Self-Reported Sleep Quality, Job Stress, and Daytime Autonomic Activities Assessed in Terms of Short-Term Heart Rate Variability among Male White-Collar Workers

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Abstract: To investigate the relationships among the amount of job stressors, self-reported sleep quality, and daytime autonomic activities, a questionnaire survey was conducted for 223 healthy male white-collar workers, and their short-term heart rate variability (HRV) was also examined. Half of the subjects complained of nightly poor sleep quality. Self-reported poor sleep quality was associated with a qualitative aspect of job stressors characterized by high amounts of “job difficulty”, less amounts of “achievement in job”, and less amounts of “support by colleagues”, and also with high amounts of personal distress and difficulty in changing their mood. Those who complained of poor sleep quality exhibited sympathetic predominance and reduced heartbeat intervals at standing rest, although job stressors was not correlated to HRV. These results suggest that their job stress disrupts nightly sleep, and also that their insufficient sleep at night causes daytime sympathetic predominance. However, the amount of job stressors was not directly associated with HRV. Further studies should focus on the relationships among chronic job stress, the satisfaction of sleep demands, and the daily and long-term variation in cardiac autonomic activities.

Key words: Cardiac autonomic activity, Heart rate variability, Job stress, Self-reported sleep quality, Sleep demand

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Introduction

Stressors such as major life events¹⁻³⁾, daily hassles⁴⁾, working conditions⁵⁾, or daytime exposure to physical environmental factors⁶⁾ can induce psychological stress that disturbs nighttime sleep⁷⁻⁹⁾, and consequently cause the aftereffects such as inefficiency in job on the next day. As an indicator of this psychological stress, the amount of perceived stressors is often assessed by means of a psychiatric interview or by a questionnaire method¹⁰⁾. However, it is difficult to find objective indicators which reflect the amount of such psychological stress¹⁰⁾.

Spectral analysis of heart rate variability (HRV) noninvasively provides specific indices related to cardiac vagal activity and systemic sympathetic activity¹¹⁻¹⁴⁾. These indices are expected to be useful in the clinical assessment of heart disease patients^{15, 16)} and diabetic patients^{17, 18)}, and in the assessment of the possible neurotoxicity in the field of occupational and environmental health¹⁹⁻²⁴⁾. Moreover, some recent studies suggest that the acute stress due to mental workload also can be reflected by the shift in autonomic activities assessed in terms of short-term HRV²⁵⁻²⁷⁾.

The purpose of this study is (1) to examine the relationship between the amount of job stressors perceived by healthy workers and their self-reported sleep quality, and (2) to examine the possible associations of daytime autonomic activities assessed in terms of short-term HRV both with the amount of perceived job stressors and also with the self-reported sleep quality. If daytime short-term HRV is associated with both of them, it is possible that the HRV can provide efficient objective indices of the amount of perceived job stressors or psychological stress which consequently affect sleep quality.

Subjects and Methods

Subjects

The subjects were male Japanese white-collar workers working at a private company located in the Tokyo Megalopolis²⁸⁻³⁰⁾. When they underwent an annual physical examination at their work sites, they were asked to participate in this study in addition to undergoing the routine checkup. Those who were under some form of medical care, those who had taken any kind of drug on the day of the examination, those who had taken a meal or beverage in the 2 h before the examination were excluded from the study. As a result, 223 subjects participated in this study. Their mean $\pm$ SD age was 30.8 ± 5.4 yr (range 21 to 42 yr), and their mean $\pm$

SD body mass index (BMI, kg/m²) was 23.3 ± 3.6 (range 16.3 to 36.8).

Information about their sleep, job, and daily habits was obtained via a self-administered questionnaire and confirmed through interviews with public health nurses. Seventy-one percent were system engineers and 64% were married. The background materials on the subjects have been reported elsewhere^{29, 30)}.

