CrossMark

BRIEF COMMUNICATION

Relationship of type of work with health-related quality of life

Yuri Kawabe[1] · Yasuyuki Nakamura[1,2] · Sayuri Kikuchi[3] · Yoshimi Suzukamo[4] ·
Yoshitaka Murakami[5] · Taichiro Tanaka[6] · Toru Takebayashi[7] · Akira Okayama[8] ·
Katsuyuki Miura[2] · Tomonori Okamura[7] · Shunichi Fukuhara[9] · Hirotsugu Ueshima[2]

Abstract

Purpose To examine the relation of work type with health-related quality of life (HRQoL) in healthy workers.
Methods We cross-sectionally examined 4427 (3605 men and 822 women) healthy workers in Japan, aged 19–69 years. We assessed HRQoL based on scores for five scales of the SF-36. Multiple regression was applied to examine the relation of work type (nighttime, shift, day to night, and daytime) with the five HRQoL norm-based scores, lower scores of which indicate poorer health status, adjusted for confounding factors, including sleeping duration.
Results Shiftwork was inversely related to role physical [regression estimate (β) = −2.12, 95 % confidence intervals (CI) −2.94, −1.30, $P < 0.001$], general health ($\beta = -1.37$, 95 % CI −2.01, −0.72, $P < 0.001$), role emotional ($\beta = -1.24$, 95% CI −1.98, −0.50, $P < 0.001$), and mental health ($\beta = -1.31$, 95% CI −2.01, −0.63, $P < 0.001$) independent of confounding factors, but not to vitality. Day-to-nighttime work was inversely related to all the five HRQoL subscales (Ps 0.012 to <0.001).
Conclusion Shiftwork was significantly inversely related to four out of the five HRQoL, except for vitality, and day-to-nighttime work was significantly inversely related to all five HRQoL, independent of demographic and lifestyle factors.

Keywords Shift work · Health-related quality of life · SF-36

For HIPOP-OHP Research Group.

✉ Yasuyuki Nakamura
nakamury@kyoto-wu.ac.jp

[1] Cardiovascular Epidemiology, Kyoto Women's University, Kyoto, Japan

[2] Departments of Public Health, Shiga University of Medical Science, Otsu, Japan

[3] Department of Community Network and Collaborative Medicine, Kyoto University Hospital, Kyoto, Japan

[4] Department of Physical Medicine and Rehabilitation, Tohoku University Graduate School of Medicine, Sendai, Japan

[5] Departments of Medical Statistics, Faculty of Medicine, Toho University, Tokyo, Japan

[6] Department of Environmental and Occupational Health, Faculty of Medicine, Toho University, Tokyo, Japan

[7] Department of Preventive Medicine and Public Health, School of Medicine, Keio University, Tokyo, Japan

[8] Research Center for Lifestyle-Related Diseases, Tokyo, Japan

[9] Department of Epidemiology and Healthcare Research, Kyoto University Graduate School of Medicine, Kyoto, Japan

Introduction

Shiftwork has long been known to disrupt circadian rhythm, sleep, and work–life balance [1]. A higher incidence of coronary heart disease, metabolic syndrome, mental and behavioral disorders, and sleep disturbances has been observed among shift workers [2–5]. Previous cross-sectional studies have reported that shiftwork and day-to-night work strongly impaired quality of life (QOL) [6–12]. However, these studies were mostly done in female nurses, QOL was not comprehensively evaluated, and important confounders, such as sleep duration, were not considered. The main purpose of the present cross-sectional study was to examine the relationship of work types as an exposure

🙂 Springer

Table 1 Characteristics of participants by group according to the work type—HIPOP-OHP study 1999–2000

