5.1
Over time working hours/month	27.9 (30.9)		
Less than 45 h		12,950	80.3
45–79 h		2326	14.4
80 h and over		860	5.4
One-way commuting time	38.2 (7.9)		
Less than 40 min		5723	35.5
40 min and more		10,413	64.5
Average sleeping hours/day			
6 h and less		6578	40.8
7 h and more		9558	59.2

Variables (scale)	Range	Average (SD)	Cronbach's α
Job control (JCQ)	24–96	66.2 (11.1)	0.79
Worksite social support (JCQ)	12–60	45.2 (7.17)	0.84
Neuroticism (EPQ-R)	0–12	5.4 (3.3)	0.77
Social desirability (SDS)	0–10	4.5 (2.0)	0.53
Depressive symptoms (CES-D)	0–60	12.3 (6.7)	0.82

SD standard deviation, *JCQ* Job Content Questionnaire, *EPQ-R* Eysenck Personality Questionnaire-Revised, *SDS* Social Desirability Scale, *CES-D* Center for Epidemiologic Scale for Depression

depressive scores than men when they worked ≥ 80 h overtime, as expected. This finding is consistent with previous studies (Artazcoz and Gutiérrez 2012; Kleppa et al. 2008; Shields 1999). Although the current study did not ask participants about their household labor, it seems reasonable to assume that women had more responsibility for domestic chores, child care, and elderly care compared to men (Milner et al. 2015; Spurgeon et al. 1997). Shimazu et al. (2013) reported that the association between family-to-work or work-to-family conflict and psychological distress among wives is greater than among husbands, which also supports out results. Moreover, long working hours are hazardous for pregnant women, because especially if associated with heavy lifting and prolonged standing, it may also increase

Table 2 Sequential regression analyses with depressive symptoms ($N = 16{,}136$)

	Model 1				Model 2			
	b	SE	*β*	*p*	*b*	SE	*β*	*p*
Step 1								
Overtime working hours	0.01	0.00	0.03	0.000	0.00	0.00	0.02	0.026
Age	−0.03	0.01	−0.04	0.000	−0.01	0.01	−0.02	0.022
Gender (woman = 1, man = 0)	0.35	0.15	0.02	0.017	−0.56	0.13	−0.03	0.000
Marital status (unmarried = 1, married = 0)	1.96	0.14	0.12	0.000	1.26	0.12	0.08	0.000
Education (no college = 1, college = 0)	0.92	0.14	0.07	0.000	0.82	0.12	0.06	0.000
Manager (manager = 1, non-manager = 0)	−1.60	0.17	−0.08	0.000	−0.85	0.15	−0.04	0.000
Blue-collar (blue-collar = 1, others = 0)	1.13	0.13	0.08	0.000	0.63	0.11	0.05	0.000
Commuting time (> 40 min = 1, ≤ 40 min = 0)	0.51	0.11	0.04	0.000	0.30	0.09	0.02	0.001
Sleeping hours (≤ 6 h = 1, ≥ 7 h = 0)	0.77	0.11	0.06	0.000	0.45	0.09	0.03	0.000
Step 2								
Job control					−0.06	0.01	−0.09	0.000
Worksite social support					−0.16	0.01	−0.17	0.000
Neuroticism					0.90	0.01	0.44	0.000
Social desirability					−0.09	0.02	−0.03	0.000
Adjusted R^2				0.060**				0.326**
ΔR^2								0.266
F change				115.380				1594.173

b partial regression coefficient, *SE* standard error, *β* standard partial regression coefficient, R^2 coefficient of determination

**$p < 0.01$

Table 3 Sequential regression analyses with depressive symptoms: interaction effects ($N = 16{,}136$)