HRV measurement

The method used to assess HRV is described in detail elsewhere²⁸⁾. After they underwent the routine checkup in the late morning or early afternoon, they lay quietly on a bed for a few minutes. An electrocardiogram (ECG, standard lead II) was recorded for each at supine rest for 3 min. Then, they stood up unaided, and an ECG was recorded at standing rest from 1 min after the change in posture to 3 min after the change in posture. The subjects were instructed to breathe regularly and not deeply during the ECG recording. Although 5-min ECG recordings are preferred for the analysis of short-term HRV³¹⁾, there was insufficient time to do this because this study was carried out as a part of the routine physical examination; a 2-min recording is, however, the minimum amount of recording time for the following analysis of short-term HRV³¹⁾. Although it is known that short-term HRV exhibits diurnal variation, short-term HRV measured in the late morning is sufficiently comparable with that measured in the early morning³²⁾.

HRV analysis

Autoregressive spectral analysis and component wave analysis^{14, 28)} were applied to the heartbeat intervals determined from the ECGs for extraction of the high-frequency component with a center frequency (f_{HF} , Hz) of 0.15–0.30 Hz resulting from respiratory sinus arrhythmia (RSA) and the low frequency component with a center frequency (f_{LF} , Hz) of 0.05–0.15 Hz resulting from Mayer wave-related sinus arrhythmia (MWSA). The power densities of these components (HF and LF, msec²) were calculated.

For the purpose of excluding the effects of breathing frequency on HF, coefficients of variation for HF and LF ($C-CV_{HF}$ and $C-CV_{LF}$, %) were also calculated, according to the following equation: $C-CV_k = 100 \cdot P_k^{1/2} / RR$, where k =RSA or MWSA, P_k =power density of k component (msec²), and RR =mean R-R interval (msec)^{14-16, 28)}. Then, $C-CV_{HF}$ was standardized for breathing frequency ($=f_{HF}$), according to previously described methods^{33, 34)}. The HF or

C-CV_{HF} mainly indicates cardiac vagal activity^{11–14}), while LF or C-CV_{LF}/C-CV_{HF} mainly indicates systemic sympathetic activity or sympathovagal balance^{13, 16, 35}).

Questionnaire

The subjects were asked to complete a questionnaire concerning their sleep, job, and daily habits in the last one month.

A simple question, “Do you sleep well in the last one month?”, was used to assess self-reported sleep quality. Yes-responders and No-responders were respectively classified into a good sleep group (GS) and a poor sleep group (PS). The amount of time spent sleeping on weekdays and that on nights before holidays was obtained from the questionnaire.

The amount of perceived job stressors in the last one month was measured by means of a 20-item inventory²⁹). This inventory was a modified version of that used in a previous study on the job stress of information system managers³⁶). The subjects chose one of four categories to each of the items (“completely the case of me”, “the case with me”, “somewhat case with me”, or “not the case with me at all”), and these categories were respectively scored from 4 to 1. In addition, two questions were used to assess the amount of general distress in job and in their personal life in the last one month. The presence or absence of a major change in job and that in personal life in the previous 6 months was also investigated.

The depressive symptoms in the last one month were measured by means of the Japanese version of Self-rating Depression Scale (SDS)³⁷). The subjects were also asked whether they could easily change their mood in usual life.

The methods for classifying current smoking status, current alcohol consumption, BMI, commuting time, and amounts of overtime have been described elsewhere^{28, 30}).

Statistical analysis

Through the factor analysis of the 20 items concerning job stressors, 5 factors (“job difficulty”, “job quantity”, “achievement in job”, “support by colleagues”, and “job decision latitude”) with eigenvalues being greater than 1.0 have been extracted²⁹). The scores of the items which exhibited a factor loading of greater than 0.5 for each of the 5 factors were summed up and divided by the number of the items for calculation of the job stressor scores responding to these five factors. The reliability coefficients (Cronbach’s alpha) for these five job stressor scales ranged from 0.67 to 0.52, showing their practical reliability.

