cial job characteristics are one factor affecting suicide rates [2].

Adverse psychosocial job characteristics can potentially lead to suicide via depression or psychiatric disorders. Many cross-sectional studies have revealed a positive association between adverse job characteristics and poor mental health, including major depressive episodes, depressive symptoms, and psychiatric morbidity [3–14]. Moreover, with a few exceptions [15], prospective analyses have also confirmed associations between job characteristics and subsequent burnout, depressive symptoms and psychiatric disorders [16–29]. However, to the best of our knowledge, only one study has prospectively shown that stress at work predicts suicide death [30]. In this study, work stress was assessed by asking participants to rate their experience of stress at work as minimal, light, moderate, or severe. However, such simple assessment of self-perceived stress might be too vague to be informative for suicide prevention, because it is not clear which specific sources of job stress are responsible for an increase in suicide risk.

The job demand-control model is currently the most prevalent job stress model [31]. It includes two components: psychological demands, which tap the quantitative and conflicting demands of work, and job control, which measures decision authority and skill utilization during a task. The two model components can be used to manipulate the work environment in an aim to reduce stress in the workplace [32]. The job demand-control model posits that workers with a combination of high psychological job demand and low job control are at risk of developing illnesses. The majority of studies support this hypothesis with respect to mental illness [22, 23, 25–28]. Moreover, many recent analyses have predicted an association between low control and mental health risks such as depression, revealing significant predictive associations [19, 22, 23, 25, 26, 33–37]. Low control has also been shown to explain health inequality by socioeconomic status [38]. Low control therefore seems to be a promising predictor of suicide. In this study, we investigate the extent to which psychosocial job characteristics are related to death from suicide among men in a Japanese community-based study.

Subjects and Methods

The Jichi Medical School Cohort Study

The Jichi Medical School Cohort Study began in 1992 and ultimately included 12,490 Japanese (4,911 men and 7,579 women) from 12 communities located across Japan [39]. Baseline data were collected between 1992 and 1995 using a standardized questionnaire and physical examination, which took place in each community. The questionnaire was distributed to the subjects to complete on their own before their health examination. In accordance with the provisions of the Health and Medical Service Law for the Aged, a mass screening examination program concerned with cardiovascular risk factors has been conducted in Japan since 1983. The law requires municipal governments to manage the program efficiently and offer it to all residents who are willing to participate. The target subjects vary according to each community, from all residents to those not offered physical examinations at their workplace or elsewhere, including subjects of the National Health Insurance program. Residents aged 40–69 years were the subjects for the mass screening examination program in 8 of the 12 communities, those aged 20–69 years were the subjects in one of the programs, those aged 35 years and older were included in one, and all adult residents were included in the remainder. In each community, the local government office invited all potential participants to participate by sending letters or using public information sources. The invitation mentioned that persons visiting hospitals or clinics because of cardiovascular diseases did not have to take the examination. People other than those in the initially defined age groups also participated in the study and are included in the database. The overall response rate was 65.4%.

Endpoint

The follow-up system established ensures that participants are annually contacted by direct interview or telephone/letter to determine their health status. Those who moved out of the study communities during the follow-up period remained in the study until the date of emigration. Data on emigration were obtained every year from municipal governments. Mortality data were collected from the Cause-of-Death Register at public health centers in each community with permission from the Agency of General Affairs and the Ministry of Health, Labor, and Welfare. We were able to ascertain the endpoint of all followed-up participants who died between the date of their health examination and end of 2002. The endpoint in our study comprised all cases of suicide (ICD 10th revision codes X60 to X84).

Psychosocial Job Characteristics

Job characteristics were derived at baseline using a Japanese version of the demand-control questionnaire translated from the WHO MONICA Psychosocial Study Questionnaire [40, 41]. The psychometric properties of the questionnaire have been reported elsewhere [42]. The job characteristics studied were job control and psychological demands. Job control was defined as the sum of two subscales each given equal weight: (1) skill discretion, measured using four parameters (possibility of learning new things, skills required, requirement for creativity, and the repetitious nature of the work), and (2) autonomy for decision making, measured using two parameters (right to make one's own decisions and freedom to choose the manner in which the work is performed). The second scale, psychological job demands, was defined using five parameters (speed in completing work, degree of difficulty, excessive workload, insufficient time allowed to complete the work, and conflicting demands). All questions were scored on a Likert scale of 1–4. Cronbach's coefficient alphas for the job control index and psychological demand index were 0.65

and 0.69, respectively. Job characteristics were also assessed as part of this cohort during the follow-up, demonstrating a moderate degree of stability with 5-year interval correlations of 0.63 (n = 377) for job control and 0.57 (n = 378) for job demands [43]. The variables were divided in such a way that the most adverse tertile indicated low control or high demands.

The Study Population

Since the aim of this analysis was to explore the effect of job characteristics on suicide, the study population was limited to 3,333 men with baseline ages of 65 and under who were currently working and whose occupations were defined. We excluded those with a history of cancer, myocardial infarction, and stroke. Workers without complete information on psychosocial job characteristics were also excluded. As a result, the final sample included 3,125 men.

The following occupations were included: farming and forestry (n = 960), fishery (236), security (17), transportation (87), construction (605), production (329), business (248), office work (198), professional (196), and the service industry (249). It should be noted that the sample population was not truly representative of the general working population of Japanese men. Workers engaged in farming, forestry, and fishery accounted for more than one third of the study population, among whom the health effect of psychosocial job characteristics has rarely been explored. More than 99% of the participants were employed by companies with fewer than 300 employees. According to the Industrial Safety and Health Law and related regulations in Japan, Japanese companies are required to conduct an annual health check-up of employees. For those not offered physical examinations at their workplace, such as workers with preindustrial occupations or those who are self-employed, the mass screening examination program is an opportunity to have their health status determined. As part of this cohort, we inferred from repeated surveys that changes in occupation or job position are not frequent in the rural settings included here [43]. Some part-time employees might have been included in the study population, but this was not ascertained.

The study design and procedures were reviewed and approved by each municipal government and the Ethics Committee for Epidemiological Research at Jichi Medical School. Written informed consent was obtained from all prospective participants.

Statistical Methods

Comparisons between psychosocial job characteristics and the studied variables at baseline were conducted using the χ^2 test for discrete variables and the t test for continuous variables. We counted person years of follow-up for each participant from the date of health examination to the date of death, date of emigration outside the study communities, or end of 2002, whichever occurred first. A total of 73 subjects (2.3% of the analytic cohort) moved out of the study communities during the study period and were analyzed as censored cases. The mean length of follow-up was 9.3 years and the total observed person years was 29,129. Cox's proportional hazard regression analysis was used to examine the association between psychosocial job characteristics and suicide death. The adjusted relative risks were estimated firstly after adjusting for age (<39, 40–49, 50–59, 60–65 years), occupation and study area (community), and then after adjusting for age, marital status (currently married, unmarried), educational attainment (lower or higher than the level of compulsory education), occupation, smoking status (nonsmoker, current smoker), alcohol consumption [nondrinker, <1 go daily (go, a traditional Japanese alcohol unit; 1 go = 28.9 g of alcohol), ≥1 go daily], total cholesterol and study area. Covariate variables were measured at baseline. Ordinal or nominal variables were represented by dummy variables, and serum total cholesterol was analyzed as a continuous variable. Statistical tests were two tailed. All analyses were conducted with SPSS for Windows, release 13.

Results

Of the participants free from overt major illnesses at baseline, 155 men died during the follow-up, and of these deaths, 14 were attributable to suicide. Suicide cases in this analysis ranged in age from 41 to 72 years. Three were in their 40s, 6 in their 50s, 4 in their 60s, and 1 in his 70s (median age: 55 years). Eleven of 14 cases occurred in 1998 or after, one occurred in 1993 and two in 1995. The present study showed a slightly lower suicide death rate (48.1 per 100,000 person years) than the Japanese national rate for men 40–69 years of age in 2000 (54.6 per 100,000 person years) [44]. Suicide cases were identified among farmers (n = 8), fishermen (1), businessmen (2), professional workers (1), construction workers (1) and production workers (1).

Table 1 shows the relationship between psychosocial job characteristics and the studied variables at baseline. Men reporting low job control were older, unmarried, and less educated compared with counterpart men. Among men with low job control, workers engaged in transportation and production were more prevalent, while businessmen and professional workers were less prevalent. Low job control was inversely associated with high job demands. Men with high job demands were younger, currently married, and more educated than counterpart men. Construction and production workers were more prevalent, while farmers were less prevalent among men with high demands. There were distributional differences in job characteristic levels across the studied areas. Low job control was significantly associated with a lower total cholesterol level, whereas high job demands were associated with a higher total cholesterol level.

Associations between job characteristics and suicide are presented in table 2. The incidence rate of suicide among men with low control at work (83.6 per 100,000 person years) was substantially higher than the reported Japanese national rate. Compared with counterpart men, the crude relative risk of suicide among men with low job

Table 1. Relationship between psychosocial job characteristics and the studied variables, the Jichi Medical School Cohort Study, baseline (1992/1995)