	Model 3			
	b	SE	*β*	*p*
Step 3				
Overtime hours × age	0.00	0.00	−0.02	0.034
Overtime hours × woman	0.02	0.01	0.03	0.014
Overtime hours × unmarried	0.00	0.00	0.01	n.s.
Overtime hours × no college	0.00	0.00	0.00	n.s.
Overtime hours × manager	0.01	0.01	0.02	0.049
Overtime hours × blue-collar	−0.01	0.00	−0.01	n.s.
Overtime hours × long commuting time	0.00	0.00	0.00	n.s.
Overtime hours × short sleeping hours	0.01	0.00	0.03	0.004
Overtime hours × job control	−0.00	0.00	−0.03	0.000
Overtime hours × worksite social support	0.00	0.00	−0.00	n.s.
Overtime hours × neuroticism	0.00	0.00	0.02	0.003
Overtime hours × social desirability	0.00	0.00	0.00	n.s.
Adjusted R^2				0.328**
ΔR^2				0.003
F change				5.265

b partial regression coefficient, *SE* standard error, *β* standard partial regression coefficient, R^2 coefficient of determination

**$p < 0.01$

the risk of preterm delivery and low birthweight (Palmer et al. 2013). Thus, the results of the current study indicate long working hours impose a heavy burden on women and reducing overtime working hours may contribute to gender equality and occupational safety.

Occupation and age were significant moderators of the relationship between long working hours and depressive symptoms. In the present study, managers and employees aged ≥ 50 years were less likely to report depressive symptoms even when they worked ≥ 80 h overtime, while blue-collar employees had higher depressive symptoms regardless of how many hours they worked overtime. This finding is in line with previous studies (Glymour et al. 2014; O'reilly and Rosato 2013; Rawshani et al. 2016) and can be explained by job control, since low SES workers have less flexibility in the choice of overtime work or autonomy. In other words, workers in higher positions have more discretion over the content and hours of work. In this sample, the average age of managers was older (45.6 vs. 39.3 years old) and their score for job control was much higher than among non-managers (74.6 vs. 64.9). The traditional Japanese companies are notable for promoting workers based on seniority (i.e., age, or duration of tenure in the company)—as opposed to a system whereby talented employees can leap-frog over more senior colleagues. As O'Reilly and Rosato (2013) reported, men, managers, and own-account workers tend to work longer hours. Since workers with high job control tend to be more

Table 4 Two-way interaction between overtime and other covariates on depression with post hoc tests results: adjusted means of CES-D score

	Overtime hours per month			*F*	*p*
	< 45	45–79	≥ 80		
Overtime hours × gender				4.82	< 0.01
Man	12.2[a]	12.1[b]	13.6[ab] **		
Woman	12.3[c]	9.9[d]	21.2[cd]		
Overtime hours × age				1.02	0.411
29 and less	12.6 **	13.3 *	14.3		
30–39	12.6[a] **	** 12.3[b]	14.2[ab] *		
40–49	11.9[c] **	12.0[c]	13.4[cd]		
50 and over	11.7	11.4	11.9		
Overtime hours × occupation				1.83	0.118
Manager	10.3[a] ** **	10.6[b] **	11.9[ab] **		
White-collar	11.8[c] **	12.1[d] **	13.7[cd]		
Blue-collar	13.0	12.5	13.6		
Overtime hours × sleeping hours	**		5	16.3	< 0.01
Short sleeping hours (≤ 6)	12.5[a]	12.8[b] *	14.0[ab]		
Long sleeping hours (≥ 7)	12.0[c]	11.5[d]	13.3[cd]		
Overtime hours × job control				4.42	0.012
Low job control (0.0–66.0)	13.0[a] **	13.2[b] **	15.5[ab] **		
High job control (66.1–96.0)	11.4[c]	11.3[d]	12.4[cd]		
Overtime hours × neuroticism				9.23	< 0.01
Low neuroticism (0.0–5.0)	9.8 **	9.7 **	10.0 **		
High neuroticism (5.1–12.0)	14.9[a]	14.8[b]	16.9[ab]		

Adjusted for gender, age, education, marital status, occupation, commuting time, and sleeping time

[abcd]$p < 0.05$; *$p < 0.05$, **$p < 0.01$ from post hoc tests (Bonferroni)

highly engaged in their work (Bakker et al. 2007), many of them contribute longer hours on a voluntary basis and thus they may experience less psychological stress. According to a model put forward by Shimazu and Schaufeli (2009), workaholism (working excessively and working compulsively) is positively associated with distress, while work engagement (vigor, dedication, and absorption) is protectively associated with psychological distress.