Type of work	Daytime	Nighttime	Shift	Day to night	P
Characteristics					
Person N	3094	73	1017	243	
Age (years)	42.6 ± 8.9	50.8 ± 6.8[†]	37.9 ± 10.1[†]	40.1 ± 9.7[†]	<0.001
% among total women	86.7	0.1*	9.3[†]	3.9[†]	<0.001
Role physical	49.6 ± 9.1	49.2 ± 9.9	48.1 ± 11.1[†]	45.8 ± 12.3[†]	<0.001
General health	48.0 ± 8.6	49.2 ± 10.2	46.2 ± 9.23[†]	45.8 ± 8.8[†]	<0.001
Vitality	46.3 ± 9.0	49.2 ± 11.6*	45.1 ± 9.3[†]	43.9 ± 9.6[†]	<0.001
Role emotional	50.1 ± 9.3	50.7 ± 9.0	49.0 ± 10.9[†]	47.0 ± 11.3[†]	<0.001
Mental health	47.5 ± 9.1	49.9 ± 10.0	45.8 ± 9.6[†]	44.5 ± 10.2[†]	<0.001
BMI (kg/m^2)#	22.8 ± 0.1	22.4 ± 0.4	23.3 ± 0.1[†]	23.4 ± 0.2[†]	<0.001
Alcohol (ml/day)	20.8 ± 30.0	29.1 ± 40.3	22.4 ± 35.3	17.1 ± 26.0	0.012
Ex-smoker (%)	17.5	24.7	15.1	14.8	0.073
Current smoker (%)	60.4	49.3	39.6[†]	50.6*	<0.001
IPAQ4 (%)	1.1	4.2*	2.3[†]	2.5*	0.001
Sleep (h)	6.40 ± 0.85	6.47 ± 1.09	6.46 ± 1.07	6.15 ± 1.06[†]	<0.001

Values are shown as mean ± SD or mean ± SE (for BMI). Characteristics of participants by group according to work type in 4427 Japanese men and women in 1999–2000 are shown. NBS HRQoL was used

BMI body mass index, *IPAQ* International Physical Activity Questionnaire classification, *NBS* norm-based scoring scores

* $P < 0.05$; [†] $P < 0.01$ compared to daytime work

with health-related QOL (HRQoL) measured with SF-36 as the outcome-dependent variables adjusted for confounding factors in a large-scale database of healthy workers in Japan.

Participants and methods

We analyzed baseline data from the high-risk and population strategy for occupational health promotion (HIPOP-OHP) study, the details of which have been described elsewhere [13–15]. In brief, the study population consisted of full-time workers at 12 large-scale companies throughout Japan in 1999–2000. The present study examined 4427 participants (3605 men and 822 women), aged 19–69 years (mean ± SD 41.6 ± 9.6 years) who underwent a physical examination and a lifestyle survey. Informed consent was obtained from each participant. Approval for the study was obtained from the Institutional Review Board of Shiga University of Medical Science for ethical issues (No. 10–16).

The study protocol was standardized according to the manual of the HIPOP-OHP research group [13]. The spare time physical activity of each participant was converted into metabolic equivalent (MET) minutes/week according to the International Physical Activity Questionnaire (IPAQ) [16]. Participants were classified into four classes of physical activity: class 1–4 at thresholds of 600, 1500, and 3000 MET minutes/week. Drinkers were defined as those consuming more than 1.25 ml (1 g) of ethanol a day. The average alcohol intake (ml) per day was obtained for each participant [14]. Smoking status was obtained.

Five subscales of SF-36

We used version 2.0 of the SF-36 questionnaire form and scoring program [17–19]. We used five out of eight subscales that were available in the HIPOP-OHP dataset: role physical, general health, vitality, role emotional, and mental health, because the HIPOP-OHP study was basically conducted for healthy workers with no physical disabilities [13]. Each domain is scored on a scale of 0–100, with lower scores indicating poorer health status. We used standardized domain scores using Japanese population norms to give a mean score of 50 and a standard deviation of 10 [norm-based score (NBS)] [18–20].

The Chi-square test was used to compare dichotomous variables between the work types, followed by a post hoc application of logistic analysis compared to the daytime work. A one-way analysis of variance was used to compare means between the groups, followed by a post hoc application of Dunnett's test compared to the daytime work when $P < 0.05$. Cohen's *d* was calculated for effect size index, when difference in HRQoL was significant compared to daytime work. BMI was standardized by age and gender, and analysis of covariance was used for

Table 2 Work type and health-related quality of life—results of multiple regression analysis—HIPOP-OHP study 1999–2000

