ELSEVIER

Social Science & Medicine 64 (2007) 2520–2532

SOCIAL SCIENCE & MEDICINE

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Perceived job stress and sleep-related breathing disturbance in Japanese male workers

Akinori Nakata[a,b,*], Masaya Takahashi[a], Tomoko Ikeda[c], Takashi Haratani[a], Minoru Hojou[d], Shunichi Araki[a]

[a]*National Institute of Occupational Safety and Health, Japan*

[b]*Division of Applied Research and Technology, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, MS-C24 Cincinnati, OH 45226, USA.*

[c]*Department of Nursing, School of Health Sciences, Ibaraki Prefectural University of Health Sciences, Ibaraki, Japan*

[d]*Ota Regional Occupational Health Center, Tokyo, Japan*

Available online 12 April 2007

Abstract

To examine the association of job stress with sleep-related breathing disturbance (SBD), a cross-sectional sample of 1940 males aged 17–83 (mean 45) years in 292 small and medium-sized enterprises in Japan were surveyed by means of a self-administered questionnaire. Perceived job stress was evaluated by the Japanese version of the Generic Job Stress Questionnaire developed by the US National Institute for Occupational Safety and Health, which included 13 job stress variables. Participants were divided into thirds according to their job stress scores. SBD was assessed by the question "Have you ever felt difficulty breathing during sleep or has anyone in your family told you that you have such difficulty?" SBD was defined as presence of symptoms more than once a month. Risk of SBD through job stress was estimated using logistic regression with odds ratios (ORs) and 95% confidence intervals (CIs) as measures of association. Prevalence of study-defined SBD was 6.7%. Participants who perceived the lowest level of social support from supervisors, and highest levels of job future ambiguity, interpersonal conflict at the workplace, job dissatisfaction, variance in workload, and quantitative workload had significantly increased risk of SBD after adjusting for potential confounders. High depressive symptoms, as measured by Center for Epidemiologic Studies Depression scale scores of 16 or higher, were also significantly associated with increased SDB. Although the results should be considered preliminary because of the self-reporting and cross-sectional design, data suggest that exposure to high job stress could be a possible risk factor for developing or aggravating SBD. Results also indicate that job stress should be considered when evaluating SBD in occupational and clinical settings.

Keywords: Japan; Job stress; Sleep; Sleep-related breathing disturbance; Male; Worker

Introduction

Sleep-related breathing disturbance (SBD), which is characterized by repetitive episodes of partial or complete upper airway obstruction during sleep, is a prevalent phenomenon but is largely

*Corresponding author. Tel.: +1 513 533 8628; fax: +1 513 533 8596.

E-mail addresses: nakataa-tky@umin.ac.jp (A. Nakata), takaham@h.jniosh.go.jp (M. Takahashi), ikedat@ipu.ac.jp (T. Ikeda), haratani@h.jniosh.go.jp (T. Haratani), hojou@big.or.jp (M. Hojou), araki@h.jniosh.go.jp (S. Araki).

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doi:10.1016/j.socscimed.2007.03.012

undiagnosed and untreated in the working population (Ohayon, Guilleminault, Priest, & Caulet, 1997; Tanigawa, Horie, Sakurai, & Iso, 2005). The main symptoms of SBD are snoring, suffocation, choking, and gasping during sleep, which lead to the fragmentation of sleep and excessive daytime sleepiness (EDS) (Young, Peppard, & Gottlieb, 2002).

The burden of this disturbance on occupational safety and health has been reported to be significant. For instance, workers experiencing either heavy snoring or obstructive sleep apnea syndrome were involved in an occupational accident 1.5–6 times more than those without such symptoms (Ulfberg, Carter, & Edling, 2000). A 10-year prospective study in Sweden also found that men who reported symptoms of SBD (snoring and EDS) had 2.2 times increased risk of occupational accidents (Lindberg, Carter, Gislason, & Janson, 2001). Several findings indicated that those with SBD had a 2- to 7-fold increase in automobile accidents (Andrich, 1989; Haraldsson, Carenfelt, & Tingvall, 1992; Barbe et al., 1998; Teran-Santos, Jimenez-Gomez, & Cordero-Guevara, 1999), and this association was even stronger among 'commercial' vehicle drivers because of a high prevalence of SBD among that population (Hartenbaum, et al., 2006; Howard et al., 2004; Stoohs, Guilleminault, Itoi & Dement, 1994).