Employees with low job control and low worksite social support were more likely to suffer from depressive symptoms, and the score difference was more marked among those working 80 + overtime working hours. This is congruent with job demands–control support model itself and those reporting buffering effects of job resources on health outcomes (Bakker and Demerouti 2007; Hino et al. 2015). As we discussed in the previous paper (Hino et al. 2015), this finding may be explained by the concept of worktime control (WTC), which refers to the self-determination of worktime aspects including control over whether, when, and how many hours one should work overtime (Nijp et al. 2012). The results of the current study also suggest that the amount of social support from supervisors or coworkers may influence depression risk regardless of how many hours they work overtime. Although we did not find a significant interaction effect of overtime working hours and worksite social support on depressive symptoms, our findings indicate that reducing long working hours and improving job control and worksite social support reduce depressive symptoms.

High neuroticism was a risk factor of depressive symptoms and its effect was more pronounced when employees work ≥ 80 h overtime. This pattern is consistent with the finding that neurotic traits are strongly related to depression (Jylhä and Isometsä 2006). We did not find an interaction effect of overtime working hours and social desirability on depressive symptoms but did a main effect, which is in line with the study that reported a negative association between social desirability and depression (Cole 1988).

The interaction of overtime working and sleeping time was significant, while a significant interaction effect of overtime working hours and commute time was not found on depressive symptoms. As many studies reported (Kahn-Greene et al. 2007), the results of the current study suggest