The job stressor scores among the GS were compared with those in the PS. HRV parameters (HF, C-CV_{HF}, LF, and C-CV_{LF}/C-CV_{HF} both at supine rest and at standing rest) among the GS were also compared with those in the PS, and then, the General Linear Model (GLM) analysis³⁸) was carried out to determine whether HRV parameters are associated with sleep quality, taking account of the possible covariates of HRV parameters (age, BMI, current smoking status, current alcohol consumption, commuting time, and amount of overtime jobed). The HF and LF were, however, logarithmically converted because in the GLM analysis, the normality of dependent variables is required. In the GLM analyses, age was assumed as a covariate, and BMI was classified by its quartiles among the subjects (group 1, BMI<20.6; group 2, 20.6 ≤ BMI<22.3; group 3, 22.3 ≤ BMI<25.2; group 4, 25.2 ≤ BMI). Finally, the correlations between the HRV parameters and the job stressor scores were examined.

Results

Daily habits

Among the subjects, 47% were nonsmokers, 40% were moderate smokers (1–24 cigarettes/day), and 13% were heavy smokers (25 or more cigarettes/day). Eighteen percent were nondrinkers, 51% drink sometimes, and 31% drink almost everyday. Sixteen percent were doing overtime of less than 20 h/mo, 62% were doing it of 20–59 h/mo, and 22% were doing it of 60 h/mo or more. One-way commuting time was less than 60 min for 21% of the subjects, 60–89 min for 43% of them, and 90 min or more for 27% of them.

Self-reported sleep quality and job stressors

As shown in Table 1, 57% were classified into the GS and 43% were classified into the PS. There was no association of the self-reported sleep quality with age, marital status, or job.

Among job stressor scores, “job difficulty” and “job quantity” exhibited significantly positive correlations to the amount of general distress in job, to that in personal life, and also to the SDS score (Table 2). The job stressor scores for “achievement in job” and “job decision latitude” exhibited significantly negative correlations to the amount of general distress in job and also to the SDS score (Table 2). The job stressor scores for “support by colleagues” exhibited significantly negative correlation to the SDS score (Table 2).

The comparison of job stressor scores between the GS and the PS is shown in Fig. 1. The PS was likely to perceive

Table 1. Distribution of self-reported sleep quality

		Self-reported sleep quality		Total
		Good	Poor	
Overall		127 (57%)	96 (43%)	223
Age (yr)	29 or younger	50 (52%)	46 (48%)	96
	30 or older	77 (61%)	50 (39%)	127
Marital status	Unmarried	78 (57%)	59 (43%)	137
	Married	48 (57%)	37 (44%)	85
Job	System engineer	94 (59%)	65 (41%)	159
	Sales	13 (48%)	14 (52%)	27
	Clerk	11 (52%)	10 (48%)	21
	Others	5 (56%)	4 (44%)	9

Number (%) of subjects. The subjects who did not give an answer for marital status or job were excluded from cross-tabulations. Age, marital status or job were not associated with self-reported sleep quality according to the results of Fisher's exact tests.

Fig. 1. Comparison of job-stressor scores between poor sleep group and good sleep group t-test; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$ **Table 2.** Correlation of job stressor scores to amount of general distress and SDS score

Job stressor score	Amount of general distress in job ¹⁾	Amount of general distress in personal life ¹⁾	SDS score ²⁾
Job difficulty	0.351***	0.233***	0.386***
Job quantity	0.265***	0.178**	0.199**
Achievement in job	-0.186**	-0.081	-0.597***
Support by colleagues	-0.104	-0.050	-0.400***
Job decision latitude	-0.146*	-0.053	-0.428***

1) Kendall rank correlation coefficient. Responses to general distress were scored as follows; No=1, A little=2, Large=3, and Very large=4. 2) Pearson correlation coefficient. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 3. Amounts of general distress in work or personal life and self-reported sleep quality