SBD is also reported to be an independent risk factor for hypertension, stroke, diabetes, depression, and premature death in many western countries (Arzt, Young, Finn, Skatrud, & Bradley, 2005; Ferini-Strambi & Fantini, 2006; Lindberg, Berne, Franklin, Svensson, & Janson, 2006; Nieto et al., 2000; Peppard, Szklo-Coxe, Hla, & Young, 2006; Peppard, Young, Palta, & Skatrud, 2000; Yaggi et al., 2005; West, Nicoll, & Stradling, 2006; Arias, Alonso-Fernandez, & Garcia-Rio F, 2006) as well as in Asian countries (Khoo, Tan, Ng, & Ho, 2004; Kim et al., 2004). In Japan, Li et al. reported that SBD was strongly associated with hypertension with odds ratio (OR) of 4.3 (95% confidence interval (CI) 1.7–10.8) in industrial workers (Li et al., 2003). In a population of power plant workers, elevation of blood pressure was significantly correlated with the degree of SBD, and this correlation was more evident in shift workers aged 40 and over (Tanigawa et al., 2006). Elevation of blood pressure was also confirmed in commercial truck drivers (Cui, Tanigawa, Sakurai, Yamagishi, & Iso, 2006).

Prevalence of SBD in those of working age has been estimated to be 3.1–26% depending on the definition, methodology, and population used in the studies, but the common findings are that men sustain SBD 2–3 times more often than women (Hida, Shindoh, et al., 1993; Hiestand, Britz, Goldman, & Phillips, 2006; Ip et al., 2004; Keenan, Ferguson, Chan-Yeung, & Fleetham, 1998; Lavie, 2002; Mayeux et al., 2001; Young et al., 1993). Although risk factors for SBD including obesity, heavy alcohol drinking or smoking have been well documented in a series of epidemiological studies (Baldwin et al., 2001; Jennum & Sjol, 1993; Khoo et al., 2004; Kim et al., 2004; Kripke et al., 1997; Lindberg & Gislason, 2000; Wetter, Young, Bidwell, Badr, & Palta, 1994; Young, et al., 2002), the potential impact of psychosocial stress on SBD is not well understood.

Recently, psychosocial job stress has been reported to be associated with sleep problems such as insomnia (Jansson & Linton, 2006; Kalimo, Tenkanen, Harma, Poppius, & Heinsalmi, 2000; Kudielka, von Kanel, Gander, & Fischer, 2004; Nakata et al., 2001, 2004; Ota et al., 2005; Tachibana et al., 1996; Utsugi et al., 2005), short sleep duration (Utsugi et al., 2005), poor sleep quality (Akerstedt, Fredlund, Gillberg, & Jansson, 2002; Cahill & Landsbergis, 1996; Doi, Minowa, & Tango, 2003; Fukasawa, et al., 2006; Kudielka et al., 2004; Ota et al., 2005; Theorell et al., 1988), sleep disruption (Akerstedt et al., 2002; Cahill & Landsbergis, 1996; Fahlen et al., 2006; Pelfrene et al., 2002), and EDS (Akerstedt et al., 2002; Kalimo et al., 2000; Takahashi et al., 2006). On the other hand, empirical evidence suggested that SBD is related to sleep symptoms such as insomnia (Krakow, et al., 2001; Krell & Kapur, 2005; Ohayon et al., 1997), EDS (Bixler et al., 2005; Cui et al., 2006; Gottlieb et al., 1999), poor sleep (Hiestand et al., 2006; Kripke et al., 1997; Redline et al., 2004), and short sleep duration (Krakow, et al., 2001; Kripke et al., 1997). On the basis of these findings, a link between job stress and SBD may be presumed.

Therefore, we designed this study to examine the association of broad aspects of job stress with SBD among 1940 male workers in small and medium-sized enterprises (SMEs). Sociodemographics, lifestyle, physical/psychological diseases under treatment, body mass index (BMI), and occupational factors were included as confounding variables.

Methods

Subjects and procedure

The study design was cross-sectional and data were collected by self-rated questionnaire from August to December 2002. Subjects were full-time workers in SMEs with 1–158 workers in Yashio city, Saitama, and Ohta ward, Tokyo. Yashio city has the highest percentage of manufacturing plants in Saitama prefecture. The Ohta ward, which is a so-called "industrial area," is unique for its number of SMEs. We randomly selected 329 enterprises from Yashio city and 61 from Ohta ward depending on the distribution of types of businesses in each city. The occupational health nurse (TI) or occupational health doctor (MH) contacted each enterprise by telephone to request participation in a questionnaire survey. Among these enterprises, 248 in Yashio city and 52 in Ohta ward agreed to participate in the survey. Questionnaires were distributed during visits to each factory and were given to 2591 workers in Yashio city and 1102 workers in Ohta ward ($n = 3693$). Finally, responses were obtained from 2884 workers (2022 men, 862 women) from 296 enterprises, representing a response rate of 78.1%. Among the 2022 men, we excluded 78 because of missing responses. Female workers were also excluded from the analyses because there were too few cases of study-defined SBD among the females ($n = 16$).