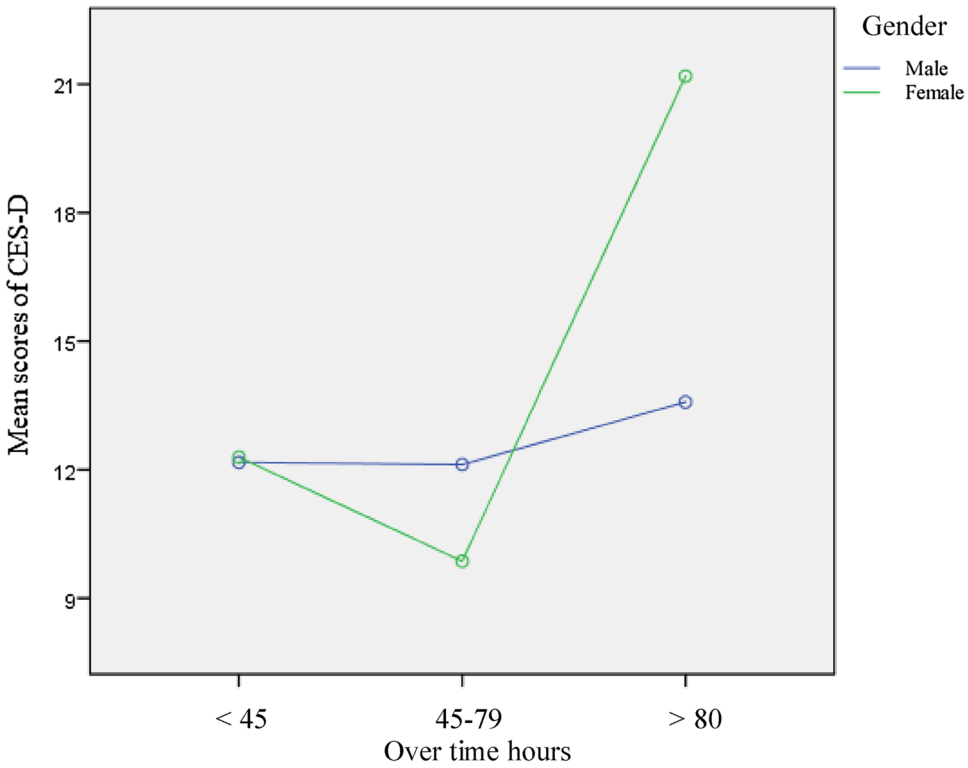

Fig. 1 Overtime hours × gender

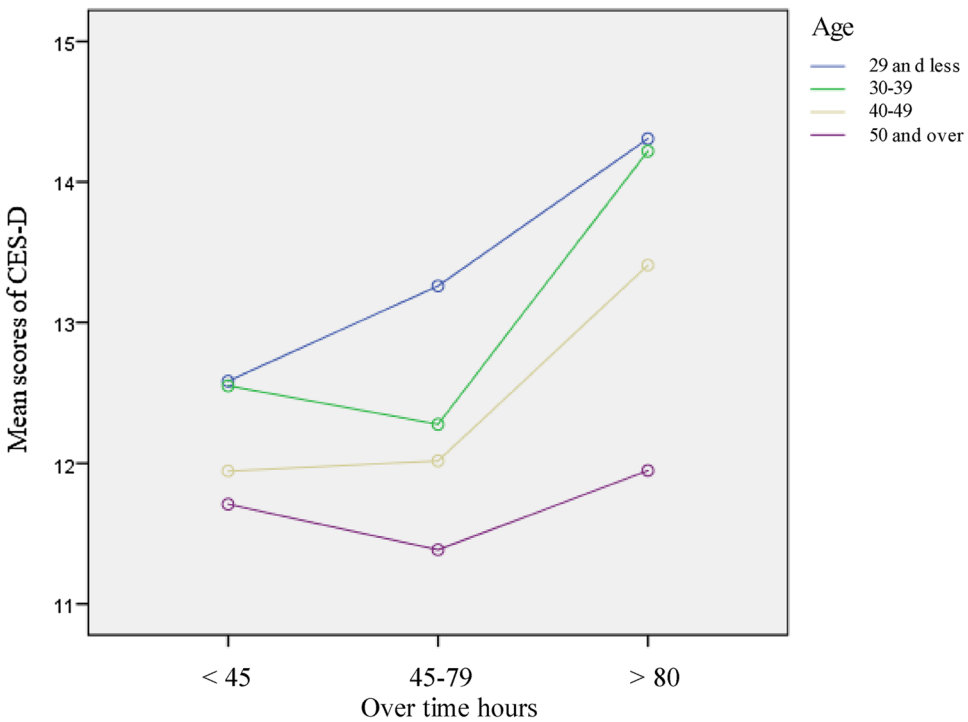

Fig. 2 Overtime hours × age

that sleep deprivation would associate with depressive symptoms because short-sleepers had higher depressive symptoms than long-sleepers even among employees who worked overtime for < 45 h. Our study results are also in line with Nakata's (2011) study that reported combination of long work and short sleep had a strongest risk for depressive symptoms among full-time employees. This might be because sleep may moderate the association between long work hours and depressive symptoms, and also short sleep is often a consequence of depression.