	Job control				p	Job demand				p
	low		others			high		others		
	n	%	n	%		n	%	n	%	
Age, years										
<39	145	12.5	298	15.2	<0.001	188	15.1	255	13.6	<0.001
40–49	278	24.0	641	32.6		415	33.3	504	26.8	
50–59	347	29.9	614	31.2		405	32.5	556	29.6	
60–65	389	33.6	413	21.0		239	19.2	563	30.0	
Marriage status										
Married	1,016	88.0	1,817	92.7	<0.001	1,148	92.5	1,685	89.9	0.012
Unmarried	139	12.0	144	7.3		93	7.5	190	10.1	
Education background										
Higher than compulsory	647	56.2	1,234	63.2	<0.001	775	62.8	1,106	59.2	0.046
Compulsory or lower	505	43.8	718	36.8		460	37.2	763	40.8	
Occupation										
Farming and forestry	342	29.5	618	31.4	<0.001	291	23.3	669	35.6	<0.001
Fisheries	90	7.8	146	7.4		94	7.5	142	7.6	
Business	67	5.8	181	9.2		80	6.4	168	8.9	
Office work	82	7.1	116	5.9		97	7.8	101	5.4	
Professional	44	3.8	152	7.7		96	7.7	100	5.3	
Security	15	1.3	2	0.1		1	0.1	16	0.9	
Service industry	84	7.2	165	8.4		102	8.2	147	7.8	
Transportation	71	6.1	16	0.8		28	2.2	59	3.1	
Construction	225	19.4	380	19.3		299	24.0	306	16.3	
Production	139	12.0	190	9.7		159	12.8	170	9.1	
Smoking status										
Nonsmoker	535	46.3	894	45.7	0.720	573	46.1	856	45.8	0.886
Current smoker	620	53.7	1,064	54.3		671	53.9	1,013	54.2	
Alcohol consumption										
Nondrinker	256	23.0	389	20.3	0.069	236	19.3	409	22.6	0.097
<28.9 g/day	303	27.2	588	30.6		369	30.2	522	28.8	
≥28.9 g/day	555	49.8	942	49.1		617	50.5	880	48.6	
Job demands										
High	304	26.2	943	48.0	<0.001					
Others	855	73.8	1,023	52.0						
Study area										
A	105	9.1	134	6.8	<0.001	71	5.7	168	8.9	0.001
B	208	17.9	536	27.3		291	23.3	453	24.1	
C	194	16.7	333	16.9		237	19.0	290	15.4	
D	38	3.3	61	3.1		31	2.5	68	3.6	
E	151	13.0	273	13.9		162	13.0	262	14.0	
F	142	12.3	179	9.1		150	12.0	171	9.1	
G	22	1.9	24	1.2		17	1.4	29	1.5	
H	157	13.5	212	10.8		147	11.8	222	11.8	
I	32	2.8	66	3.4		45	3.6	53	2.8	
J	35	3.0	26	1.3		16	1.3	45	2.4	
K	11	0.9	42	2.1		19	1.5	34	1.8	
L	64	5.5	80	4.1		61	4.9	83	4.4	
	Mean	SD	Mean	SD	p	Mean	SD	Mean	SD	p
Total cholesterol, mg/dl	183.3	34.6	187.2	34.1	0.003	187.2	34.4	184.7	34.2	0.047

Table 2. Incidence rates (IRs) and relative risks (RRs) of suicide by psychosocial job characteristics, the Jichi Medical School Cohort Study, 1992/1995–2002

Job characteristics	Suicide cases	IR[a]	Model 1			Model 2			Model 3		
			RR[b]	95% CI	p	RR[c]	95% CI	p	RR[d]	95% CI	p
Control											
High	5	27.2	1.00			1.00			1.00		
Low	9	83.6	3.07	1.03–9.16	0.044	4.07	1.31–12.59	0.015	4.10	1.31–12.83	0.015
Demand											
Low	10	57.4	1.00			1.00			1.00		
High	4	34.2	0.60	0.19–1.90	0.382	0.73	0.22–2.38	0.599	0.73	0.22–2.38	0.598

[a] Crude IR per 100,000 person years of follow-up.
[b] Crude RR.
[c] Adjusted for age, occupation and study area.
[d] Adjusted for age, occupation, study area, marital status, education, smoking, alcohol consumption, and total cholesterol.

control was 3.07 (95% confidence interval: 1.03–9.16). The relative risk with low job control increased after covariate variables were added to the model, and the adjusted relative risks indicated that men with low job control were more than fourfold likely to commit suicide than their counterparts. In contrast, high job demand had a rather protective but insignificant association with suicide. The crude relative risk indicated men with high job demands had a 40% lower risk of suicide than counterpart men, but adjusting for covariate variables made the association toward the null.

Discussion

A fourfold increase in risk of suicide death was revealed among men with low job control. The Nurses' Health Study prospectively showed for the first time that, compared with perceived light stress at work, suicide risk increased among women reporting severe stress [30]. This finding, which was revealed by simple assessment of self-perceived stress, therefore warranted a more extensive evaluation of work stress. In the present study, information about exposure to job characteristics was therefore obtained with a validated instrument. Psychosocial job characteristics were conceptualized using the job demand-control model, the most widely used conceptualization of unhealthy work stress in current epidemiological studies. The findings indicate that control at work is crucial for Japanese workers as previously shown among western working populations in terms of the association between low job control and mental health risk [22, 23, 25, 26, 33–35, 37]. Since modification of the work structure to give workers more control can be useful in stress reduction [32], our study provides implications for prevention of suicide death.

The age trend of suicide cases was similar to the national data on Japanese suicide mortality [44], but the present study showed a slightly lower suicide death rate for men than the reported Japanese national rate. This might be explained by the fact that follow-up of the study population started slightly before the surge of suicide deaths among Japanese men. In addition, we cannot deny the possibility that those with the worst work conditions selected to opt out of the study. Recent statistics show a high suicide incidence among men engaged in farming, forestry and fishery, administration, professional jobs, and the service industry, and a particularly increased incidence among those in the last three occupations, who are thought to suffer from the most harsh work conditions at present [45, 46]. Thus, the study population probably underrepresented the most at risk groups, other than farming, forestry, and fishery. Furthermore, a considerable number of the workers might have survived a long career. Moreover, a small at risk population (29,000) relative to the rare outcome of suicide might be vulnerable to sampling bias. Nevertheless, the adjusted relative risks of suicide among men exposed to low job control were notable, and the confidence intervals of these findings were acceptable.

Around the time when the study population was recruited, the average retirement age of Japanese employees

was 63 years [47]; but some workers in the cohort are thought to have retired later because of the rather rural study setting, which included a large proportion of workers engaged in preindustrial occupations such as farming, employees of medium-small sized enterprises and self-employed individuals. Nonoccupational factors might have more strongly affected suicide, in particular among older cases, and might reflect the observed associations. However, analysis after excluding four cases who committed suicide at ages over 60 continued to reveal increased relative risks of suicide among men with low job control (crude relative risk: 3.99; 95% confidence interval: 1.03–15.43; $p = 0.045$, and multivariate relative risk: 6.12; 95% confidence interval: 1.45–25.82; $p = 0.014$, respectively).

A possible explanation for the association between low job control and suicide is that adverse job characteristics can cause depression or psychiatric disorders, which can lead to suicide [48, 49]. Well-designed prospective studies have confirmed the association between job characteristics and the risk of mental illness [19, 22, 23, 25, 26]. Another possibility is that long-term exposure to low job control leads to a sustained feeling of learned helplessness, which can make people vulnerable to stressors and in turn increase the risk of suicide [50]. Smoking, alcohol consumption and low serum total cholesterol might mediate the association between job characteristics and suicide [51–53], and thus, adjusting for these variables might lead to overadjustment. However, in this study, adjustment actually strengthened the associations. Low educational attainment, an indicator of socioeconomic status, predicted mortality in this cohort for both men and women [unpubl. data]. Moreover, in Japan, suicide among men is often associated with low socioeconomic status, including low income [54]. However, the observed association between low job control and suicide was independent of socioeconomic indicators such as education and occupation.

High job demands showed a weak protective effect with respect to suicide in the present study. This is inconsistent with the increased concern over suicide from overwork in Japan [55]. The present study related job demands at baseline with suicide during an average 9-year follow-up. As the less stable test-retest reliability indicates [43], job demands can change from time to time. Therefore, this study does not exclude the possibility that workers are at higher risk of suicide when they work extremely long hours or under extremely high job demands. It is also possible that an increase in job demands among workers whose ordinary work is less demanding is associated with a high risk of suicide. Recent observations of the unexpected associations between psychological demands and health outcome suggest the concept of psychological job demands should be more refined [56, 57]. Among a diverse population such as ours, the items of the demands scale might measure different dimensions [58]; that is, for some workers, high demands at work might imply a challenging or mentally stimulating job [57]. Another possibility is that workers with low psychological job demands might have included those with workloads reduced by redundancy [59].

A major limitation of the present study is that the prevalence of negative emotions such as depression [14] and hostility [60] was not ascertained at baseline. The observed association could be spurious if people with such tendencies exhibit a higher probability of reporting negative experiences at work [61]. Nevertheless, the protective (but insignificant) effect of job demands on suicide contradicts this conjecture. In addition, recent studies indicate that the impact of a tendency toward negative affectivity should not be overstated [26]. In the present study, the mean length of follow-up of the suicide cases was 5.6 (SD = 3.0) years. A previous 5-year follow-up study of Japanese middle-aged workers showed an association between depressive mood and subsequent suicide [62], but the actual 'induction time' was probably shorter than 5 years. It is unlikely therefore that a temporal depressive episode at baseline was responsible for an increased risk of suicide [63].

The alpha coefficient of the job control measurements was slightly low, and our exposure assessment was limited to one point in time, both of which could make the associations null. Nevertheless, the long-term stability of our measurements was shown to be statistically significant [43]. Some investigators have examined the duration or cumulativeness of exposure to adverse job characteristics, revealing the importance of cumulative job control [56, 64, 65]. The determination of death by suicide from death certificates can be problematic, since a proportion of suicides might be misclassified as deaths from other types of injury or accident. Misclassification of a suicide (that is, classification as an accident) could also bias the results towards the null.

On the other hand, our study had a number of strengths. For example, bias attributable to sample attrition is implausible as the follow-up rate was high. We excluded individuals with major illnesses at baseline, which might have influenced both the exposure (job characteristics) and outcome (the risk of suicide). Thus, selection bias due to ill subjects with certain types of jobs was un-

likely. Furthermore, we took into account relevant risk factors of suicide, except factors such as low income and negative emotions.

Conclusion

Low job control was shown to be associated with an increased risk of suicide death among male workers in this Japanese community-based population. Since job control can be altered to help reduce stress in the workplace, increasing control at work could be one worthwhile strategy for preventing, or at least reducing, the risk of suicide death. Given the considerable impact of suicide on the society, the finding underlies the need for further research on the psychosocial risk factors of suicide in the workplace.