To elucidate the relationship between job stress and SBD, we further excluded 4 enterprises with only 1 worker from all subsequent analyses. We also excluded enterprises with 2 or fewer workers for the analysis of intragroup conflict at the workplace and social support from supervisors and coworkers. Twenty-six enterprises had 2 or fewer workers.

The questionnaire elicited information on demographics, lifestyle, height and body weight, physical/psychological disease(s) currently under treatment, job type, and industrial sector. Characteristics shown in Table 1 are those of a total of 1940 male workers.

The Medical Ethical Committee of the University of Tokyo approved the study, and written informed consent was obtained from all participants.

Variables

Job stress—The Japanese version of the generic job stress questionnaire (GJSQ) developed by the

Table 1
Characteristics of 1940 male workers[a,b]

Characteristics	
Sleep-related breathing disorder (yes)	130 (6.7)
Age (years), mean (SD)	45.1 (13.4)
Age group, years	
16–29	294 (15.1)
30–39	466 (24.0)
40–49	336 (17.3)
50–59	537 (27.7)
60–83	307 (15.8)
Marital status	
Married	1312 (67.6)
Not married	628 (32.4)
Highest education completed	
Junior high school	433 (22.3)
High school	863 (44.5)
Vocational/college/university	644 (33.2)
Smoking status	
Current	1143 (58.9)
Former	226 (11.6)
Never	571 (29.4)
Alcohol consumption (g ethanol/day)	
Nondrinker	472 (24.3)
0.01–4.9	249 (12.8)
5.0–14.9	436 (22.5)
15.0–24.9	382 (19.7)
> 25.0	401 (20.7)
Caffeine intake (cups of coffee or tea/day)	
Almost none	193 (9.9)
1 to 2	907 (46.8)
⩾3	840 (43.3)
Body mass index (kg/height (m)^2) (in quintiles)	
<20.5	386 (19.9)
20.5–22.0	392 (20.2)
22.1–23.5	376 (19.4)
23.6–25.4	394 (20.3)
> 25.4	392 (20.2)
Disease(s) currently under treatment (yes)	
Hypertension	268 (13.8)
Diabetes mellitus	91 (4.7)
Depression	14 (0.72)
Job type	
Managerial/clerical	394 (20.3)
Sales/service	206 (10.6)
Technical	91 (4.7)
Production/manufacturing	928 (47.8)
Other	321 (16.5)
Industrial sector	
Ceramic/clay/stone	27 (1.4)
Textile	41 (2.1)
Papermaking	111 (5.7)
Printing	41 (2.1)
Chemical	268 (13.8)

Table 1 (*continued*)

Characteristics	
Leather	35 (1.8)
Metalworking	822 (42.4)
Food	109 (5.6)
Machinery	299 (15.4)
Construction	27 (1.4)
Transportation	111 (5.7)
Others	49 (2.5)
Work schedule	
Nonshift	1854 (95.6)
Shift/night	86 (4.4)

[a]Unless otherwise indicated, values are expressed as *n* (%).
[b]Data may not total 100% due to rounding.

National Institute for Occupational Safety and Health (NIOSH) was used to assess participants' level of job stress (Haratani, Kawakami, Araki, Hurrell, Sauter, & Swanson, 1996; Hurrell, & McLaney, 1988; Nakata et al., 2004, 2006). Examination of the psychometric properties of the Japanese version of the questionnaire following translation showed consistently high levels of internal reliability (Cronbach's alpha, 0.68–0.95), stability over 1 year (r, 0.44–0.71) and factor-based validity (Haratani et al., 1996).

Eight scales for psychological job stressors, 2 scales for psychological stress reactions, and 3 scales for social support were selected. The scale that included job control, social support, and job satisfaction was a positively oriented scale, in which higher scores indicate low stress. The remaining 7 scales were negatively oriented scales with higher scores indicating high stress. The psychometric properties of the 13 GJSQ scales used in this study are shown in Table 2.

Participants were stratified into 3 groups of equal size on the basis of job stress scores (high, intermediate, and low) with the exception of the Center for Epidemiologic Studies Depression (CES-D) scale for depressive symptoms. The CES-D scale cut-off score is 16, which differentiates between those exhibiting high levels of depressive symptoms (CES-D score 16 or above) and those with lower levels of depression (15 and below) (Radloff, 1977).

Definition of SBD—The question with regard to SBD during the past 1-year period used in this study was adopted and modified from that used in previous epidemiological studies as follows (Khoo et al., 2004; Ng, Seow, & Tan, 1998): have you ever felt difficulty breathing during sleep or has anyone in your family told you that you have such difficulty?

(never or almost never /few times a year/more than once a month/more than once a week/more than three times a week/almost every day)

SBD was defined as present if the answer was "more than once a month," "more than once a week," "more than 3 times a week" or "almost every day."