		Self-reported sleep quality					Self-reported sleep quality		
		Good	Poor	Total			Good	Poor	Total
Amount of distress in job	No	26 (62%)	16 (38%)	42	Amount of distress in personal life	No	52 (69%)	23 (31%)	75
	A little	82 (66%)	55 (34%)	137		A little	58 (50%)	59 (50%)	117
	Large	14 (44%)	18 (56%)	32		Large	13 (59%)	9 (41%)	22
	Very large	4 (40%)	6 (60%)	10		Very large	3 (43%)	4 (57%)	7

Number of subjects (%). The subjects who did not give answer for amount of distress in job or in personal life were excluded from cross-tabulations. $\chi^2_{MH} = 3.4$ (not significant) for amount of distress in job; $\chi^2_{MH} = 3.4$ ($p < 0.05$) for amount of distress in personal life.

a greater amount of "job difficulty" (2.8 ± 0.6 vs 3.0 ± 0.5 , mean $\pm$ SD; $p < 0.01$), and a less amount of "achievement in job" (2.8 ± 0.8 vs 2.6 ± 0.8 , mean $\pm$ SD; $p < 0.05$) and "support by colleagues" (3.3 ± 0.5 vs 3.0 ± 0.6 , mean $\pm$ SD; $p < 0.001$) than the GS. No difference in the amount of "job quantity"

(2.8 ± 0.7 vs 2.6 ± 0.7 , mean $\pm$ SD) or "job decision latitude" (2.5 ± 0.7 vs 2.3 ± 0.6 , mean $\pm$ SD) was found between the GS and the PS.

No significant difference in the amount of general distress in job was found between the GS and the PS (Table 3),

Table 4. Overtime, commuting time, and self-reported sleep quality

		Self-reported sleep quality		Total
		Good	Poor	
Amount of overtime in the last 3 months	Standard	25 (71%)	10 (29%)	35
	Long	73 (53%)	66 (47%)	139
	Very long	29 (59%)	20 (41%)	49
Commuting time	Short	35 (54%)	30 (46%)	65
	Moderate	56 (57%)	41 (42%)	97
	Long	36 (59%)	25 (41%)	61

Number (%) of subjects. Amounts of overtime in the last 3 months (per month): standard, <20 h; large, 20–59 h; very large, ≥60 h. One-way commuting times: short, <60 min; moderate, 60–89 min; long, ≥90 min. The subjects who did not give answer for overtime or commuting time were excluded from cross-tabulations. $\chi^2_{MH}=0.8$ (not significant) for overtime; $\chi^2_{MH}=0.4$ (not significant) for commuting time.

Table 5. Difficulty in changing mood and self-reported sleep quality

		Self-reported sleep quality		Total
		Good	Poor	
“Can you easily change your mood?”	Yes	64 (76%)	20 (24%)	84
	Don't know	60 (50%)	60 (50%)	120
	No	3 (16%)	16 (84%)	19

Number of subjects (%). $\chi^2_{MH}=27.8$ ($p<0.001$).

whereas those who felt a greater amount of distress in their personal life were likely to complain of poor sleep quality (Table 3). Commuting time or the amount of overtime were not associated with self-reported sleep quality (Table 4). The presence or absence of a major change in job or that in the personal life was not correlated to sleep quality. Those who felt difficulty in changing their mood were likely to complain of poor sleep quality (Table 5). The SDS score among the PS was significantly higher than that among the GS (44.5 ± 6.6 vs 39.0 ± 6.1 , mean $\pm$ SD; $p<0.001$).

Self-reported sleep quality and HRV

HRV parameters in the GS were compared with those in the PS (Table 6). No difference in the HRV parameters at supine rest was found between the GS and the PS. At standing rest, however, the PS exhibited reduced HF and C-CV_{HF}, and also induced C-CV_{LF}/C-CV_{HF} compared with the GS. These three HRV parameters (HF, C-CV_{HF}, and C-CV_{LF}/C-CV_{HF} at standing rest) were significantly associated with self-reported sleep quality also in the GLM analyses (Table 7). There was no difference in the mean heartbeat interval

at supine rest between the GS and the PS (893.6 ± 133.2 vs 881.8 ± 126.4 , msec, mean $\pm$ SD). However, the mean heartbeat interval at standing rest in the GS was significantly greater than that in the PS (738.9 ± 105.8 vs 708.4 ± 99.2 , msec, mean $\pm$ SD; ANOVA, $F=4.8$, $p<0.05$).