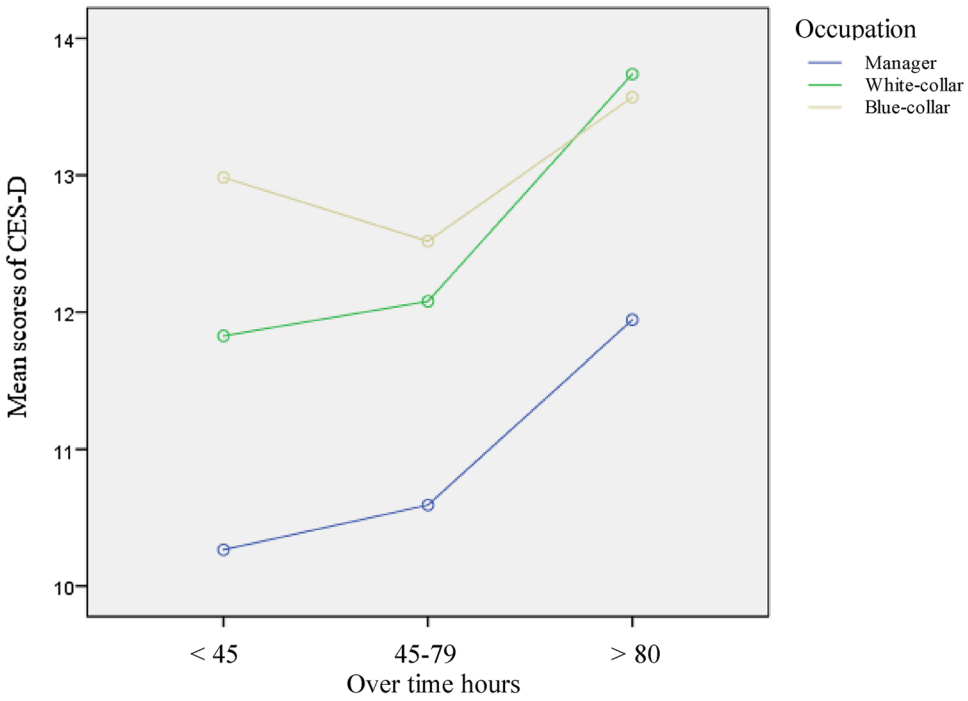

Fig. 3 Overtime hours × occupation

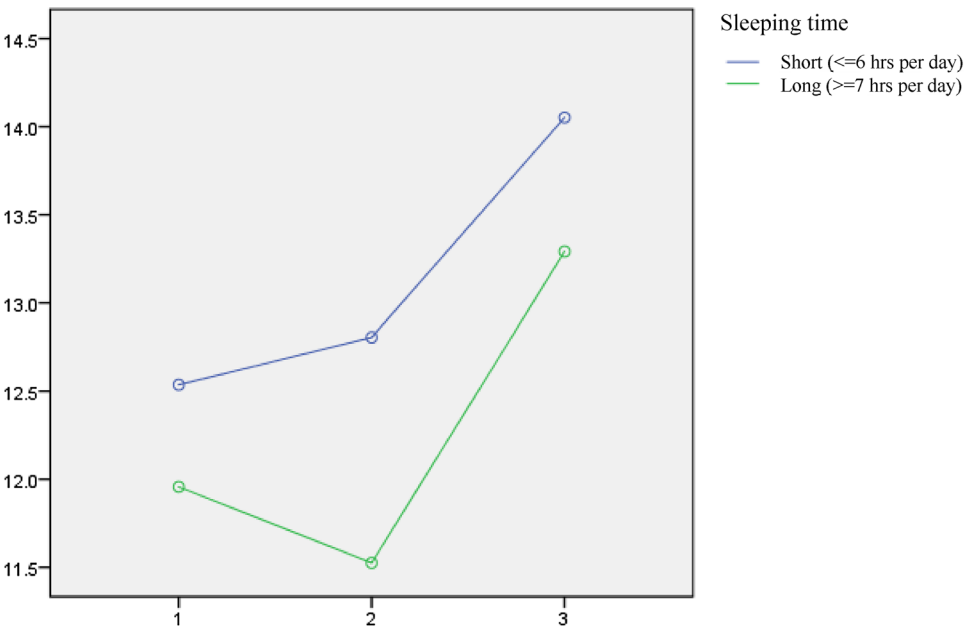

Fig. 4 Overtime hours × sleeping time

Some possible limitations of our study should be considered. First, a causal relationship cannot be determined because this is a cross-sectional study. A prospective study is required to elucidate the causal relationship between overtime working hours and depressive symptoms and its moderators. Second, overtime working hours were measured by self-report, which may cause recall bias. Information of overtime working hours should obtain from company data or from employees on a daily basis to avoid this bias. Finally, our sample was only from male-dominated manufacturing companies in Japan; therefore, there may be some degree of some health worker effect among female employees and generalization of the findings should be done with caution.