Other potential confounding variables—Other variables were age, marital status, educational level, lifestyle, physical/psychological disease(s) currently under treatment, job type, industrial sector, and work schedule. Lifestyle factors included smoking status, alcohol consumption (number of alcoholic drinks consumed/day, with one drink estimated as about 9 g of pure ethanol), caffeine intake (cups of tea or coffee/day), and BMI (calculated as weight in kilograms divided by the square of height in meters). Diseases currently under treatment were identified by asking subjects if they had any of the following: hypertension, hyperlipidemia, diabetes mellitus, depression, menopausal disorder, and/or other diseases. Subjects who reported 'other diseases' were asked to specify the disease(s). Subjects reported various diseases including cardiovascular, cerebrovascular, liver, renal, gastrointestinal, neurologic diseases, hyperthyroidism, cancer prostatomegaly, rheumatism, musculoskeletal disorders, panic disorder, and allergy (self-report).

Statistical analyses

We attempted to identify potential confounding factors associated with SBD using univariate and multivariate logistic regression analyses. Univariate analyses were performed to detect the relationship of SBD with each of the variables, and the variables were then analyzed using the forward selection stepwise procedure ($p \leqslant 0.05$ for inclusion and $p \geqslant 0.10$ for exclusion) in multivariate analyses. Strong inter-correlations between variables were checked and excluded from the multivariate model (Table 3). Of the disease(s) currently under treatment, we selected hypertension and depression to be included in the model because they had been found to be correlated with SBD in many previous studies (Khoo et al., 2004; Kim et al., 2004; Li et al., 2003; Lindberg et al., 2006; Nieto et al., 2000; Peppard et al., 2006; Peppard et al., 2000; Tanigawa et al., 2006; West et al., 2006).

Table 2
Psychometric properties of 13 scales of the NIOSH job stress questionnaire in 1940 male workers

Job stress scale	Number of items	Mean	SD	Observed range	Possible range	α	Construct measured
Job stressors							
Quantitative workload (Quinn)	4	12.6	4.2	4–20	4–20	.88	How much work must be done daily
Variance in workload	3	8.9	3.3	3–15	3–15	.90	How often the workload varies
Job control	16	47.1	14.4	16–80	16–80	.96	How much the worker feels that tasks, workplace setting, and decisions at work are controllable
Skill underutilization	3	10.7	3.1	3–15	3–15	.79	How much the worker feels that his skills and ability are utilized in the job
Responsibility for people	4	10.3	4.4	4–20	4–20	.91	How much responsibility is felt for the future, job security, morale, welfare and lives of other workers
Intragroup conflict at the workplace	8	22.7	4.6	8–40	8–40	.65	How much the worker feels that relationships with the working group are friendly, harmonious, cooperative, and supportive
Job future ambiguity	4	15.4	4.0	4–20	4–20	.81	How certain the worker is about future career such as opportunities for promotion and advancement, usefulness of job skills, and future responsibilities
Employment opportunities	3	11.9	2.0	3–15	3–15	.72	Feelings about the job in relationship to other jobs that the worker might get
Social supports							
Supervisors	4	13.8	4.2	4–20	4–20	.88	Amount of social support received from supervisors
Coworkers	4	14.3	3.7	4–20	4–20	.85	Amount of social support received from colleagues
Family	4	14.8	4.2	4–20	4–20	.85	Amount of social support received from family
Psychological stress reactions							
Job satisfaction	4	8.1	1.9	4–13	4–16	.73	Whether the worker would accept the current job if given the choice to take a new job or recommend the job to others
Depressive symptoms (CES-D)	20	15.4	8.2	0–52	0–60	.83	Level of depressive symptoms experienced in the past week

Note: SD, standard deviation.

Table 3
Factors associated with sleep-related breathing disturbance among 1940 male workers