When amount of time spent sleeping on weekdays, that on nights before holidays, difficulty in changing mood, or the SDS score was added to the GLM models shown in Table 7, none of these variables was associated with the above HRV parameters.

Job stressors and HRV

None of the HRV parameters were correlated to any of five job stressor scores (Pearson correlation coefficients (r) were between -0.060 and 0.122 , not significant). The mean heartbeat interval at supine rest or that at standing rest was not correlated to any of five job stressor scores ($-0.019 < r < 0.040$). The amount of general distress in job, or personal life, and the presence or absence of a major change in job, or personal life were not correlated to the HRV parameters or the mean heartbeat interval, regardless of

Table 6. Mean (SD) of HRV parameters among the good sleep group and the poor sleep group

Parameter Posture	ln(HF) supine rest	C-CV _{HF} supine rest	ln(HF) standing rest	C-CV _{HF} standing rest	ln(LF) supine rest	C-CV _{LF} /C-CV _{HF} supine rest	ln(LF) standing rest	C-CV _{LF} /C-CV _{HF} standing rest
Self-reported sleep quality	F=0.0	F=0.0	F=7.5**	F=5.2*	F=0.0	F=0.5	F=1.0	F=6.7*
Good (N=127)	5.77 (1.09)	2.31 (1.28)	4.81 (1.14)	1.75 (1.03)	5.68 (1.33)	1.15 (0.75)	5.84 (1.26)	2.10 (1.62)
Poor (N=96)	5.79 (1.07)	2.30 (1.09)	4.39 (1.13)	1.47 (0.78)	5.71 (1.41)	1.23 (0.93)	5.67 (1.35)	2.76 (2.57)

One-way ANOVA (df=1, 221); **p<0.01, *p<0.05.

Table 7. GLM analysis of HRV parameters

Dependent variable (Posture)	ln(HF) (supine rest)	C-CV _{HF} (supine rest)	ln(HF) (standing rest)	C-CV _{HF} (standing rest)	ln(LF) (supine rest)	C-CV _{HF} /C-CV _{LF} (supine rest)	ln(LF) (standing rest)	C-CV _{HF} /C-CV _{LF} (standing rest)
F-value	4.9***	4.5**	2.2*	2.0*	0.7	1.9*	1.6	2.5**
Independent variable								
Age	F=19.5***	F=22.2***	F=2.6	F=3.4	F=0.8	F=4.0*	F=5.3*	F=0.1
BMI	F=5.7***	F=4.7**	F=1.6	F=1.2	F=1.0	F=2.0	F=1.7	F=1.1
Current smoking status	F=1.1	F=0.0	F=1.3	F=2.4	F=0.1	F=0.7	F=1.2	F=0.3
Current alcohol consumption	F=1.4	F=1.0	F=0.1	F=0.2	F=0.6	F=0.8	F=1.6	F=2.1
Commuting time	F=2.7	F=3.2*	F=1.6	F=1.4	F=1.4	F=3.3*	F=0.0	F=2.7*
Amounts of overtime	F=1.4	F=1.4	F=3.6*	F=2.4	F=0.3	F=0.1	F=0.8	F=6.0**
Self-reported sleep quality	F=0.0	F=0.0	F=9.3**	F=6.6*	F=0.1	F=1.1	F=1.2	F=7.7**

N=223. HF and LF, power densities of HF and LF (msec²); C-CV_{HF} and C-CV_{LF}, component coefficients of HF and LF (%). BMI (body mass index, kg/m²), smoking status, and alcohol consumption were categorically analyzed, while age was analyzed as a covariate (see ref. 26). F-test for model; *p<0.05, **p<0.01, ***p<0.001. F-test for independent variables; *p<0.05, **p<0.01, ***p<0.001.

posture. When these variables were added to the GLM models shown in Table 7, none of them was associated with the above HRV parameters.