Appendix

The Jichi Medical School Cohort Study Group

Akizumi Tsutsumi (Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama); *Atsushi Hashimoto* (Aichi Prefectural Aichi Hospital, Aichi); *Eiji Kajii* (Department of Community and Family Medicine, Jichi Medical School, Tochigi); *Hideki Miyamoto* (former Department of Community and Family Medicine, Jichi Medical School, Tochigi); *Hidetaka Akiyoshi* (Department of Pediatrics, Fukuoka University School of Medicine); *Hiroshi Yanagawa* (Saitama Prefectural University, Saitama); *Hitoshi Matsuo* (Gifu Prefectural Gifu Hospital, Gifu); *Jun Hiraoka* (Tako Central Hospital, Chiba); *Kaname Tsutsumi* (Kyushu International University, Fukuoka); *Kazunori Kayaba* (Saitama Prefectural University); *Kazuomi Kario* (Department of Cardiology, Jichi Medical School, Tochigi); *Kazuyuki Shimada* (Department of Cardiology, Jichi Medical School, Tochigi); *Kenichiro Sakai* (Akaike Town Hospital, Fukuoka); *Kishio Turuda* (Takasu National Health Insurance Clinic, Gifu); *Machi Sawada* (Agawa Osaki National Health Insurance Clinic, Kochi); *Makoto Furuse* (Department of Radiology, Jichi Medical School, Tochigi); *Manabu Yoshimura* (Kuze Clinic, Gifu); *Masahiko Hosoe* (Gero Hot-Spring Hospital, Gifu); *Masahiro Igarashi, Masafumi Mizooka* (Kamagari National Health Insurance Clinic, Hiroshima); *Naoki Nago* (Tsukude Health Insurance Clinic, Aichi); *Nobuya Kodama* (Sakugi Clinic, Hiroshima); *Noriko Hayashida* (Tako Central Hospital, Chiba); *Rika Yamaoka* (Awaji-Hokudan Public Clinic, Hyogo); *Seishi Yamada* (Wara National Health Insurance Hospital, Gifu); *Shinichi Muramatsu* (Department Neurology, Jichi Medical School, Tochigi); *Shinya Hayasaka, Shizukiyo Ishikawa* (Department of Community and Family Medicine, Jichi Medical School, Tochigi); *Shuzo Takuma* (Akaike Town Hospital, Fukuoka); *Tadao Gotoh* (Wara National Health Insurance Hospital, Gifu); *Takafumi Natsume* (Oyama Municipal Hospital, Tochigi); *Takashi Yamada* (Kuze Clinic, Gifu); *Takeshi Miyamoto* (former Okawa Komatsu National Health Insurance Clinic, Kochi); *Tomohiro Deguchi* (Akaike Town Hospital, Fukuoka); *Tomohiro Saegusa* (Sakuma National Health Insurance Hospital, Shizuoka); *Yoshihiro Shibano* (Saiseikai Iwaizumi Hospital, Iwate); *Yoshihisa Ito* (Department of Laboratory Medicine, Asahikawa Medical College, Hokkaido); *Yosikazu Nakamura* (Department of Public Health, Jichi Medical School, Tochigi).

Acknowledgement

This study was supported by a grant-in-aid from the Foundation for the Development of the Community, Tochigi, Japan.

References

1 Japan Ministry of Health, Labour, and Welfare Special Committee on Prevention of Suicide: A suggestion for preventing suicide (in Japanese). Tokyo, The Japan Ministry of Health, Labour, and Welfare 2002.
2 Amagasa T, Nakayama T, Takahashi Y: Karojisatsu in Japan: characteristics of 22 cases of work-related suicide. J Occup Health 2005;47:157–164.
3 Bourbonnais R, Brisson C, Moisan J, Vezina M: Job strain and psychological distress in white-collar workers. Scand J Work Environ Health 1996;22:139–145.
4 Braun S, Hollander RB: Work and depression among women in the Federal Republic of Germany. Women Health 1988;14:3–26.
5 Bromet EJ, Dew MA, Parkinson DK, Cohen S, Schwartz JE: Effects of occupational stress on the physical and psychological health of women in a microelectronics plant. Soc Sci Med 1992;34:1377–1383.
6 Cropley M, Steptoe A, Joekes K: Job strain and psychiatric morbidity. Psychol Med 1999;29:1411–1416.
7 D'Souza RM, Strazdins L, Lim LLY, Broom DH, Rodgers B: Work and health in a contemporary society: demands, control, and insecurity. J Epidemiol Community Health 2003;57:849–854.
8 Estryn-Behar M, Kaminski M, Peigne E, Bonnet N, Vaichere E, Gozlan C, Azoulay S, Giorgi M: Stress at work and mental health status among female hospital workers. Br J Ind Med 1990;47:20–28.
9 Karasek RA Jr: Job demands, job decision latitude, and mental strain: implications for job redesign. Adm Sci Q 1979;24:285–307.
10 Landsbergis PA: Occupational stress among health care workers: a test of the job demands-control models. J Organ Behav 1988; 9:217–239.
11 Loscocco KA, Spitze G: Working conditions, social support, and the well-being of female and male factory workers. J Health Soc Behav 1990;31:313–327.
12 Pikhart H, Bobak M, Pajak A, Malyutina S, Kubinova R, Topor R, Sebakova H, Nikitin Y, Marmot M: Psychosocial factors at work and depression in three countries of Central and Eastern Europe. Soc Sci Med 2004;58:1475–1482.
13 Weinberg A, Creed F: Stress and psychiatric disorder in healthcare professionals and hospital staff. Lancet 2000;355:533–537.
14 Williams R, Barefoot J, Blumenthal J, Helms M, Luecken L, Pieper C, Siegler IC, Suarez EC: Psychosocial correlates of job strain in a sample of working women. Arch Gen Psychiatry 1997;54:543–548.
15 Carayon P: A longitudinal test of Karasek's Job Strain Model among office workers. Work Stress 1993;7:299–314.

16 Borritz M, Bultmann U, Rugulies R, Christensen KB, Villadsen E, Kristensen TS: Psychosocial work characteristics as predictors for burnout: findings from 3-year follow up of the PUMA Study. J Occup Environ Med 2005;47:1015–1025.
17 Bromet EJ, Dew MA, Parkinson DK, Schulberg HC: Predictive effects of occupational and marital stress on the mental health of a male workforce. J Organ Behav 1988;9:1–13.
18 Kawakami N, Araki S, Kawashima M: Effects of job stress on occurrence of major depression in Japanese industry: a case-control study nested in a cohort study. J Occup Med 1990;32:722–725.
19 Kawakami N, Haratani T, Araki S: Effects of perceived job stress on depressive symptoms in blue-collar workers of an electrical factory in Japan. Scand J Work Environ Health 1992; 18:195–200.
20 Kivimäki M, Elovainio M, Vahtera J, Virtanen M, Stansfeld S: Association between organizational inequity and incidence of psychiatric disorders in female employees. Psychol Med 2003;33:319–326.
21 Mino Y, Shigemi J, Tsuda T, Yasuda N, Bebbington P: Perceived job stress and mental health in precision machine workers of Japan: a 2 year cohort study. Occup Environ Med 1999;56:41–45.
22 Niedhammer I, Goldberg M, Leclerc A, Bugel I, David S: Psychosocial factors at work and subsequent depressive symptoms in the Gazel cohort. Scand J Work Environ Health 1998;24:197–205.
23 Paterniti S, Niedhammer I, Lang T, Consoli SM: Psychosocial factors at work, personality traits and depressive symptoms. Br J Psychiatry 2002;181:111–117.
24 Romanov K, Appelberg K, Honkasalo ML, Koskenvuo M: Recent interpersonal conflict at work and psychiatric morbidity: a prospective study of 15,530 employees aged 24–64. J Psychosom Res 1996;40:169–176.
25 Stansfeld SA, Fuhrer R, Head J, Ferrie J, Shipley M: Work and psychiatric disorder in the Whitehall II study. J Psychosom Res 1997;43:73–81.
26 Stansfeld SA, Fuhrer R, Shipley MJ, Marmot MG: Work characteristics predict psychiatric disorder: prospective results from the Whitehall II study. Occup Environ Med 1999;56:302–307.
27 Wang J: Perceived work stress and major depressive episodes in a population of employed Canadians over 18 years old. J Nerv Ment Dis 2004;192:160–163.
28 Wang J: Work stress as a risk factor for major depressive episode(s). Psychol Med 2005;35: 865–871.
29 Ylipaavalniemi J, Kivimäki M, Elovainio M, Virtanen M, Keltikangas-Järvinen L, Vahtera J: Psychosocial work characteristics and incidence of newly diagnosed depression: a prospective cohort study of three different models. Soc Sci Med 2005;61:111–122.
30 Feskanich D, Hastrup JL, Marshall JR, Colditz GA, Stampfer MJ, Willett WC, Kawachi I: Stress and suicide in the Nurses' Health Study. J Epidemiol Community Health 2002; 56:95–98.
31 Karasek R, Theorell T: Healthy Work: Stress, Productivity, and the Reconstruction of Working Life. New York, Basic Books, 1990, pp 1–381.
32 Orth-Gomér K, Eriksson I, Moser V, Theorell T, Fredlund P: Lipid lowering through work stress reduction. Int J Behav Med 1994; 1:204–214.
33 Godin I, Kittel F: Differential economic stability and psychosocial stress at work: associations with psychosomatic complaints and absenteeism. Soc Sci Med 2004;58:1543–1553.
34 Griffin JM, Fuhrer R, Stansfeld SA, Marmot M: The importance of low control at work and home on depression and anxiety: do these effects vary by gender and social class? Soc Sci Med 2002;54:783–798.
35 Mausner-Dorsch H, Eaton WW: Psychosocial work environment and depression: epidemiologic assessment of the demand-control model. Am J Public Health 2000;90: 1765–1770 (Erratum in: Am J Public Health 2001;91:828).
36 Tsutsumi A, Kayaba K, Theorell T, Siegrist J: Association between job stress and depression among Japanese employees threatened by job loss in a comparison between two complementary job-stress models. Scand J Work Environ Health 2001;27:146–153.
37 Tyssen R, Vaglum P, Gronvold NT, Ekeberg O: Suicidal ideation among medical students and young physicians: a nationwide and prospective study of prevalence and predictors. J Affect Disord 2001;64:69–79.
38 Stansfeld SA, Head J, Marmot MG: Explaining social class differences in depression and well-being. Soc Psychiatry Psychiatr Epidemiol 1998;33:1–9.
39 Ishikawa S, Gotoh T, Nago N, Kayaba K: The Jichi Medical School (JMS) Cohort Study: design, baseline data and standardized mortality ratios. J Epidemiol 2002;12:408–417.
40 World Health Organization: MONICA Psychosocial Optional Study MOPSY. Suggested Measurement Instruments (EUR/ICP/NCD 011, 3037H). Copenhagen, WHO Regional Office for Europe, 1989.
41 Uehata T: Stress, life style and health (in Japanese). Koshu Eisei In Kenkyu Hokoku 1993; 42:385–401.
42 Tsutsumi A, Kayaba K, Tsutsumi K, Igarashi M: Association between job strain and prevalence of hypertension: a cross sectional analysis in a Japanese working population with a wide range of occupations: the Jichi Medical School Cohort Study. Occup Environ Med 2001;58:367–373.
43 Kayaba K, Tsutsumi A, Gotoh T, Ishikawa S, Miura Y: Five-year stability of job characteristics scale scores among a Japanese working population. J Epidemiol 2005;15:228–234.
44 Japan Ministry of Health, Labour, and Welfare: Health and Welfare Statistics 2002 (in Japanese). Tokyo, Japan Health and Welfare Statistics Association, 2002.
45 Statistics and Information Department, Minister's Secretariat, Ministry of Health, Labour, and Welfare: Outline of Vital Statistics according to Occupation and Industry, Special Report on Vital Statistics. Tokyo, The Japan Ministry of Health, Labour, and Welfare, 1999.
46 Statistics and Information Department, Minister's Secretariat, Ministry of Health, Labour, and Welfare: Outline of Vital Statistics according to Occupation and Industry, Special Report on Vital Statistics. Tokyo, The Japan Ministry of Health, Labour, and Welfare, 2003.
47 Japan Ministry of Labour: Analyses on Labour and Economy 1989 (white paper) (in Japanese). Tokyo, The Japan Ministry of Labour, 1989.
48 Benazzi F: Suicidal ideation and depressive mixed states. Psychother Psychosom 2005; 74:61–62.
49 Moscicki EK: Identification of suicide risk factors using epidemiologic studies. Psychiatr Clin North Am 1997;20:499–517.
50 Lennerlof L: Learned helplessness at work. Int J Health Serv 1988;18:207–222.
51 Head J, Stansfeld SA, Siegrist J: The psychosocial work environment and alcohol dependence: a prospective study. Occup Environ Med 2004;61:219–224.
52 Kivimäki M, Leino-Arjas P, Luukkonen R, Riihimaki H, Vahtera J, Kirjonen J: Work stress and risk of cardiovascular mortality: prospective cohort study of industrial employees. BMJ 2002;325:857–860.
53 Landsbergis PA, Schnall PL, Deitz DK, Warren K, Pickering TG, Schwartz JE: Job strain and health behaviors: results of a prospective study. Am J Health Promot 1998;12:237–245.
54 Lester D, Motohashi Y, Yang B: The impact of the economy on suicide and homicide rates in Japan and the United States. Int J Soc Psychiatry 1992;38:314–317.
55 Inoue K, Matsumoto M: Karo Jisatsu (suicide from overwork): a spreading occupational threat. Occup Environ Med 2000;57:284–285.
56 Johnson JV, Stewart W, Hall EM, Fredlund P, Theorell T: Long-term psychosocial work environment and cardiovascular mortality among Swedish men. Am J Public Health 1996;86:324–331.
57 Steenland K, Johnson J, Nowlin S: A follow-up study of job strain and heart disease among males in the NHANES1 population. Am J Ind Med 1997;31:256–260.
58 Kristensen TS, Bjorner JB, Christensen KB, Borg V: The distinction between work pace and working hours in the measurement of quantitative demands at work. Work Stress 2004;18:305–322.