Factor	Univariate OR (95%CI)	*p* value	Multivariate OR (95%CI)	*p* value
Age (in years)	—	0.604	—	—
16–29	1.00	—	—	—
30–39	0.97 (0.54–1.73)	—	—	—
40–49	1.21 (0.66–2.20)	—	—	—
50–59	1.03 (0.58–1.80)	—	—	—
⩾60	0.69 (0.34–1.40)	—	—	—
Marital status	—	0.432	—	—
Unmarried	1.00	—	—	—
Married	1.17 (0.79–1.74)	—	—	—
Highest education completed	—	0.872	—	—
Junior high school	1.00	—	—	—
High school	1.13 (0.70–1.84)	—	—	—
Vocational/college/university	1.13 (0.68–1.87)	—	—	—
Smoking	—	0.555	—	—
Never	1.00	—	—	—
Former	1.28 (0.71–2.27)	—	—	—
Current	0.96 (0.64–1.44)	—	—	—
Alcohol consumption (g ethanol/day)	—	0.225	—	—
Nondrinker	1.00	—	—	—
0.01–4.9	0.98 (0.53–1.79)	—	—	—
5.0–14.9	0.79 (0.46–1.36)	—	—	—
15.0–24.9	0.71 (0.40–1.28)	—	—	—
> 25.0	1.31 (0.80–2.17)	—	—	—
Caffeine intake (cups of coffee or tea/day)	—	0.912	—	—
Almost none	1.00	—	—	—
1 to 2	1.08 (0.57–2.04)	—	—	—
3 or more	1.14 (0.60–2.16)	—	—	—
Body mass index (kg/height (m)^2) (in quintiles)	—	<0.001	—	<0.001
<20.5	1.00	—	1.00	—
20.5–22.0	0.66 (0.34–1.29)	—	0.49 (0.22–1.08)	—
22.1–23.5	0.80 (0.42–1.53)	—	0.74 (0.36–1.52)	—
23.6–25.4	1.22 (0.68–2.18)	—	0.94 (0.48–1.84)	—
> 25.4	2.25 (1.33–3.82)	—	1.97 (1.09–3.55)	—
Disease(s) currently under treatment	—	—		—
Hypertension	—	<0.001		<0.001
No	1.00	—	1.00	—
Yes	2.58 (1.72–3.88)	—	2.59 (1.62–4.16)	—
Diabetes mellitus	—	0.044	—	—
No	1.00	—	—	—
Yes	1.96 (1.16–15.7)	—	—	—
Depression	—	0.029	—	0.059
No	1.00	—	1.00	—
Yes	4.28 (1.02–3.78)	—	4.76 (0.95–23.9)	—
Job type	—	0.076	—	—
Managerial/clerical	1.00	—	—	—
Sales/service	0.81 (0.41–1.59)	—	—	—
Technical	1.33 (0.61–2.92)	—	—	—
Production/manufacturing	0.60 (0.37–0.96)	—	—	—
Others	1.05 (0.57–1.93)	—	—	—

Table 3 (*continued*)

Factor	Univariate OR (95%CI)	*p* value	Multivariate OR (95%CI)	*p* value
Industrial sector	—	0.755	—	—
Ceramic/clay/stone	1.00	—	—	—
Textile	1.04 (0.06–17.4)	—	—	—
Papermaking	2.21 (0.26–18.7)	—	—	—
Printing	2.90 (0.29–29.5)	—	—	—
Chemical	2.32 (0.30–18.0)	—	—	—
Leather	2.52 (0.22–29.6)	—	—	—
Metalworking	1.71 (0.23–14.7)	—	—	—
Food	3.84 (0.47–31.7)	—	—	—
Machinery	1.90 (0.25–14.7)	—	—	—
Construction	2.76 (0.24–32.5)	—	—	—
Transportation	2.76 (0.35–22.1)	—	—	—
Others	1.98 (0.20–19.9)	—	—	—
Work schedule	—	0.968	—	—
Nonshift	1.00	—	—	—
Shift/night	1.02 (0.44–2.38)	—	—	—

OR, odds ratio; CI, confidence interval.
All variables were entered and analyzed by the forward selection stepwise procedure ($p \leqslant 0.05$ for inclusion and $p \geqslant 0.10$ for exclusion) in a multivariate model. Only variables with $p < 0.10$ are shown for mutlivariate model.
— Estimates could not be calculated are not shown.

Risk of SBD because of job stress was estimated using multivariate logistic regression with ORs and 95% CIs as measures of association. Model A adjusted for BMI (in quartiles) and disease(s) currently under treatment (hypertension and depression) since these factors were strongly associated with SBD. Model B (fully adjusted model) adjusted for age in 10-year increments, marital status (married/not married), highest educational level (junior high school, high school, vocational/college/university), smoking status (never, former, current), alcohol consumption (0, 0.01–4.9, 5.0–14.9, 15.0–25.0, 25.0 < g/day), caffeine intake (almost none, 1–2, 3 or more, cups/day), BMI (in quartiles), disease(s) currently under treatment (hypertension, diabetes mellitus, and depression, yes/no), job type (managerial/clerical, sales/service, technical, manufacturing/production, other), industry sector (ceramic/clay/stone, textile, papermaking, printing, chemical, leather, metalworking, food, machinery, construction, transportation, other), and work schedule (shift/nonshift work). Subjects with missing data were excluded from each job stress scale (listwise exclusion). Partial correlation coefficients adjusting for confounders were used to examine the linear relationship between scores of job stress scales that were grouped into 3 levels and SBD. The significance level for all statistical analyses was $p < 0.05$ (two-tailed test). All data were analyzed using the Statistical Package for the Social Sciences version 14.0 (SPSS Inc., Chicago, IL, USA).