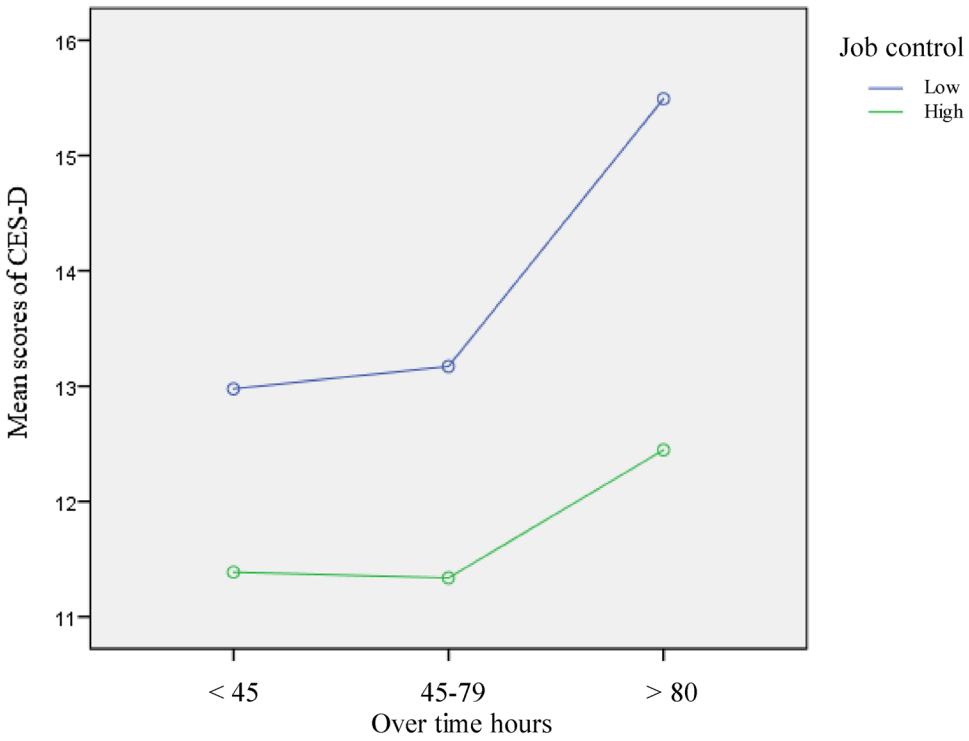

Fig. 5 Overtime hours × job control

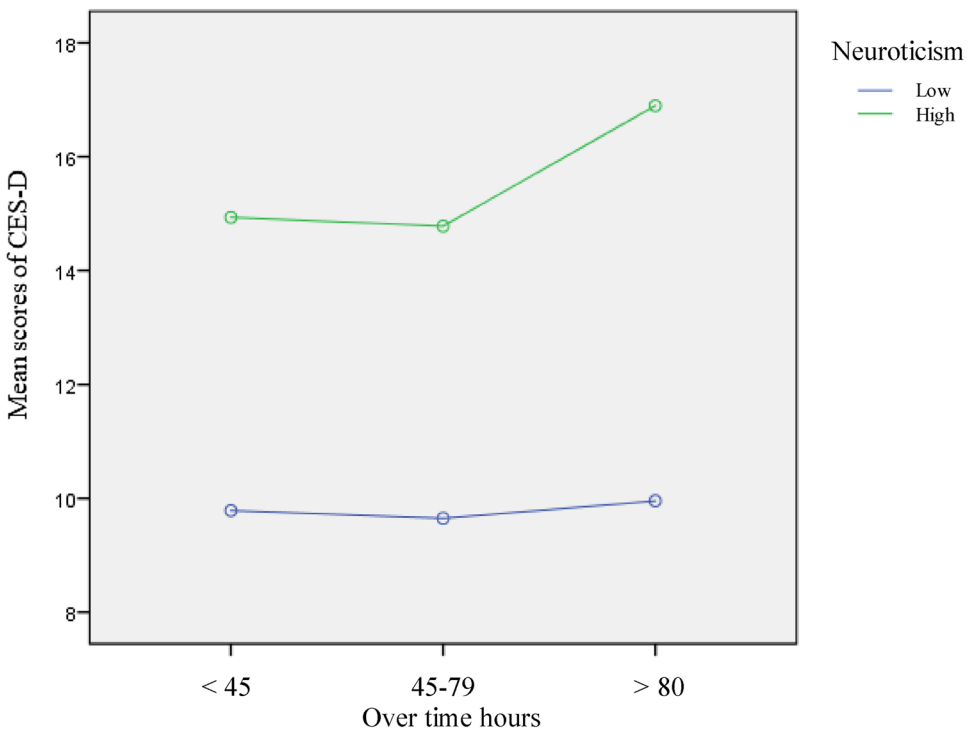

Fig. 6 Overtime hours × neuroticism

Conclusion

Long overtime working hours were a predictor of depressive symptoms, independent of employee characteristics, commute or sleeping time, job resources, and personality traits. However, severity of depressive symptoms was greater among women, younger employees, non-managers, employees with low job control, employees with low worksite social support, and employees with high neuroticism when they suffer from long overtime working hours.