59 Sokejima S, Kagamimori S: Working hours as a risk factor for acute myocardial infarction in Japan: case-control study. BMJ 1998; 317:775–780.
60 Romanov K, Hatakka M, Keskinen E, Laaksonen H, Kaprio J, Rose RJ, Koskenvuo M: Self-reported hostility and suicidal acts, accidents, and accidental deaths: a prospective study of 21,443 adults aged 25–59. Psychosom Med 1994;56:328–336.
61 Burke MJ, Brief AP, George JM: The role of negative affectivity in understanding relations between self-reports of stressors and strains: a comment on the applied psychology literature. J Appl Psychol 1993;78:402–412.
62 Tamakoshi A, Ohno Y, Yamada T, Aoki K, Hamajima N, Wada M, Kawamura T, Wakai K, Song Lin Y: Depressive mood and suicide among middle-aged workers: findings from a prospective cohort study in Nagoya, Japan. J Epidemiol 2000;10:173–178.
63 Koivumaa-Honkanen H, Honkanen R, Viinamaki H, Heikkila K, Kaprio J, Koskenvuo M: Life satisfaction and suicide: a 20-year follow-up study. Am J Psychiatry 2001;158: 433–439.
64 Amick BC 3rd, McDonough P, Chang H, Rogers WH, Pieper CF, Duncan G: Relationship between all-cause mortality and cumulative working life course psychosocial and physical exposures in the United States labor market from 1968 to 1992. Psychosom Med 2002;64:370–381.
65 Bosma H, Marmot MG, Hemingway H, Nicholson AC, Brunner E, Stansfeld SA: Low job control and risk of coronary heart disease in Whitehall II (prospective cohort) study. BMJ 1997;314:558–565.

Industrial Health 2007, 45, 415–425

Original Article

Association between Job Stressors and Heavy Drinking: Age Differences in Male Japanese Workers

Hisanori HIRO[1]*, Norito KAWAKAMI[2], Katsutoshi TANAKA[1], Ken NAKAMURA[1] and the Japan Work Stress and Health Cohort Study Group

[1]Kitasato University Graduate School of Medical Sciences, 15–1 Kitasato 1, Sagamihara, Kanagawa 228-8555, Japan

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

Received May 31, 2006 and accepted January 10, 2007

Abstract: The objective of the present study is to investigate the association between various occupational stressors and heavy drinking among male Japanese workers in different age groups. Using the Generic Job Stress Questionnaire, 13 occupational stressors and 2 workplace support indicators were assessed. The questionnaire survey was conducted of 25,104 workers, and the present study analyzed the data from 17,501 male workers. Heavy drinking was defined as weekly alcohol consumption of >275 g, and a total of 1,131 men (6.5%) were classified as heavy drinkers. After adjusting for shift work, occupational class, marital status and smoking, heavy drinking was related to "support from supervisor" for the 18–29 and 50–72 yr-old groups. For the 30–39 yr-old group, heavy drinking was related to "intragroup conflict", "job control" and "cognitive demands." For the 40–49 yr-old group, heavy drinking was related to "physical environment", "quantitative workload" and "underutilization of abilities." The present study clarified that certain occupational stressors relate to heavy drinking, and that this association varies among different age groups.

Key words: Alcohol, Stress, Workplace, Job stressor, Social support

Introduction

Numerous cross-sectional and longitudinal studies have been conducted to assess the association of occupational environment and stress with alcohol consumption, harmful drinking, and alcohol dependence[1–29]. However findings are still conflicting and inconclusive[1].

Most studies in this field have shown some association between drinking and job stress. For example, as far as cross-sectional studies are concerned, Hingson *et al.* conducted a household survey and reported that job stress was associated with mean alcohol consumption, heavy drinking, and drunkenness[2]. House *et al.* found that job tension was associated with average weekly alcohol consumption[3]. In addition, Ragland *et al.* studied urban transit operators and documented that those who often experienced job stress were likely to drink heavily[4]. As far as longitudinal studies are concerned, Crum *et al.* reported that, among men, even after adjusting for job insecurity and workplace support, alcohol dependence and abuse were associated with high-strain jobs[5].

However, Mensch *et al.* show low correlation between alcohol consumption and job stress among young men[6], and Cooper *et al.* documented no significant relationship between job pressure and alcohol consumption or problem drinking[7]. Head *et al.* also reported no significant association between objectively assessed stress and alcohol dependence among male workers by cohort study[8].

Many types of job stressors exist. Some of them have been suggested to correlate to drinking[9]. San José *et al.* reported that males and females in the range of 45–74 yr old reporting high hazardous physical working conditions

*To whom correspondence should be addressed.

and high demands were more likely to be heavy drinkers than to be light drinkers[10]. Hemmingsson *et al.* found that low work control was related to later alcohol abuse among young men by longitudinal study[11]. Greenberg *et al.* reported that low job autonomy, low use of capacities and lack of participation in decision making in the workplace were associated with heavy drinking and negative consequences from drinking[12]. Clarke *et al.* investigated the relationship of drinking frequency, alcohol consumption, duration of heavy drinking, and severity of alcohol dependence to six of the eight factors common to jobs with high incidence of alcohol dependence as reported by Plant (availability of alcohol, social pressure to drink, separation from family due to work commitments, lack of supervision, collusion in heavy drinking by colleagues, and strains and stresses; they excluded high or low income and recruitment of individuals predisposed to drink heavily)[13]. They found no significant correlation. Moreover, when they examined nine occupational stress factors and stressors (feeling strained, working alone, working irregular shifts, dangerous work, work overload, responsibility for others, job security, complicated work, and assessment by quantity of output), they found that, among men, none correlated to alcohol consumption and frequency, and among women, a significant correlation existed only with "responsibility for others".

There are few studies for Japanese workers. Kawakami *et al.* studied male workers in a Japanese computer factory and found lack of intrinsic rewards was correlated to heavy and problem drinking. Job overload, lack of control over pace and job future ambiguity was not significantly correlated to them[14]. Hagihara *et al.* reported that "work requiring advanced knowledge and skill", "time pressure", "clear job purpose or goal" was related with heavy drinking among male white-collar workers[15]. They conducted another study for 30–50 yr-old male white-collar workers and documented that job demands and skill discretion (such as a variety of skills and creativity at work) defined in the job demands-control model[30] were associated with alcohol consumption[16].

Some studies have used the demand/control model[30] to assess psychosocial work environments. Using such a model, highly stressful work environments are those with high job demand and low job control. However, different studies have arrived at different conclusions[1, 5, 17, 18]. In addition, several studies have used the effort-reward imbalance model. Using this model, work is considered stressful if despite high effort, rewards, such as wages, social approval, job security, and career advancement opportunities, are low[31]. Some studies have found that this imbalance increases the risk for alcohol dependence among men[8], but others have found no significant correlation with heavy drinking[1].

Drinking is also reported to be influenced by social support[19]. Workplace support can be divided into general support and support that directly relates to drinking, and both types of support may play a role in drinking among workers[32]. Hemmingsson *et al.* found evidence that low level of workplace support was related to later alcohol abuse among young men[11]. But in the Japanese study by Kawakami *et al.*, lack of workplace support was not correlated to heavy and problem drinking[14]. Hagihara *et al.* reported that social support has both positive and negative influences on the relationship between job stress and alcohol consumption[20].

As far as the interaction between stress and drinking is concerned, various models, including the tension reduction hypothesis[33], have been proposed, but it is generally accepted that no single model could explain all cases[34]. Cooper *et al.* stated that this association was complicated by individual differences in types of stress, coping mechanisms, responses to stress, and expectancies for effects of drinking[35]. Furthermore, national and racial differences exist in the use of alcohol to relieve stress and tension[36], and clear gender differences have been reported[37, 38]. In terms of age, studies have shown that young people are more likely to use alcohol to relieve and deal with stress[11, 39]. In contrast, some studies have not shown a clear correlation between stress factors and alcohol consumption among the elderly[40].

Therefore, the discrepancies in the results of previous studies on the association between job stress and heavy drinking are due to not only study design and measurement methods, but also race, gender, age, stress vulnerability, motivation to drink, and geographical factors.