Variable	Role physical		General health		Vitality		Role emotional		Mental health	
	β	95 % CI	β	95 % CI	β	95 % CI	β	95 % CI	β	95 % CI
All participants (N = 4427)										
R^2	0.023		0.054		0.074		0.016		0.038	
Night vs daytime	−0.41	−2.91, 2.10	1.75	−0.28, 3.80	1.71	−0.38, 3.80	0.08	−2.32, 2.48	1.58	−0.60, 3.76
Shift vs daytime	−2.11†	−2.89, −1.34	−1.37†	−2.02, −0.72	−0.61	−1.27, 0.05	−1.24†	−1.98, −0.50	−1.31†	−2.01, −0.63
Day to night vs daytime	−3.51†	−4.89, −2.13	−1.47†	−2.63, −0.32	−1.55*	−2.74, −0.37	−2.56†	−3.88, −1.24	−2.34†	−3.57, −1.12

Results of analyses by multiple regression analysis to examine the relation of work type with NBS HRQoL (role physical, role emotional, general health, vitality, and mental health) adjusted for lifestyle factors and other factors, including age, sex (man = 1, woman = 0), alcohol consumption (ml/day), IPAQ classification (IPAQ2 to IPAQ4 vs IPAQ1), sleep hours, smoking status (ex-smoker, current smoker, and never smoker). R^2 for regression model, β with 95 % confidence intervals are also shown

Italic values indicate statistical significance at the 5 % level

β regression coefficient, *IPAQ* International Physical Activity Questionnaire classification

* $P < 0.05$; † $P < 0.01$

comparison. Multiple regression was applied to examine the relation of work type (nighttime, shift, day to night, and daytime) with the five HRQoL, adjusted for confounders, including age, sex (man = 1, woman = 0), alcohol consumption (ml/day), IPAQ classification (IPAQ2 to IPAQ4 vs IPAQ1), sleep hours, smoking status (ex-smoker, current smoker, and never smoker). Significant interaction terms with age and gender with other variables (age × ex- and current smoking in general health, age × IPAQ in vitality and mental health) were entered. The interactions between the work type and gender/age were not statistically significant. Spearman's correlations between the five HRQoL and the canonical correlations of background characteristics associated with the linear combination of the five subscales of HRQoL were obtained. All *P* values were two-sided, and $P < 0.05$ was considered significant. All analyses were performed using SAS version 9.4 for Windows (SAS Institute, Cary, NC).

Results

Among 4427 men and women, 3094 were in daytime work, 73 in fixed night work, 1017 in shiftwork, and 243 in day-to-night work. With effect size (f^2): 0.15, power level: 0.80, number of predictors: 6, probability level: 0.05, the sample size required was estimated to be 97. Characteristics of participants by work type are given in Table 1. There were fewer women in the groups other than the daytime work group. The mean age, vitality, and the percentages of IPAQ4 were larger in fixed nighttime work compared to daytime work. The four other HRQoL in fixed nighttime work were not different compared to daytime work. Compared to daytime work, the mean age, all five HRQoL, and the percentage of current smokers in the shiftwork were lower, while the mean BMI was larger. Compared to daytime work, the mean age, all five HRQoL, sleep hours, and the percentage of current smokers in the day-to-night work group were lower, while the percentages of IPAQ4 were larger. Percentage of ex-smoker was not different between four work type groups. Cohen's *ds,* obtained when difference in HRQoL was significant compared to daytime work, were between 0.1 and 03. All these indicated small effect sizes.