Acknowledgements The following are members of JSTRESS (the Japan Work Stress and Health Cohort Study) group: Takashi Haratani (National Institute of Occupational Safety and Health, Japan), Fumio Kobayashi (Aichi Medical University, Japan), Masao Ishizaki (Kanazawa Medical University, Japan), Takeshi Hayashi (Hitachi Health Care Center, Japan), Osamu Fujita (Kariya Toyota General Hospital, Japan), Yoshiharu Aizawa (Kitasato University, Japan), Shogo Miyazaki (Kanda Christian Clinic, Japan), Hisanori Hiro (University of Occupational and Environmental Health, Japan),Takeshi Masumoto (Kimitsu Health Service Center, Japan), Shuji Hashimoto (Fujita Health University School of Medicine, Japan), and Shunichi Araki (Saitama Occupational Health Promotion Center, Japan).

Funding This study was supported by a special research grant for the prevention of work-related diseases in 1995–1999 from the Ministry of Health, Labour and Welfare, Japan.

Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

References

Artazcoz L, Gutiérrez VA (2012) Gender differences in the relationship between long working hours and health status in Catalonia. Archivos de Prevencion de Riesgos Laborales 15:129–135

Bakker AB, Demerouti E (2007) The job demands-resources model: state of the art. J Manag Psychol 22:309–328

Bakker AB, Hakanen JJ, Demerouti E, Xanthopoulou D (2007) Job resources boost work engagement, particularly when job demands are high. J Educ Psychol 99:274

Bannai A, Tamakoshi A (2014) The association between long working hours and health: a systematic review of epidemiological evidence. Scand J Work Environ Health 40:5–18

Cole DA (1988) Hopelessness, social desirability, depression, and parasuicide in two college student samples. J Consult Clin Psychol 56:131–136

Crowne DP, Marlowe D (1960) A new scale of social desirability independent of psychopathology. J Consult Psychol 24:349–354

Eysenck SB, Eysenck HJ, Barrett P (1985) A revised version of the psychoticism scale. Person Individ Difl 6:21–29

Fujino Y, Horie S, Hoshuyama T et al (2006) A systematic review of working hours and mental health burden. Sangyo Eiseigaku Zasshi 48:87–97

Glymour MM, Avendano M, Kawachi I (2014) Socioeconomic status and health. In: Berkman LF, Kawachi I, Glymour MM (eds) Social epidemiology, 2nd edn. Oxford University Press, Oxford, pp 17–63

Hino A, Inoue A, Kawakami N et al (2015) Buffering effects of job resources on the association of overtime work hours with psychological distress in Japanese white-collar workers. Int Arch Occup Environ Health 88:631–640

Hosokawa T, Ohyama M (1993) Reliability and validity of a Japanese version of the short-form Eysenck Personality Questionnaire—revised. Psychol Rep 72:823–832

Johnson JV, Hall EM (1988) 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

Jylhä P, Isometsä E (2006) The relationship of neuroticism and extraversion to symptoms of anxiety and depression in the general population. Depress Anxiety 23:281–289

Kahn-Greene ET, Killgore DB, Kamimori GH et al (2007) The effects of sleep deprivation on symptoms of psychopathology in healthy adults. Sleep Med 8:215–221

Karasek RA (1979) Job demands, job decision latitude, and mental strain: implications for job redesign. Admin Sci Q 24:285–308

Karasek RA (1985) Job Content Questionnaire and user's guide. University of Massachusetts at Lowell, Lowell

Kato R, Haruyama Y, Endo M et al (2014) Heavy overtime work and depressive disorder among male workers. Occup Med 64:622–628

Kawakami N, Kobayashi F, Araki S et al (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 the Job Content Questionnaire. Int J Behav Med 2:358–375