It is supposed that certain job stressors are associated with heavy drinking among male Japanese workers. Based on the results of the above-mentioned studies, we hypothesized that the association between occupational stress and heavy drinking varies among different age groups in male Japanese workers. In order to prove this hypothesis, the association between various job stressors and heavy drinking was investigated by different age groups using the scale that could assess lots of job stressors.

Methods

Subjects

The present study was conducted using the data obtained as a baseline survey of the Japan Work Stress and Health Cohort Study (JSTRESS Study) (reported in detail elsewhere[41, 42]). A questionnaire was distributed to 29,471 workers at nine companies and factories from April 1996 to

May 1998; 25,104 workers replied (average response rate, 85.2%). Of the total respondents, 19,681 men answered questions about age, recent drinking history, and average alcohol consumption. After excluding 2,180 nondrinkers, a total of 17,501 men remained as subjects. Nondrinkers were eliminated in order to further clarify the association between job stressors and heavy drinking, because many have specific reasons for abstaining from drinking or cannot drink due to constitutional factors. Women were also excluded, because habitual drinkers are few among them.

Job stressors and heavy drinking assessment

Job stressors and workplace social support indicators were measured using the Generic Job Stress Questionnaire (GJSQ)[43]. The GJSQ was developed by researchers at the U.S. National Institute for Occupational Safety and Health (NIOSH) and assesses the components of the job-stress model. In addition to 13 stressors (physical environment, role conflict, role ambiguity, intragroup conflict, intergroup conflict, job control, quantitative work load, variance in work load, underutilization of abilities, responsibility for people, cognitive demands, job future ambiguity, and employment opportunities), it can assess buffers of stress-stress reactions (social support and self-esteem). It is designed in a modular style, and researchers can adjust forms and scales to suit each investigation. The degree of reliability for the internal consistency of each stressor ranged from 0.75 to 0.89. The validity and reliability of the Japanese version of the GJSQ have been confirmed[44, 45]. Thirteen job stressor scales and two workplace support indicator scales (supervisor support and coworker support) were used in the present study. The questionnaire contained the following: a ten-item physical environment scale, eight-item role conflict scale, six-item role ambiguity scale, eight-item intragroup conflict scale, eight-item intergroup conflict scale, sixteen-item job control scale, eleven-item quantitative workload scale, three-item variance in workload scale, three-item underutilization of abilities scale, four-item responsibility for people scale, five-item cognitive demands scale, four-item job future ambiguity scale, three-item employment opportunities scale, four-item social support from supervisors scale, and four-item social support from coworkers scale.

Heavy drinking was defined as weekly alcohol consumption of >275 g. This is based on alcohol consumption with increased risk for sickness absence as reported by a previous study[46]. This definition is also based on the estimates of increased health risk related to hazardous alcohol consumption, commonly used several countries[1]. For each subject, based on answers provided on the questionnaire form (average alcohol consumption per drinking day, average number of drinking days per month and types of alcohol beverages), weekly alcohol consumption (in grams) were calculated.

Statistical analysis

Subjects were divided into the following four age groups: 18–29, 30–39, 40–49 and 50–72 yr.

First of all, the average score for the above-mentioned 13 job stressors and workplace support indicators was calculated for each age group, and average scores were subjected to a variance analysis. The Scheffe method was used for multiple comparison. The scores of the job stressors and workplace supports were divided into tertiles labeled "low", "intermediate" or "high", so that, for example, those subjects within the top third of all scores on the physical environment scale were labeled as having "high physical environment score".

Next, the association between job stressors and heavy drinking was analyzed in three stages. First of all, logistic regression analysis was conducted by handling heavy drinking as a dependent variable and the 13 job stressor scores and 2 workplace support indicators as independent variables. For each job stressor, adjusted odds ratio and 95% confidence interval for heavy drinking were calculated. Second, the same analysis was conducted adjusting for shift work and occupational class. Third, the same analysis was conducted additionally adjusting for marital status and smoking. These analyses were carried out using SPSS 10.0J.

Ethical considerations

Because the present study analyzed the data obtained by the JSTRESS study, it was not reviewed by the Kitasato Ethical Review Board. Prior to implementation, the Human Subject Committee at Gifu University approved the investigation methods, contents and procedures of the JSTRESS study.

Results

Descriptive statistics

The rate of daily drinking (≥28 d/month) was 11.1% among the 18–29 yr old group, 26.8% among the 30–39 yr old group, 36.1% among the 40–49 yr old group and 37.9% among 50–72 yr old group.

Of the total subject population, 1,131 men (6.5%) were identified as heavy drinkers. The mean and standard deviation of weekly alcohol consumption were 351.0 mg and 168.6 mg in heavy drinkers, 81.3 mg and 65.5 mg in non-heavy drinkers.

Table 1. Demographic variables, occupational class and shift work by age group among male respondents of the baseline survey of the Japan Work Stress and Health Cohort Study

	Age group (yr)			
	18–29 (n=2,256)	30–39 (n=5,328)	40–49 (n=6,832)	50–72 (n=3,085)
	n (%)	n (%)	n (%)	n (%)
Heavy drinkers*	45 (2.0)	259 (4.9)	549 (8.0)	278 (9.0)
Basic education				
Less than high school	10 (0.4)	112 (2.1)	845 (12.7)	973 (32.4)
High school or some college	1,546 (69.5)	2,819 (53.8)	3,978 (59.6)	1,592 (53.0)
College or higher	667 (30.0)	2,309 (44.1)	1,850 (27.7)	440 (14.6)
Unknown	33 (–)	88 (–)	159 (–)	80 (–)
Marital status				
Married	612 (27.6)	4,059 (77.3)	5,972 (89.3)	2,861 (95.2)
Never married	1,596 (71.9)	1,100 (20.9)	569 (8.5)	63 (2.1)
Previously married	11 (0.5)	92 (1.8)	145 (2.2)	81 (2.7)
Unknown	37 (–)	77 (–)	146 (–)	80 (–)
Occupational class				
Manager	0	301 (5.7)	1,741 (25.9)	812 (27.0)
Professionals	232 (10.5)	1,290 (24.5)	796 (11.8)	198 (6.6)
Technicians	485 (22.0)	1,195 (22.7)	747 (11.1)	182 (6.1)
Clerks	149 (6.7)	400 (7.6)	422 (6.3)	185 (6.2)
Service & sales workers	13 (0.6)	44 (0.8)	69 (1.0)	80 (2.7)
Craft and related trade workers	314 (14.2)	561 (10.7)	960 (14.3)	427 (14.2)
Machine operators and assemblers	804 (36.4)	999 (19.0)	1,216 (18.1)	602 (20.0)
Laborers	163 (7.4)	297 (5.6)	404 (6.0)	283 (9.4)
Other	49 (2.2)	177 (3.4)	372 (5.5)	239 (7.9)
Unknown	47 (–)	64 (–)	105 (–)	77 (–)
Shift work				
Yes	810 (36.2)	1,376 (25.9)	1,065 (15.7)	440 (14.4)
No	1,430 (63.8)	3,931 (74.1)	5,702 (84.3)	2,620 (85.6)
Unknown	16 (–)	21 (–)	65 (–)	25 (–)
Smoking				
Smoker	1,230 (54.9)	2,951 (55.8)	3,833 (56.8)	1,504 (49.9)
Non-smoker	1,009 (45.1)	2,336 (44.2)	2,921 (43.2)	1,513 (50.1)
Unknown	17 (–)	41 (–)	78 (–)	68 (–)

*Average weekly consumption >275 g of absolute alcohol.

Table 1 shows the subject profiles in each age group. A χ^2 test showed a significant difference in the proportion of heavy drinkers among the age groups ($p<0.01$); the tendency was toward a higher proportion of heavy drinkers with increasing age. Moreover, χ^2 test showed a significant difference in the proportion of rotating-shift workers ($p<0.01$); the tendency was toward a lower proportion of rotating-shift workers with increasing age.

Job stressor and workplace support scores

Table 2 shows the average scores for the job stressors and workplace support indicators for each age group. The average scores of Physical environment, role conflict, role ambiguity, intragroup conflict, intergroup conflict, quantitative work load, underutilization of abilities, job future ambiguity, social support from supervisor and social support from coworkers were higher in younger age groups. The average scores of job control, responsibility for people, cognitive demands and employment opportunities were higher in elder age groups. Analysis of variance (multiple comparison by Scheffe method) showed a significant intergroup difference for role conflict, role ambiguity, intragroup conflict, intergroup conflict, quantitative work load, variance in work load, job future ambiguity, and employment opportunities among all age groups ($p<0.01$, $p<0.05$). As to the other job stressors, a significant difference was seen for some two-group combinations. Similarly, for the social support indicators, a significant difference was seen for some two-group combinations.

Table 2. Job stressor and workplace support scale scores by age groups

	Score range	18–29 N	18–29 Mean (SD)	30–39 N	30–39 Mean (SD)	40–49 N	40–49 Mean (SD)	50–72 N	50–72 Mean (SD)
Job stressor									
Physical environment	10–20	2,216	14.6 (2.9)	5,242	14.1 (3.0)	6,641	13.9 (3.1)	2,913	13.8 (3.0)
Role conflict	8–56	2,200	24.5 (7.2)	5,223	25.7 (7.4)	6,613	23.9 (7.5)	2,955	22.2 (7.8)
Role ambiguity	6–42	2,208	20.1 (5.6)	5,258	19.0 (5.7)	6,669	17.2 (5.6)	2,982	16.2 (5.7)
Intragroup conflict	8–40	2,196	20.0 (5.1)	5,203	20.4 (5.1)	6,534	19.6 (4.9)	2,874	18.9 (5.1)
Intergroup conflict	8–40	2,196	20.0 (5.2)	5,203	20.4 (5.1)	6,534	19.5 (5.1)	2,874	19.0 (5.2)
Job control	16–90	2,194	39.8 (9.9)	5,186	46.2 (11.4)	6,582	50.6 (12.6)	2,927	50.7 (13.4)
Quantitative work load	11–55	2,195	36.6 (6.2)	5,187	38.3 (6.5)	6,550	37.7 (6.5)	2,916	35.7 (6.6)
Variance in work load	3–15	2,228	8.9 (3.0)	5,273	9.5 (3.0)	6,707	9.2 (3.0)	2,994	8.5 (3.1)
Underutilization of abilities	3–15	2,231	11.0 (2.8)	5,274	10.3 (2.7)	6,717	10.1 (2.8)	2,995	10.2 (2.8)
Responsibility for people	4–20	2,225	8.0 (3.3)	5,253	10.1 (3.9)	6,683	11.9 (4.2)	2,979	11.9 (4.3)
Cognitive demands	4–20	2,228	14.2 (2.3)	5,258	15.0 (2.4)	6,725	15.2 (2.4)	3,015	15.2 (2.5)
Job future ambiguity	4–20	2,224	15.2 (3.1)	5,251	14.7 (3.4)	6,684	14.3 (3.7)	2,972	13.8 (4.3)
Employment opportunities	3–15	2,224	11.3 (1.8)	5,250	11.5 (1.7)	6,683	12.0 (1.8)	3,004	12.3 (1.8)
Workplace support									
Social support from supervisor	4–20	2,219	15.1 (3.0)	5,240	14.8 (3.1)	6,660	14.8 (3.1)	2,973	14.9 (3.2)
Social support from coworkers	4–20	2,219	15.7 (2.8)	5,240	15.2 (2.8)	6,660	15.1 (2.8)	2,973	15.1 (2.9)