Results

Characteristics of subjects are shown in Table 1. Prevalence of study-defined SBD was 6.7% (95% CI 5.6–7.8). Participants ranged in age from 17 to 83 (mean 45) years with 43.5% of men being over 50 years of age. Two-thirds were married. Overall, 59% were current smokers and 11.6% were former smokers. Production/manufacturing and managerial/clerical positions accounted for 68% of workers while metalworking (42.4%) had the largest survey population among all the industrial sectors. The prevalence of hypertension was 13.8%, diabetes mellitus 4.7%, and depression 0.72%.

Frequencies of reported SBD in this study population were: 0.8% for 'almost every day', 1.1% for 'more than three times a week,' 1.8% for 'more than once a week,' 3.0% for 'more than once a month,' and 7.9% for 'few times a year.'

Psychometric properties of 13 scales of the NIOSH GJSQ used in this study are shown in

Table 2. Cronbach's alphas were calculated for each subscale and the values for each of the scales were satisfactory (Cronbach's alphas, 0.65–0.96).

Factors associated with SBD other than job stress in male workers are shown in Table 3. The univariate logistic regression analyses suggest that BMI and disease(s) currently under treatment (hypertension, diabetes mellitus, and depression) were significantly associated with an increased risk of SBD. When the forward selection stepwise procedure was applied, BMI and disease(s) currently under treatment (hypertension and depression) were the factors associated with SBD.

The relationships between job stressors, social support, and psychological stress reactions and SBD are shown in Table 4. Age-adjusted logistic regression analyses revealed that 8 out of 13 job stress variables were significantly associated with SBD. In the multivariate logistic regression analyses (Model A), participants who perceived the lowest level of social support from supervisors, highest levels of job future ambiguity, interpersonal conflict at the workplace, depressive symptoms, job dissatisfaction, variance in workload, and quantitative workload had significantly increased risk of SBD. A significant dose-dependent relationship between the above job stress variables and SDB was observed. Further adjustment (Model B) yielded similar results with the exception of intermediate quantitative workload.

To clarify further the relationship between job stress and SBD, we attempted to use more strict definition of SBD as 'more than once a week'. We found a consistent relationship between job stress and SBD even though the definition was changed (data not shown).

Discussion

A focus of the present study was to examine the association of psychosocial job stress with SBD among male workers. These workers were categorized into 3 equal-sized groups according to their job stress scores. Prevalence of perceived SBD during the last 1-year period was compared among the 3 groups. The results revealed that workers exposed to a low level of social support from supervisors and high levels of job future ambiguity, interpersonal conflict at the workplace, depressive symptoms, job dissatisfaction, variance in workload, and quantitative workload had 1.7–3.3 times higher odds of reporting SBD than those with counterparts with lower exposure. This association was strengthened as the job stress increased. Although the results of this study should be considered preliminary in light of the self-reporting and cross-sectional design, these data suggest that male workers with high job stress are at greater risk for SBD.

Many previous epidemiological studies have identified a series of risk factors for SBD as stated earlier. However, to date no epidemiological study has focused on the potential relationship between psychosocial job stress and SBD. In this study, we observed that psychosocial job stress was a significant factor for SBD, even after controlling for a broad range of potential confounding factors. Although the current study failed to adopt a gold standard diagnostic test, i.e., an overnight polysomnography for the diagnosis of SBD, our results suggest that job stress should also be taken into account when evaluating SBD in both occupational and clinical settings.

The reasons why psychosocial job stress is associated with an increase in SBD remain unknown. However, it seems reasonable to think that the workers who developed SBD or other associated sleep symptoms may have problems such as irritability with coworkers or supervisors, inability to concentrate at work, difficulty accomplishing assigned tasks in a timely manner, and uncertainty that they will be able to continue their employment, leading to expressions of higher job stress. This possibility could be supported by the fact that sleep apnea is often accompanied by cognitive dysfunction (Engleman & Douglas, 2004). Another possibility is that job stress may influence SBD. Several previous studies have shown that socioeconomic and psychosocial job status is related to sleep. For example, anticipation of job change or unemployment was reported to have an adverse effect on sleep health (Ferrie, Shipley, Marmot, Stansfeld, & Smith, 1995). Hyyppa et al. reported that middle-aged workers who had been stably employed, but became unemployed during the economic recession, suffered from sleep problems more often than workers who were continuously employed (Hyyppa, Kronholm, & Alanen, 1997). Several studies reported that job stresses are related to EDS (Akerstedt et al., 2002; Kalimo et al., 2000; Takahashi et al., 2006). Thus it is presumable that workers who are uncertain about the future of their careers, have a heavy workload, experience poor human relationship at the workplace, and are dissatisfied with their work could develop poor

Table 4
Relationship between job stressors, social support, and psychological stress reactions and sleep-related breathing disorder in male workers