Kawakami N, Haratani T, Kobayashi F et al (2004) Occupational class and exposure to job stressors among employed men and women in Japan. J Epidemiol 14:204–211

Kitamura T, Suzuki T (1986) Nihongo-ban Social Desirability Scale ni tsuite [Japanese version of Social Desirability Scale]. Soc Psychiatry 9:173–180

Kivimäki M, Jokela M, Nyberg ST et al (2015) Long working hours and risk of coronary heart disease and stroke: a systematic review and meta-analysis of published and unpublished data for 603 838 individuals. Lancet 386:1739–1746

Kleppa E, Sanne B, Tell GS (2008) Working overtime is associated with anxiety and depression: the Hordaland Health Study. J Occup Environ Med 50:658–666

Kuroda S (2010) Do Japanese Work Shorter Hours than before? Measuring trends in market work and leisure using 1976–2006 Japanese time-use survey. J Jpn Int Econ 24:481–502

Madsen IE, Nyberg ST, Hanson LM et al (2017) Job strain as a risk factor for clinical depression: systematic review and meta-analysis with additional individual participant data. Psychol Med 47:1342–1356

Milner A, Smith P, LaMontagne AD (2015) Working hours and mental health in Australia: evidence from an Australian population-based cohort, 2001–2012. Occup Environ Med 72:573–579

Ministry of Internal Affairs and Communications (2016) The survey on time use and leisure activities 2016. https://www.stat.go.jp/english/data/shakai/2016/k-gaiyou.html. Accessed 22 Dec 2018

Nagashima S, Suwazono Y, Okubo Y et al (2007) Working hours and mental and physical fatigue in Japanese workers. Occup Med 57:449–452

Nakata A (2011) Work hours, sleep sufficiency, and prevalence of depression among full-time employees: a community-based cross-sectional study [CME]. J Clin Psychiatry 72:605–614

Nijp HH, Beckers DG, Geurts SA et al (2012) Systematic review on the association between employee worktime control and work-nonwork balance, health and well-being, and job-related outcomes. Scand J Work Environ Health 38:299–313

O'Reilly D, Rosato M (2013) Worked to death? A census-based longitudinal study of the relationship between the numbers of hours spent working and mortality risk. Int J Epidemiol 42:1820–1830

Palmer KT, Bonzini M, Harris EC et al (2013) Work activities and risk of prematurity, low birth weight and pre-eclampsia: an updated review with meta-analysis. Occup Environ Med 70:213–222

Radloff LS (1977) The CES-D scale: a self-report depression scale for research in the general population. Appl Psychol Meas 1:385–401

Rawshani A, Svensson AM, Zethelius B et al (2016) Association between socioeconomic status and mortality, cardiovascular disease, and cancer in patients with type 2 diabetes. JAMA Intern Med 176:1146–1154

Shields M (1999) Long working hours and health [1994–1997 data]. Health Rep 11:33–48

Shima S, Shikano T, Kitamura T et al (1985) Atarashii yokuutsusei jiko hyouka shakudo ni tsuite [New self-rating scale for depression]. Clin Psychiatry 27:717–723

Shimazu A, Schaufeli WB (2009) Is workaholism good or bad for employee well-being? The distinctiveness of workaholism and work engagement among Japanese employees. Ind Health 47:495–502

Shimazu A, Kubota K, Bakker A et al (2013) Work-to-family conflict and family-to-work conflict among Japanese dual-earner couples with preschool children: a spillover-crossover perspective. J Occup Health 55:234–243

Sparks K, Cooper C, Fried Y et al (1997) The effects of hours of work on health: a meta-analytic review. J Occup Organ Psychol 70:391–408

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 54:367–375

Van der Hulst M (2003) Long workhours and health. Scand J Work Environ Health 29:171–188

Virtanen M, Jokela M, Madsen IE et al (2018) Long working hours and depressive symptoms: systematic review and meta-analysis of published studies and unpublished individual participant data. Scand J Work Environ Health 44:239–250

Watanabe K, Imamura K, Kawakami N (2016) Working hours and the onset of depressive disorder: a systematic review and meta-analysis. Occup Environ Med 73:877–884

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.