Discussion

As shown in Table 1, approximately half of young/middle-aged male white-collar workers complained of their poor sleep quality. The question used to assess this subjective sleep quality was, however, very simple. The quality, quantity, and duration of their sleep problems, as well as the physiological characteristics of their sleep are not investigated in this study. It should be considered in the following discussion that the above facts provide some limitations on the interpretation to the results in this study.

The job stressors perceived as high amounts of "job difficulty", less amounts of "achievement in job", and less amounts of "support by colleagues", was associated with self-reported poor sleep quality (Fig. 1), suggesting that perceived job stress causes insomnia which is called *psychophysiological insomnia* or *adjustment sleep disorders*

in the International Classification of Sleep Disorders⁴⁰. It seems that self-reported sleep quality is especially associated with the qualitative aspect of job stress characterized by the above job stressors, because, in contrast with this, the objective workload indicated by the amount of overtime or commuting time, the job stress perceived in terms of "job quantity", or the perceived amount of distress in job, was not related to the self-reported sleep quality (Table 4, Fig. 1, and Table 3). However, this may result from the fact that subjective sleep quality was assessed by a single, simple question in this study. If subjective sleep quality is assessed in more detail in future studies, the association of the subjective sleep quality with objective workload may be confirmed.

The distress experienced in personal life also seems to contribute to the self-reported sleep quality (Table 3). This shows that distress in personal life should be taken into consideration, even if future studies on stress and sleep will be carried out in the field of occupational health.

It is important that difficulty in changing mood was associated with the self-reported sleep quality (Table 4).

Changing mood by oneself is a way of stress-coping, and difficulty in this stress-coping may increase and/or prolong perceived job stress or distress in personal life³⁹⁾.

It appears reasonable that the PS exhibited the high SDS score, because the SDS include an item concerning sleeplessness. However, even if the SDS score was recalculated excluding the above item, the SDS score in the PS still remained higher than that in the GS. This shows that the self-reported poor sleep quality is associated with depressive symptoms.

On the other hand, self-reported sleep quality was correlated to the daytime HRV parameters and mean heartbeat interval at standing rest (Table 6); namely, the PS exhibited daytime sympathetic predominance at this posture. This was not explained by other possible covariates of the HRV parameters (age, BMI, current smoking status, current alcohol consumption, commuting time, or amount of overtime), as shown in Table 7. How can we explain these results?

One of possible interpretations is as follows. The above daytime sympathetic predominance at standing rest in the PS may result from their poor sleep quality at night. Some previous experimental studies have shown that restricted nighttime sleep causes the following aftereffects on the next day; an increase in heart rate (HR)^{41, 42)}, blood pressure^{41, 42)}, urinary catecholamine levels⁴²⁾ and sympathetic activity assessed in terms of HRV⁴²⁾, and also the decrease in parasympathetic activity assessed in terms of HRV⁴²⁾. Lusardi *et al.*⁴¹⁾ argued that insufficient sleep represents a stressful condition which promotes an increased synthesis of catecholamines through the activation of superior centers. Mougin *et al.*⁴³⁾ reported induced HR at submaximal exercise on the day after restricted sleep, suggesting that sleep loss acts as a stress, accentuating the stress imposed by exercise, and inappropriately increases catecholamines. These previous findings seem to agree with the results in our study, suggesting that the daytime sympathetic predominance in the PS may reflect the chronic effects of their poor sleep quality or insufficient sleep.