One-way ANOVA (multiple comparison: Scheffe):

Not significant:

Physical environment 40–49:50–72, Job control 40–49:50–72,

Underutilization of abilities 30–39:40–49, 40–49:50–72, 30–39:50–72, Responsibility for people 40–49:50–72,

Cognitive demands 30–39:50–72, 40–49:50–72, Social support from supervisor 18–29:50–72, 30–39:40–49, 30–39:50–72, 40–49:50–72,

Social support from coworkers 30–39:40–49, 30–39:50–72, 40–49:50–72

$p<0.05$: Role conflict 18–29:40–49, Intergroup conflict 18–29:30–39

$p<0.01$: Others

Logistic regression analysis

When the scores for the thirteen job stressors and the two workplace supports were entered as explanatory variables, "physical environment" and "social support from supervisor" were significantly and positively associated with heavy drinking for the 18–29 yr-old group. For the 30–39 yr-old group, "physical environment", "role conflict" and "intragroup conflict" were significantly and positively associated with heavy drinking, and "cognitive demands" was negatively associated with heavy drinking. For the 40–49 yr-old group, in addition to "physical environment", significant associations existed with "quantitative work load" and with "underutilization of abilities". "Physical environment" and "underutilization of abilities" were positively associated with heavy drinking, and "quantitative workload" was negatively associated with heavy drinking. For the 50–72 yr-old group, "responsibility for people" and "social support from supervisor" were significantly associated with heavy drinking. In the "responsibility for people" scale, the proportion of heavy drinkers was lowest in intermediate score group. In the "social support from supervisor" scale, it was highest in the intermediate score group.

When rotating shift and occupational class were added as explanatory variables, only one factor, "social support from supervisor" was significantly and positively associated with heavy drinking for the 18–29 yr-old group and 50–72 yr-old group. For the 50–72 yr-old group, the proportion of heavy drinkers was highest in intermediate score group. For the 30–39 yr-old group, "role conflict", "intragroup conflict" and "job control" were significantly and positively associated with heavy drinking, and "cognitive demands" was negatively associated with heavy drinking. For the 40–49 yr-old group, the association of job stressors and workplace supports with heavy drinking remained unchanged.

Table 3 shows the results of the analysis including marital status and smoking as explanatory variables. Even when adjusted for marital status and smoking, there was no change in the association of heavy drinking with the job stressors and workplace support indicators for three groups. For the 30–39 yr-old group, "intragroup conflict", "job control" and "cognitive demands" were significantly associated with heavy drinkers. But "role conflict" was not significantly associated with heavy drinkers. No significant correlation existed between shift rotation and heavy drinking for any age group.

Table 3. Association of job stressors and workplace supports with heavy drinking by age groups: odds ratios (ORs) with 95% confidence intervals (CIs)

	Age group (years)							
	18–29		30–39		40–49		50–72	
	n	OR (95% CI)	n	OR (95% CI)	n	OR (95% CI)	n	OR (95% CI)
Job stressors								
Physical environment								
Low score (<14, n=6,524)	569	1.00	1,660	1.00	2,293	1.00	899	1.00
Intermediate score (n=4,718)	564	1.24 (0.46–3.35)	1,272	0.97 (0.66–1.42)	1,415	1.07 (0.83–1.40)	572	1.12 (0.75–1.67)
High score (>15, n=5,770)	767	1.57 (0.60–4.07)	1,566	1.27 (0.87–1.85)	1,568	1.34* (1.02–1.77)	650	1.17 (0.75–1.80)
Role conflict								
Low score (<22, n=5,998)	643	1.00	1,299	1.00	1,886	1.00	964	1.00
Intermediate score (n=5,117)	578	1.01 (0.43–2.38)	1,337	1.44 (0.98–2.12)	1,635	0.87 (0.67–1.13)	610	0.76 (0.51–1.15)
High score (>27, n=5,876)	679	1.41 (0.56–3.55)	1,862	0.98 (0.64–1.50)	1,755	0.92 (0.69–1.23)	547	1.03 (0.67–1.58)
Role ambiguity								
Low score (<16, n=6,281)	391	1.00	1,307	1.00	2,263	1.00	1,066	1.00
Intermediate score (n=4,529)	550	0.42 (0.15–1.16)	1,232	0.72 (0.49–1.07)	1,406	1.05 (0.81–1.36)	502	0.79 (0.51–1.21)
High score (>19, n=6,307)	959	0.89 (0.38–2.08)	1,959	0.80 (0.54–1.18)	1,607	0.76 (0.56–1.02)	553	1.22 (0.78–1.91)
Intragroup conflict								
Low score (<18, n=5,686)	613	1.00	1,317	1.00	1,910	1.00	855	1.00
Intermediate score (n=5,996)	689	1.57 (0.69–3.58)	1,644	1.15 (0.77–1.71)	1,903	0.91 (0.70–1.19)	726	0.76 (0.51–1.12)
High score (>22, n=5,125)	598	0.92 (0.31–2.69)	1,537	1.63*(1.05–2.54)	1,463	1.27 (0.93–1.75)	540	0.68 (0.41–1.12)
Intergroup conflict								
Low score (<18, n=5,636)	628	1.00	1,300	1.00	1,918	1.00	815	1.00
Intermediate score (n=5,545)	609	0.86 (0.37–2.01)	1,510	1.19 (0.80–1.78)	1,733	1.16 (0.88–1.52)	705	1.34 (0.90–2.00)
High score (>22, n=5,626)	663	0.84 (0.32–2.23)	1,688	1.11 (0.70–1.75)	1,625	1.07 (0.77–1.49)	601	1.32 (0.80–2.18)
Job control								
Low score (<44, n=5,690)	1,165	1.00	1,681	1.00	1,239	1.00	508	1.00
Intermediate score (n=5,451)	590	1.60 (0.78–3.28)	1,573	1.23 (0.86–1.76)	1,618	1.16 (0.87–1.54)	643	0.83 (0.53–1.31)
High score (>52, n=5,748)	145	0.30 (0.36–2.40)	1,244	1.54* (1.00–2.37)	2,419	1.06 (0.77–1.47)	970	0.84 (0.51–1.39)
Quantitative work load								
Low score (<35, n=6,101)	787	1.00	1,406	1.00	1,700	1.00	942	1.00
Intermediate score (n=5,458)	612	0.79 (0.34–1.83)	1,405	0.81 (0.55–1.20)	1,801	0.72* (0.55–0.94)	671	1.01 (0.67–1.53)
High score (>40, n=5,289)	501	0.74 (0.25–2.19)	1,687	0.92 (0.57–1.47)	1,775	0.72 (0.51–1.01)	508	1.09 (0.63–1.90)
Variance in work load								
Low score (<8, n=5,568)	669	1.00	1,254	1.00	1,559	1.00	831	1.00
Intermediate score (n=5,915)	677	1.55 (0.65–3.69)	1,541	1.01 (0.68–1.50)	1,827	0.98 (0.74–1.29)	705	0.95 (0.63–1.45)
High score (>10, n=5,719)	554	1.64 (0.51–5.31)	1,703	1.20 (0.73–1.96)	1,890	0.99 (0.70–1.41)	585	0.93 (0.53–1.65)
Underutilization of abilities								
Low score (<10, n=6,786)	564	1.00	1,796	1.00	2,221	1.00	932	1.00
Intermediate score (n=4,179)	430	0.63 (0.25–1.55)	1,169	0.99 (0.69–1.40)	1,322	1.04 (0.80–1.37)	484	0.88 (0.58–1.34)
High score (>11, n=6,252)	906	0.56 (0.25–1.25)	1,533	0.92 (0.64–1.33)	1,733	1.42** (1.10–1.84)	705	1.09 (0.73–1.61)

(Continued)

Discussion

Recently Osaki *et al.* conducted a nationwide survey on alcohol drinking behavior and alcohol dependence among Japanese adults using a representative sampling method, and reported that daily drinking rate was 18.6% for 20–29 yr-old men, 25.4% for 30–39 yr-old men, 36.1% for 40–49 yr-old men and 44.7% for 50–59 yr-old men[47]. The rate of daily drinking in this sample was slightly lower but almost comparable.

There were fair differences of the average scores for the job stressors among age groups. They are certainly reflected with some characteristic aspects of the working situation in each age group, which can indirectly affect the relationship between job stressors and heavy drinking.

In the present study, we were able to confirm that a significant correlation exists between heavy drinking and several job stressors and that this relationship varies among the different age groups.