The results of multiple regression analysis are shown in Table 2 and Fig. 1. Fixed night work was related to none of the five HRQoL scores, as compared to daytime work, probably due to small number of participants in this group. Compared to daytime work, shiftwork was significantly inversely related to role physical, general health, role emotional, and mental health, but not related to vitality. Compared to daytime work, day-to-night work was significantly inversely related to all five HRQoL scores.
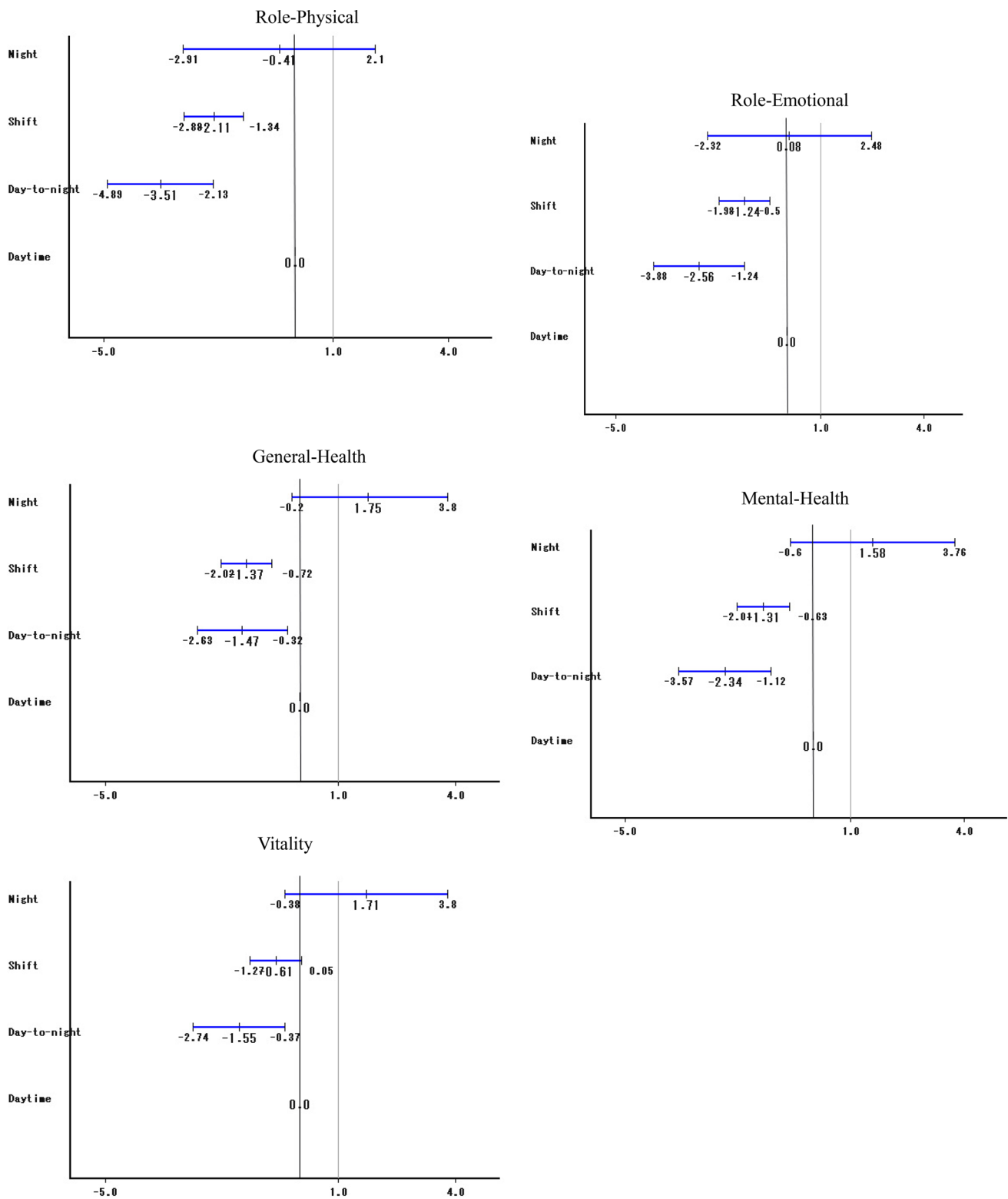
Fig. 1 Coefficients for five subscales of HRQoL for night vs day; shift vs day; and day-to-nighttime vs day adjusted for covariates and their associated confidence intervals are shown

Spearman's correlations between the five HRQoL and the canonical correlations of background characteristics associated with the linear combination of the five subscales of HRQoL are given in Table 3. Spearman's correlations between the five HRQoL were good. All the canonical correlations were statistically significant.