Job stress scales[a]		No.	Age-adjusted				Multivariate A[b]				Multivariate B[c]			
			OR	95% CI	*p*	*p* for trend	OR	95% CI	*p*	*p* for trend	OR	95% CI	*p*	*p* for trend
Job stressors														
Quantitative workload	Low	659	1.00			.026	1.00			.018	1.00			.070
	Intermediate	604	1.65	1.02–2.65	.041		1.67	1.03–2.72	.038		1.50	0.84–2.65	.168	
	High	628	1.76	1.10–2.83	.020		1.78	1.11–2.88	.018		1.80	1.04–3.11	.035	
Variance in workload	Low	683	1.00			.015	1.00			.006	1.00			.022
	Intermediate	597	0.88	0.54–1.42	.595		1.03	0.62–1.70	.908		0.87	0.47–1.60	.656	
	High	605	1.72	1.12–2.63	.013		1.93	1.20–3.12	.007		1.99	1.13–3.49	.017	
Job control	High	603	1.00			.859	1.00			.683	1.00			.627
	Intermediate	607	0.81	0.50–1.29	.372		0.98	0.61–1.55	.915		0.85	0.49–1.49	.575	
	Low	572	0.99	0.62–1.57	.962		1.10	0.69–1.74	.700		1.12	0.62–2.00	.716	
Skill underutilization	Low	574	1.00			.285	1.00			.325	1.00			.221
	Intermediate	636	0.95	0.59–1.53	.823		1.01	0.62–1.64	.967		0.92	0.50–1.69	.789	
	High	664	1.26	0.81–1.98	.308		1.21	0.77–1.92	.407		1.33	0.76–2.32	.316	
Responsibility for people	Low	740	1.00			.339	1.00			.907	1.00			.756
	Intermediate	611	1.33	0.87–2.05	.193		1.39	0.90–2.15	.141		1.25	0.75–2.08	.392	
	High	567	1.19	0.75–1.89	.460		1.03	0.65–1.64	.885		0.82	0.47–1.45	.501	
Intragroup conflict at the workplace[d]	Low	627	1.00			.001	1.00			.001	1.00			.001
	Intermediate	639	1.53	0.93–2.49	.092		1.40	0.85–2.32	.187		1.41	0.77–2.56	.264	
	High	550	2.12	1.31–3.43	.002		2.18	1.34–3.53	.002		2.45	1.38–4.34	.002	
Job future ambiguity	Low	573	1.00			.010	1.00			.005	1.00			.001
	Intermediate	632	2.14	1.28–3.57	.004		2.52	1.50–4.25	.001		2.90	1.55–5.41	.001	
	High	546	2.01	1.19–3.39	.009		2.14	1.26–3.64	.005		2.90	1.54–5.43	.001	
Employment opportunities	Low	737	1.00			.285	1.00			.281	1.00			.136
	Intermediate	533	0.65	0.39–1.08	.095		0.70	0.42–1.18	.179		0.59	0.31–1.11	.099	
	High	644	1.36	0.89–2.07	.152		1.21	0.80–1.82	.362		1.35	0.83–2.20	.230	
Social support														
Supervisors[d]	High	757	1.00			<.001	1.00			.001	1.00			<.001
	Intermediate	638	1.65	1.04–2.63	.033		1.47	0.88–2.44	.142		1.78	0.97–3.26	.062	
	Low	435	2.47	1.52–4.02	<.001		2.38	1.39–4.08	.002		3.25	1.69–6.25	<.001	
Coworkers[d]	High	787	1.00			.022	1.00			.030	1.00			.107
	Intermediate	590	1.13	0.72–1.79	.598		1.06	0.65–1.74	.814		1.09	0.62–1.92	.756	
	Low	454	1.68	1.07–2.64	.024		1.31	0.79–2.16	.298		1.24	0.69–2.25	.471	
Family	High	690	1.00			.856	1.00			.844	1.00			.683
	Intermediate	574	0.85	0.53–1.34	.472		0.84	0.53–1.35	.475		0.98	0.57–1.67	.933	
	Low	561	1.05	0.68–1..63	.834		1.07	0.68–1.66	.784		0.87	0.48–1.56	.634	
Psychological stress reactions														
Job satisfaction	High	695	1.00			.045	1.00			.026	1.00			.011
	Intermediate	790	1.26	0.81–1.96	.304		1.32	0.86–2.01	.204		1.19	0.73–1.96	.486	
	Low	402	1.64	1.00–2.68	.050		1.73	1.05–2.85	.032		2.16	1.19–3.91	.011	
Depressive symptoms (CES-D)	<16	1057	1.00			<.001	1.00			<.001	1.00			<.001
	⩾16	668	2.10	1.43–3.08	<.001		2.08	1.41–3.07	<.001		2.18	1.39–3.42	.001	

Note: OR, odds ratio; CI, confidence interval.