While the causes for age difference could not be clarified

Table 3. (Continued) Association of job stressors and workplace supports with heavy drinking by age groups: odds ratios (ORs) with 95% confidence intervals (CIs)

	Age group (years)							
	18–29		30–39		40–49		50–72	
	n	OR (95% CI)	n	OR (95% CI)	n	OR (95% CI)	n	OR (95% CI)
Responsibility for people								
Low score (<9, n=5,661)	1,167	1.00	1,734	1.00	1,182	1.00	496	1.00
Intermediate score (n=5,404)	585	0.63 (0.29–1.34)	1,611	0.98 (0.70–1.38)	1,518	1.00 (0.75–1.34)	641	0.67 (0.42–1.05)
High score (>12, n=6,075)	148	0.52 (0.11–2.39)	1,153	0.98 (0.65–1.48)	2,576	1.14 (0.84–1.55)	984	0.96 (0.60–1.52)
Cognitive demands								
Low score (<14, n=4,528)	691	1.00	1,166	1.00	1,191	1.00	517	1.00
Intermediate score (n=5,817)	687	0.97 (0.47–2.04)	1,505	0.72 (0.51–1.02)	1,793	0.96 (0.73–1.26)	667	1.38 (0.90–2.10)
High score (>15, n=6,881)	522	0.72 (0.28–1.88)	1,827	0.67* (0.47–0.97)	2,292	1.15 (0.87–1.52)	937	1.09 (0.70–1.69)
Job future ambiguity								
Low score (<13, n=5,530)	416	1.00	1,363	1.00	1,881	1.00	846	1.00
Intermediate score (n=6,317)	839	1.04 (0.43–2.56)	1,773	0.90 (0.64–1.27)	1,883	0.83 (0.65–1.07)	640	1.12 (0.77–1.63)
High score (>16, n=5,284)	645	1.25 (0.48–3.26)	1,362	0.84 (0.57–1.24)	1,512	0.94 (0.71–1.23)	635	0.79 (0.52–1.22)
Employment opportunities								
Low score (<12, n=6,909)	988	1.00	2,189	1.00	1,976	1.00	603	1.00
Intermediate score (n=5,138)	573	0.68 (0.31–1.48)	1,329	0.83 (0.59–1.15)	1,602	0.89 (0.69–1.15)	631	0.78 (0.51–1.19)
High score (>12, n=5,114)	339	0.86 (0.35–2.10)	980	1.09 (0.77–1.55)	1,698	1.10 (0.87–1.40)	887	1.03 (0.71–1.50)
Workplace supports								
Social support from supervisor								
Low score (<14, n=5,342)	533	1.00	1,408	1.00	1,628	1.00	681	1.00
Intermediate score (n=6,432)	681	3.69* (1.16–11.68)	1,725	0.86 (0.61–1.22)	2,040	1.03 (0.79–1.34)	777	1.66* (1.10–2.50)
High score (>16, n=5,418)	686	5.44** (1.60–18.42)	1,365	0.70 (0.45–1.07)	1,608	1.05 (0.76–1.45)	663	1.33 (0.80–2.22)
Social support from coworkers								
Low score (<15, n=6,062)	525	1.00	1,610	1.00	1,934	1.00	848	1.00
Intermediate score (n=5,510)	556	1.16 (0.47–2.86)	1,491	1.04 (0.73–1.49)	1,809	0.86 (0.67–1.11)	629	0.84 (0.56–1.25)
High score (>16, n=5,520)	819	0.63 (0.24–1.61)	1,397	1.12 (0.75–1.68)	1,533	0.83 (0.61–1.13)	644	0.80 (0.50–1.28)
Shift work								
No (n=13,683)	1,215	1.00	3,330	1.00	4,472	1.00	1,819	1.00
Yes (n=3,691)	685	1.34 (0.65–2.78)	1,168	1.05 (0.76–1.44)	804	0.77 (0.57–1.04)	302	1.16 (0.74–1.82)
Occupational class								
A group (n=9,135)	780	1.00	2,873	1.00	3,203	1.00	1,131	1.00
B group (n=7,236)	1,120	1.34 (0.60–3.01)	1,625	1.56* (1.11–2.19)	2,073	1.13 (0.88–1.45)	990	0.88 (0.60–1.29)
Marital status								
Married (n=13,504)	528	1.00	3,489	1.00	4,755	1.00	2,029	1.00
Never/previously married (n=3,657)	1,372	1.86 (0.79–4.34)	1,009	1.17 (0.85–1.62)	521	1.30 (0.96–1.75)	92	1.38 (0.71–2.69)
Smoking								
Non-smoker	854	1.00	2,014	1.00	2,365	1.00	1,099	1.00
Smoker	1,046	5.58** (2.13–14.57)	2,484	1.91** (1.40–2.60)	2,911	1.63** (1.32–2.01)	1,022	1.97** (1.44-2.71)

A group: managers/professionals/technicians/clerks, B group: service&sales workers/craft and related trade workers/machine operators and assemblers/laborers.

*$p<0.05$, **$p<0.01$.

in the present study, several hypotheses could be formed.

First of all, as suggested by Kasl *et al.*[40], when compared to young people, older people have set drinking habits which are not affected by environmental factors. This could explain the finding that no significant correlation existed between heavy drinking and all job stressors for the 50–72 yr-old group. But then the same results were found among 18–29 yr-old groups. Japanese young workers may tend to cope their stress with other means but drinking.

Secondly, certain stressors may affect drinking behavior in different age groups[19]. For the 30–39 yr old group, heavy drinking correlated to intragroup conflict, job control and cognitive demands. Intragroup conflict may induce high strain that relate to heavy drinking because of work ethics

and workplace responsibilities among the group. The higher job control, the higher the incidence of heavy drinking. The direction of this relationship was opposite to what was expected. But findings about this relationship are somewhat inconclusive in previous studies[10, 21, 22]. It may be also affected with national and rational differences about the use of alcohol to relieve stress and tension. The higher cognitive demands were, the lower the prevalence of heavy drinking was. The direction of this relationship was also opposite to what was initially expected. For the 30–39 yr-old group, lower class occupations (B group), which are supposed to have lower cognitive demands compared to higher class occupations (managers, etc.), were more likely to be heavy drinker. Occupational difference in norms and behaviors for drinking, not just cognitive demands itself, may be a primary factor for the negative association between cognitive demands and heavy drinking. For the 40–49 yr-old group, heavy drinking was correlated to physical environment, quantitative workload and underutilization of abilities. Japanese male workers between the ages of 40–49 tend to be busy with things besides work, such as family obligations, and if quantitative workload is high, the amount of time for drinking may be reduced, thus lowering the likelihood of heavy drinking. Underutilization of abilities may play a role because of prides for abilities among the group. In the report by San José *et al.*, physical working conditions and job demands were significantly associated with heavy drinking among middle and old aged citizens[10]. Greenberg *et al.* reported that low use of capacities and lack of participation in decision making in the workplace were associated with heavy drinking and negative consequences from drinking[12]. The results of the present study are similar to those of the reports.

Moreover, social support from supervisor was related with heavy drinking among two age groups. In 18–29 yr-old group, the higher the social support from supervisor, the higher the incidence of heavy drinking. In 50–72 yr-old group, the risk for heavy drinking was highest in intermediate group. In general, social support is thought to alleviate stress, and the greater the social support, the lower the stress[11, 19]. Support from supervisor and coworkers is an important form of social support. Lack of supervision can delay the recognition of problem drinking, thereby promoting heavy drinking[48]. However, supervisors and coworkers can play different roles in heavy drinking as Hagihara *et al.* pointed out[20]. Some of the high scores for support from supervisor might have resulted from men being encouraged to drink during social gatherings and meetings. Furthermore, if supervisors are tolerant of heavy drinking and problems stemming from it, heavy drinking can be exacerbated. In other words, supervisors can enable heavy drinking[49]. This could have played a role for the 18–29 yr-old and 50–72 yr-old groups.

As to shift rotation, the present study did not show a significant correlation to heavy drinking. Regland *et al.* reported that shift work was associated with alcohol consumption[18]. There are several forms of rotating shifts, such as 2-shift and 3-shift schedules. In order to more closely investigate the association between heavy drinking and rotating shift, it will be necessary to include shift pattern and duration of employment as variables.

Some of the advantages of the present study are that numerous questions and items related to job stress were analyzed in a large number of male workers. It was possible to investigate various stressors and confounding factors.

However, when interpreting the results of the present study, it is necessary to consider its limitations.

First of all, it is well known that people underestimate alcohol consumption. This can undervalue the true association between heavy drinking and stressors. In addition to the items that exhibited a significantly correlation to heavy drinking, other important job stressors might exist. We did not also take drinking pattern into consideration. Drinking the weekly total in fewer settings can be more harmful than drinking the same total amount spread throughout the week. The relation of job stressors with drinking may be different by drinking pattern.

Secondly, although we used a questionnaire that evaluates many facets of job stressors, there may be other job stressors that closely correlate to heavy drinking. For example, differences are apparent in the volume of drinking and the severity of problem drinking among the different occupations. In the past, some studies have been conducted on the association between occupation and drinking[50–52]. Even when adjusting for demographic variations, there appear to be significant differences in the incidence of alcohol dependence and the volume of alcohol consumption among various occupations. Hypotheses that explain such occupational differences can be roughly divided into four groups[52]: 1) the structural model states that alienation and stress caused by the structural characteristics of work influence drinking; 2) the social control model states that workplaces with loose regulations about drinking promote heavy drinking in people with a tendency for alcohol dependence; 3) the social availability model states that problem drinking is facilitated if drinking is a norm for a group. In Japan, studies have suggested that attitudes toward drinking at the workplace (tolerance toward problem drinking, and acceptance of the

benefits of drinking for work) correlate to problem drinking[53]; and 4) the motivational model states that motivation to drink is accelerated by physically poor working environments or break-ups of trust, social and sexual relationships. Job stressors are most closely related to the first and fourth models. It is possible that the components for these models influence the association between heavy drinking and job stressors. For example, if a workplace with poor physical environments tends to be more lenient about problem drinking, then only the association between heavy drinking and physical environment may be apparent. Besides, some combinations of job stressors may be strongly related to heavy drinking. As the aim of the present study was investigating the association of each stressor with heavy drinking, we did not examine the possibilities. It should be studied in the future.

Thirdly, we did not consider stressors that are not directly related to workplace as explanatory variables. It is possible that such stressors could explain the age differences. Moreover, we did not add individual factors such as coping styles and expectancies for effects of drinking to explanatory variables. They can modify the relation between job stress and heavy drinking. But it is difficult to intervene for them in the workplace.

Lastly, the present study was cross sectional, and only the association between heavy drinking and job stress was investigated. Therefore, some findings could be interpreted ambiguously. Several job stressors may actually encourage heavy drinking, but on the other hand, problem drinking may affect job stress. For example, workers who have occupational problems caused by heavy drinking may experience strong intragroup conflicts. In order to more closely assess the effects of occupational stress on heavy drinking, longitudinal studies will be needed in the future.

Despite these limitations, the present study yielded important findings regarding the relationship between job stressors and heavy drinking. At present, measures to improve mental health are being promoted in many workplaces in Japan. Assessment and improvement of job stress are also important in improving mental health. Investigating stress-reducing measures from the viewpoint of preventing problem drinking can contribute to maintenance and promotion of worker health. The results of this study suggests that the scheme of the stress management for preventing heavy and problem drinking should be formed individually for each age group. The measure which is effective among some age groups may be invalid among other age groups. Further studies should be conducted on this point.