Table 3 Spearman's correlation coefficients and canonical correlations

	General health	Vitality	Role emotional	Mental health
Spearman's correlation coefficients				
Role physical	0.300	0.323	0.647	0.353
P	<0.001	<0.001	<0.001	<0.001
General health		0.497	0.298	0.451
P		<0.001	<0.001	<0.001
Vitality			0.366	0.661
P			<0.001	<0.001
Role emotional				0.499
P				<0.001

	Cor	Adj Cor	Eigenvalue	*E* proportion	*E* cumulative	*P*
Canonical correlations						
1	0.300	0.297	0.099	0.780	0.780	<0.001
2	0.133	–	0.018	0.142	0.922	<0.001
3	0.080	–	0.007	0.051	0.973	<0.001
4	0.058	–	0.003	0.027	1	0.005

Spearman's correlations and *P* values between five subscales of HRQoL are shown in the upper panel, and the canonical correlations of background characteristics associated with the linear combination of the five subscales of HRQoL are shown in the lower panel

Cor canonical correlation, *Adj Cor* adjusted canonical correlations, *E* eigenvalue

Discussion

In the present study, we found that shiftwork was significantly inversely related to four out of the five HRQoL, except for vitality, while day-to-night work was significantly inversely related to all five HRQoL, independent of demographic and lifestyle factors.

Several previous studies showed the effect of shiftwork on physical and mental health. Coffery et al. [6] showed overall job performance was lower, and job-related stress was higher in rotating shift nurses compared to nurses in other work types. Driesen et al. [7] showed that men and women involved in shiftwork were associated with a higher prevalence of depressed mood. Gordon et al. [8] showed that compared to men working non-variable work schedules, those who were working variable shifts exhibited higher rates of heavy drinking, job stress, and emotional problems. On the other hand, Skipper et al. [9] showed that shiftwork was not significantly related to either nurses' physical health or mental depression.

Nakata reported that full-time employees working >10 h per day, sleeping <6 h per day, or reporting insufficient sleep were positively associated with depression [10] and risk of workplace injury [11], but inversely associated with self-rated health scale [12]. He emphasized that longer working hours with shorter sleep or insufficient sleep exerted synergistic undesirable associations with the above conditions. Our analysis included sleep hours, and

we found that day-to-night work was significantly inversely related to all five HRQoL, compared to daytime work, independent of sleeping duration. Thus, factors other than sleep disturbance may be operating in the inverse relation of day-to-night work with HRQoL.

The disruption of circadian rhythm and impairment of sleep associated with shiftwork have been shown to generate physical and mental health problems. Melatonin and glucocorticoids may be linked to an adverse psychosocial work environment and to irregular work schedules [21]. Furthermore, social contacts are more difficult to maintain and familial relationships are impaired due to families' constant attempts to adapt to changing daily rhythms and this may interfere with the adaptation to shiftwork and protect from undesirable outcomes [21].

The strengths of the present study include being population based, large scale, and multisite with highly standardized methods. Thus, the findings are likely to be generalizable to middle-aged Japanese. However, the present study has some limitations. First, the present study was limited by its cross-sectional design. Some workers might have been left because of a variety of reasons, and thus, the sample may not be representative. Second, key variables such as socioeconomic status are missing. Third, the sample size of women was small. We need further studies in women with sufficient number of participants. Fourth, observed differences in HRQoL subscales between work types were relatively small in relation to the currently

discussed minimum importance difference for the SF-36 dimensions [22].

In conclusion, shiftwork was significantly inversely related to four out of five HRQoL, except for vitality, and day-to-night work was significantly inversely related to all five HRQoL in a large-scale database of mostly male healthy workers in Japan, independent of demographic and lifestyle factors. Wherever possible, these two work types should be avoided.

References

1. Hale, H. B., Williams, E. W., Smith, B. N., & Melton, C. E, Jr. (1971). Neuroendocrine and metabolic response to intermittent night shift work. *Aerospace Medicine, 42*, 156–162.

2. Fujino, Y., Iso, H., Tamakoshi, A., Inaba, Y., Koizumi, A., Kubo, T., et al. (2006). A prospective cohort study of shift work and risk of ischemic heart disease in Japanese male workers. *American Journal of Epidemiology, 164*, 128–135.

3. Karlsson, B., Knutsson, A., & Lindahl, B. (2001). Is there an association between shift work and having a metabolic syndrome? Results from a population based study of 27,485 people. *Occupational and Environmental Medicine, 58*, 747–752.

4. Woo, J. M., & Postolache, T. T. (2008). The impact of work environment on mood disorders and suicide. Evidence and implications. *International Journal on Disability and Human Development, 7*, 185–200.

5. Ohayon, M. M., Lemoine, P., Arnaud-Briant, V., & Dreyfus, M. (2002). Prevalence and consequences of sleep disorders in a shift worker population. *Journal of Psychosomatic Research, 53*, 577–583.