[a]All scales were divided into thirds, with the exception of CES-D scale for depressive symptoms.

[b]Adjusted for BMI and disease(s) currently under treatment (hypertension and depression).

[c]Adjusted for age group, marital status, educational level, smoking status, alcohol consumption, caffeine intake, BMI, disease(s) currently under treatment (hypertension, diabetes mellitus, depression), job type, work schedule, and industrial sector.

[d]Enterprises with two or fewer workers were excluded from the analyses.

sleep health, including SBD. The third possibility is that the relationship between job stress and SBD might be explained by the effect of unadjusted/unknown confounders. Potential unadjusted confounders such as lack of exercise (Koskenvuo et al., 1994; Lindberg, & Gislason, 2000), occupational exposure to solvents (e.g. Heiskel, et al, 2002; Ulfberg, Carter, Talback, & Edling, 1997), snoring (Ip et al., 2004; Kim et al., 2004; Young et al., 2002), and wide neck circumference (e.g. Ip et al., 2004; Nieto et al., 2000; Young et al., 2002) have been reported to be independently associated with SBD. Inclusion of these factors when examining the relationship between job stress and SBD may result in a more accurate assessment.

At present, job stress is a major occupational health issue in many industrialized countries including Japan. According to the national surveys performed every 5 years in Japan, more than half (52.2%) of male employees reported job-related distress in 1982. This percentage has consistently increased, reaching 63.8% in 2002 and is expected to remain high (Japan Ministry of Health, Labor, and Welfare, Japan, 2002). Sleep problems were shown to be prevalent among the working population (Doi, 2005; Doi et al., 2003; Nakata et al., 2004, 2005; Ota et al., 2005; Utsugi et al., 2005) and in addition job stress was reported to be one of the most significant but modifiable risk factors for sleep problems. Thus it is plausible that job stress may be associated with SBD in Japanese male workers. Further investigations are warranted to clarify the causal relationship between job stress and SBD.

A potential criticism of the methodology of the current study is that we evaluated SBD subjectively by a single question. Although we asked if any of the subject's family members had witnessed episodes of SBD, we did not involve the subject's cohabiters or bed partners in the assessment. Another criticism of this methodology is that subjects without cohabiters or bed partners may underreport their SBD. This may also be true for subjects who do have cohabiters but do not sleep in the same room with them. We also need to be aware that the definition of SBD in this study may capture other disorders that may relate to breathing during sleep such as chronic obstructive pulmonary disease, asthma, heart failure and others. Thus the study's accuracy in evaluating SBD is limited and the results need to be interpreted carefully.

Other possible limitations are as follows. First, information on SBD and job stress was obtained by self-reporting, which may introduce recall/reporting bias. Therefore it might be difficult to generalize the findings of the study to objectively measured SBD via polysomnography. Second, since the study subjects were recruited from healthy workers, subjects with SBD in this study could be mainly comprised of mild-to-moderate cases. Subjects with mild SBD may be unaware of their own symptoms, leading to an underreporting of SBD. Third, we statistically controlled for health conditions by differentiating subjects who were 'currently' under treatment. We may, therefore, have missed individuals who actually had various diseases for which they were not currently being treated. Fourth, the data in this study came from a single survey of workers in two geographically small areas (Yashio city and Ohta ward). As only 130 males were diagnosed as having SBD in this study, we could not totally rule out the possibility that the relationships with job stress were found by chance. Further research with a larger sample size or a well-designed case-control study is needed. Fifth, response bias may have occurred if the nonrespondents differed from the respondents with respect to job stress and SBD. The nonresponding population may have more problems related to job stress and SBD. Of a total of 3693 subjects, 809 (21.9%) refused to or could not participate in the survey. Reasons for nonresponse were: the person responsible for the worksite did not have enough time to recruit workers, workers declined participation, the factory was too far to visit, the worker had retired, and workers did not show any interest in the survey. However, we could not examine this possible bias because detailed nonrespondent data were unavailable. Sixth, the inherent nature of the cross-sectional design does not permit the conclusion that job stress causes SBD.

In conclusion, despite the fact that job stress and SBD were assessed by self-report, as well as other limitations, these data suggested that exposure to high job stress could be a possible risk factor for developing SBD in men. Although it may be difficult to generalize our findings to women, the present finding underscores the need for further investigation of whether decreasing job stress will reduce the occurrence of SBD.

Acknowledgment

We are grateful to all volunteers who participated in this study. The authors would like to express our

deepest appreciation to Yuji Ohyama and Yosei Fujioka, and Satoe Fukui, for their help in the study. This research was supported in part by an appointment to the Research Participation Program at the Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the US Department of Energy and CDC. The research was also supported in part by the Japanese Ministry of Education, Culture, Sports, Science and Technology (16659634).

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