Acknowledgement

The authors express special thanks to other members of the Japan Work Stress and Health Cohort Study Group: Takashi Haratani (Japan National Institute of Occupational Safety and Health), Yoshiharu Aizawa (Kitasato University), Fumio Kobayashi (Aichi Medical University), Masao Ishizaki (Kanazawa Medical University), Takeshi Hayashi (Hitachi Information and Telecommunication Systems, Ltd.), Osamu Fujita (Aichi Education University), Takeshi Masumoto (Mitsubishi Chemistry Co.), Shogo Miyazaki (Meiji University Law School), Shuji Hashimoto (Fujita Health University School of Medicine) and Shunichi Araki (Japan National Institute of Occupational Safety and Health).

References

1) Kouvonen A, Kivimaki M, Cox SJ, Poikolainen K, Cox T, Vahtera J (2005) Job strain, effort-reward imbalance, and heavy drinking: a study in 40,851 employees. J Occup Environ Med **47**, 503–13.
2) Hingson R, Mangione T, Barrett J (1981) Job characteristics and drinking practices in the Boston metropolitan area. J Stud Alcohol **42**, 725–38.
3) House JS, Strecher V, Metzner HL, Robbins CA (1986) Occupational stress and health among men and women in the Tecumseh Community Health Study. J Health Soc Behav **27**, 62–77.
4) Ragland DR, Greiner BA, Yen IH, Fisher JM (2000) Occupational stress factors and alcohol-related behavior in urban transit operators. Alcohol Clin Exp Res **24**, 1011–9.
5) Crum RM, Muntaner C, Eaton WW, Anthony JC (1995) Occupational stress and the risk of alcohol abuse and dependence. Alcohol Clin Exp Res **19**, 647–55.
6) Mensch BS, Kandel DB (1988) Do job conditions influence the use of drug? J Health Soc Behav **29**, 169–84.
7) Cooper ML, Russel M, Frone MR (1990) Work stress and alcohol effects: a test of stress-induced drinking. J Health Soc Behav **31**, 260–76.
8) Head J, Stansfeld SA, Siegrist J (2004) The psychosocial work environment and alcohol dependence: a prospective study. Occup Environ Med **61**, 219–44.
9) Janes CR, Ames GM (1993) The workplace. In: Recent developments in alcoholism, Vol 11, Galanter M (Ed.), 123–41, Plenum Press, New York.
10) San José B, van de Mheen H, van Oers JAM, Mackenbach JP, Garretsen HFL (2000) Adverse working conditions and alcohol use in men and women. Alcohol Clin Exp Res **24**, 1207–13.
11) Hemmingsson T, Lundberg I (1998) Work control, work demands, and work social support in relation to alcoholism among young men. Alcohol Clin Exp Res **22**, 921–7.
12) Greenberg ES, Grunberg L (1995) Work alienation and

problem alcohol behavior. J Health Soc Behav **36**, 83–102.
13) Clarke M, Farid B, Romaniuk H (1990) Occupational risk factors in alcoholism. Br J Addict **85**, 1611–4.
14) Kawakami N, Araki S, Haratani T, Hemmi T (1993) Relations of work stress to alcohol use and drinking problems in male and female employees of a computer factory in Japan. Environ Res **62**, 314–24.
15) Hagihara A, Tarumi K, Miller AS, Nebeshima F, Nobutomo K (2000) Work stressors and alcohol consumption among white-collar workers: a signal detection approach. J Stud Alcohol **61**, 462–5.
16) Hagihara A, Tarumi K, Nobutomo K (2001) A signal detection approach to the combined effects of work stressors on alcohol consumption. J Stud Alcohol **62**, 798–805.
17) Kuper H, Marmot M (2003) Job strain, job demands, decision latitude, and risk of coronary heart disease within the Whitehall II study. J Epidemiol Community Health **57**, 147–53.
18) Ragland DR, Greiner BA, Psych D, Krause N, Holman BL, Fisher JM (1995) Occupational and nonoccupational correlates of alcohol consumption in urban transit operators. Prev Med **24**, 634–45.
19) Vasse PM, Nijhuis FJN, Kok G (1998) Associations between work stress, alcohol consumption and sickness absence. Addiction **93**, 231–41.
20) Hagihara A, Tarumi K, Nobutomo K (2003) Positive and negative effects of social support on the relationship between work stress and alcohol consumption. J Stud Alcohol **64**, 874–83.
21) Romelsjö A, Hasin D, Hilton M, Bostrom G, Diderichsen F, Haglund B, Hallqvist J, Karlsson G, Svanstrom L (1992) The relationship between stressful working conditions and high alcohol consumption and severe alcohol problems in an urban general population. Br J Addict **87**, 1173–83.
22) Kuper H, Marmot M (2003) Job strain, job demands, decision latitude, and risk of coronary heart disease within the Whitehall II study. J Epidemiol Community Health **57**, 147–53.
23) Niedhammer I, Goldberg M, Leclerc A, David S, Bugel I, Landre MF (1998) Psychosocial work environment and cardiovascular risk factors in an occupational cohort in France. J Epidemiol Community Health **52**, 93–100.
24) Gorman DM (1988) Employment, stressful life events and the development of alcohol dependence. Drug Alcohol Depend **22**, 151–9.
25) Allamani A, Cipriani F, Innocenti S, Lumuto C, Marchi M, Morretini A (1988) Alcohol drinking patterns and work areas: epidemiological study of factory and rural workers in Florence, Italy. Br J Addict **83**, 1169–78.
26) Seeman M, Seeman AZ, Budros A (1988) Powerlessness, work, and community: a longitudinal study of alienation and alcohol use. J Health Soc Behav **29**, 185–98.
27) Parker DA, Harford TC (1992) Gender-role attitudes, job competition and alcohol consumption among women and men. Alcohol Clin Exp Res **16**, 159–65.
28) Fagin L, Carson J, Leary J, De Villiers N, Bartlett H, O'Malley P, West M, McElfatrick S, Brown D (1996) Stress, coping and burnout in mental health nurses: finding from three research studies. Int J Soc Psychiatry **42**, 102–11.
29) Richman JA, Flaherty JA, Rospenda KM (1996) Perceived workplace harassment experiences and problem drinking among physicians: broadening the stress/alienation paradigm. Addiction **91**, 391–403.
30) Karasek R, Theorell T (1990) Healthy work, stress, productivity, and the reproduction of working life. Basic Books, New York.
31) Siegrist J (1996) Adverse health effects of high effort/low reward conditions. J Occup Health Psychol **1**, 27–41.
32) Rice C, Longabaugh R, Stout RL (1997) A comparison sample validation of "Your Workplace": an instrument to measure perceived alcohol support and consequences from the work environment. Addict Behav **22**, 711–22.
33) Conger JJ (1956) Alcoholism: theory, problem and challenge.II. reinforcement theory and the dynamics of alcoholism. Q J Stud Alcohol **17**, 296–305.
34) Pohorecky LA (1991) Stress and alcohol interaction: an update of human research. Alcohol Clin Exp Res **15**, 438–59.
35) Cooper ML, Russel M, Skinner JB, Frone MR, Mudar P (1992) Stress and alcohol use: moderating effects of gender, coping, and alcohol expectancies. J Abnorm Psychol **101**, 139–52.
36) Neff JA (1986) Alcohol consumption and psychological distress among U.S. anglos, hispanics and blacks. Alcohol Alcohol **21**, 111–9.
37) Ames GM, Rebhun LA (1996) Women, alcohol and work: Interactions of gender, ethnicity and occupational culture. Soc Sci Med **43**, 1649–63.
38) Dawson DA, Grant BF, June Ruan W (2005) The association between stress and drinking: modifying effects of gender and vulnerability. Alcohol Alcohol **40**, 453–60.
39) Bonaguro JA, McLaughlin M, Sussman K (1987) Adolescent stress and alcohol usage. In: Chemical Dependencies, Chambers CA, Jorciardi JA, Petersen DM, Siegal HA and White OZ (Eds.), 300–6, Ohio University Press, Ohio.
40) Kasl SV, Ostfeld AM, Berkman LF, Jacobs SC (1996) Stress and alcohol consumption: the role of selected social and environmental factors. In: Stress and addiction, Gottheil E, Druley KA, Pashko S and Weinstein SP (Eds.), 40–59, Plenum Press, New York.
41) Kawakami N, Haratani T, Kobayashi F, Ishizaki M, Hayashi T, Fujita O, Aizawa Y, Miyazaki S, Hiro H, Masumoto T, Hashimoto S, Araki S (2004) Occupational class and exposure to job stressors among employed men and women in Japan. J Epidemiol **14**, 204–11.
42) Kawakami N, Tsutsumi A, Haratani T, Kobayashi F, Ishizaki M, Hayashi T, Fujita O, Aizawa Y, Miyazaki S, Hiro H, Masumoto T, Hashimoto S, Araki S (2006) Job strain, worksite support, and nutrient intake among employed Japanese men and women. J Epidemiol **16**, 79–89.
43) Hurrell Jr JJ, Nelson DL, Simmons BL (1998) Measuring job stressors and strains: where we have been, where we are, where we need to go. J Occup Health Psychol **3**, 368–89.

44) Haratani T, Kawakami N, Araki S (1993) Reliability and validity of the NIOSH Generic Job Stress Questionnaire. Sangyo Igaku **35** (Suppl), S214.
45) Haratani T (2004) Practical application pf the NIOSH Generic Job Stress Questionnaire. Occupational Mental Health **12**, 12–9.
46) Vahtera J, Poikolainen K, Kivimäki M, Ala-Mursula L, Pentti J (2002) Alcohol intake and sickness absence: a curvilinear relation. Am J Epidemiol **156**, 969–76.
47) Osaki Y, Matsushita S, Shirakawa T, Hiro H, Higuchi S (2005) Nationwide survey alcohol drinking and alcoholism among Japanese adults. Jpn J Alcohol & Drug Dependence **40**, 455–70.
48) Whitehead PC, Simpkins J (1983) Occupational factors in alcoholism. In: The pathogenesis of alcoholism, Kissn B and Begleiter H (Eds.), 405–553, Plenum Press, New York.
49) Roman PA, Blum TC, Martin JK (1992) 'Enabling' of male problem drinkers in work groups. Br J Addict **87**, 275–89.
50) Plant MA (1977) Alcoholism and occupation: a review. Br J Addict **72**, 309–16.
51) Harford TC, Parker DA, Grant BF, Dawson DA (1992) Alcohol use and dependence among employed men and women in the United States in 1988. Alcohol Clin Exp Res **16**, 146–8.
52) Mandel W, Eaton WW, Anthony JC, Garrison R (1992) Alcoholism and occupations: a review and analysis of 104 occupations. Alcohol Clin Exp Res **16**, 734–46.
53) Hiro H (1997) Occupational stress and problem drinking. Jpn J Alcohol & Drug Dependence **32**, 450–1.