6. Coffey, L. C., Skipper, J. K, Jr, & Junq, F. D. (1988). Nurses and shift work: Effects on job performance and job-related stress. *Journal of Advanced Nursing, 13*, 245–254.

7. Driesen, K., Jansen, N. W., Kant, I., Mohoren, D. C., & van Amelsvoort, L. G. (2010). Depressed mood in the working population: Associations with work schedules and working hours. *Chronobiology International, 27*, 1062–1079.

8. Gordon, N. P., Cleary, P. D., Parker, C. E., & Czeisler, C. A. (1986). The prevalence and health impact of shiftwork. *American Journal of Public Health, 76*, 1225–1228.

9. Skipper, J. K, Jr, Jung, F. D., & Coffey, L. C. (1990). Nurses and shiftwork: Effects on physical health and mental depression. *Journal of Advanced Nursing, 15*, 835–842.

10. Nakata, A. (2011). Work hours, sleep sufficiency, and prevalence of depression among full-time employees: A community-based cross-sectional study. *Journal of Clinical Psychiatry, 72*, 605–614.

11. Nakata, A. (2011). Effects of long work hours and poor sleep characteristics on workplace injury among full-time male employees of small- and medium-scale businesses. *Journal of Sleep Research, 20*, 576–584.

12. Nakata, A. (2012). Investigating the associations between work hours, sleep status, and self-reported health among full-time employees. *International Journal of Public Health, 57*, 403–411.

13. Okamura, T., Tanaka, T., Babazono, A., Yoshita, K., Chiba, N., Takebayashi, T., et al. (2004). The high-risk and population strategy for occupational health promotion (HIPOP-OHP) study: Study design and cardiovascular risk factors at the baseline survey. *Journal of Human Hypertension, 18*, 475–485.

14. Okamura, T., Tanaka, T., Yoshita, K., Chiba, N., Takebayashi, T., Kikuchi, Y., et al. (2004). Specific alcoholic beverage and blood pressure in a middle-aged Japanese population: The high risk and population strategy for occupational health promotion (HIPOP-OHP) study. *Journal of Human Hypertension, 18*, 9–16.

15. Naito, M., Nakayama, T., Okamura, T., Miura, K., Yanagita, M., Fujieda, Y., et al. (2008). Effect of a 4-year workplace-based physical activity intervention program on the blood lipid profiles of participating employees: The high-risk and population strategy for occupational health promotion (HIPOP-OHP) study. *Atherosclerosis, 197*, 784–790.

16. Katano, S., Nakamura, Y., Nakamura, A., Suzukamo, Y., Murakami, Y., Tanaka, T., et al. (2012). Relationship between health-related quality of life and clustering of metabolic syndrome diagnostic components. *Quality of Life Research, 21*, 1165–1170.

17. Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., et al. (2003). The International Physical Activity Questionnaire (IPAQ): A comprehensive reliability and validity study in twelve countries. *Medicine and Science in Sports and Exercise, 35*, 1381–1395.

18. Fukuhara, S., & Suzukamo, T. (2004). *Manual of SF-36v2 Japanese version*. Kyoto: Institute for Health Outcome & Process Evaluation Research.

19. Fukuhara, S., Bito, S., Green, J., Hsiao, A., & Kurokawa, K. (1998). Translation, adaptation, and validation of the SF-36 Health Survey for use in Japan. *Journal of Clinical Epidemiology, 51*, 1037–1044.

20. Fukuhara, S., Ware, J. E, Jr, Kosinski, M., Wada, S., & Gandek, B. (1998). Psychometric and clinical tests of validity of the Japanese SF-36 Health Survey. *Journal of Clinical Epidemiology, 51*, 1045–1053.

21. Vogel, M., Braungardt, T., Meyer, W., & Schneider, W. (2012). The effects of shift work on physical and mental health. *Journal of Neural Transmission, 119*, 1121–1132.

22. Wyrwich, K. W., Nelson, H. S., Tierney, W. M., Babu, A. N., Kroenke, K., & Wolinsky, F. D. (2003). Clinically important differences in health-related quality of life for patients with asthma: an expert consensus panel report. *Annals of Allergy, Asthma & Immunology, 91*, 148–153.