However, the reason why the sympathetic predominance among the PS was observed only at standing rest should be discussed. This fact suggests that insufficient sleep causes a hyperresponse in autonomic cardiac control accompanied with the change in posture, in agreement with the report of Mougin *et al.*⁴³⁾. On the other hand, it has been known that $C-CV_{HF}$ at supine rest decreases, while $C-CV_{LF}/C-CV_{HF}$ at supine rest increases in the late afternoon³²⁾. It is also reported that HF or $C-CV_{HF}$ increases, while LF or $C-CV_{LF}/C-CV_{HF}$ decreases during slow wave sleep at night^{44, 45)}. Mental

workload at night, however, reduces electroencephalogram delta power density and induces LF during subsequent non REM sleep⁴⁶⁾. Taking these findings together, it is possible that slow wave sleep is related to the recovery of cardiac parasympathetic function from fatigue. If this recovery process is disrupted by insufficient sleep, the dysfunction of autonomic cardiac control may induce a hyperresponse in the change in HRV accompanied with the change in posture. This speculation needs to be investigated in further studies.

If the above speculation is true, why did the time spent sleeping on weekdays exhibited no correlation to HRV? As discussed in our previous paper³⁰⁾, this does not seem surprising. The actual amount of time spent sleeping, in general, does not indicate the satisfaction of sleep demand, because there are large individual differences in sleep requirements.

Another possible interpretation concerning the correlation between the daytime HRV and self-reported sleep quality in this study should be discussed. Is it probable that the daytime sympathetic predominance assessed in terms of HRV caused the self-reported poor sleep quality at night? This appears to agree with the suggestions of some previous researchers^{6, 9)} that sympathetic hyperactivity due to daytime noise exposure disrupts nighttime sleep. If the above interpretation is true, however, the cause of the daytime sympathetic predominance observed in the PS cannot be explained by the results in this study. Because the daytime sympathetic predominance was not explained by the perceived amount of job stressors, personal distress, or other possible covariates of HRV parameters. There seems to be no evidence for the above interpretation based on the findings in this study. Anyway, the HRV parameters examined in this study provided no efficient indices of the amount of perceived job stressors or distress.

The sympathetic predominance observed in the PS is not a direct indicator of disease. However, some epidemiological studies^{47–50)} have suggested that too little sleep is correlated to mortality, while many recent researches have shown that reduced cardiac parasympathetic activity can indicate cardiovascular abnormalities or dysfunctions^{15, 16, 51–56)}. There seems to be the need to investigate the possible associations of chronic job stress or satisfactions of sleep demands with sympathetic predominance in autonomic cardiac control in more detail. Such investigations may lead to a clue to reveal the possible link between heavy workload and heart attacks⁵⁷⁾. These studies should include the assessment of the daily and long-term variations in autonomic activity as functions of daily sleep quality, sleep quantity, and satisfaction of sleep

demand. In such ecologic studies, the HRV test which takes the change in posture into account can be useful for assessing the secondary effects of insufficient sleep, because it is noninvasive and easy for application to many subjects.

Conclusion

Half of the young/middle-aged male white-collar workers complained of nightly poor sleep quality to a simple question. The complaints of poor sleep quality was associated with the qualitative aspect of job stressors characterized by high amounts of "job difficulty", less amounts of "achievement in job", and less amounts of "support by colleagues", and also with high amounts of personal distress and difficulty in changing their own mood. These results suggests that psychological stress causes psychophysiological insomnia or adjustment sleep disorders. Although the quality, quantity, and duration of their nightly sleep problems are not investigated in detail, it seems important to investigate the causes of and countermeasure to workers' sleep problems in future studies, taking account of their job stress, personal distress, and stress-coping. In these studies, the method to assess the subjective sleep quality also should be refined.

Those who complained of poor sleep quality exhibited sympathetic predominance assessed in terms of daytime HRV and reduced heartbeat interval at standing rest. Any of job stressors or personal distress was, however, not correlated to the HRV parameters, suggesting that HRV parameters cannot provide efficient indices of perceived job stress. The above sympathetic predominance may result from their poor sleep quality or insufficient sleep at night. Further studies should focus on the associations of chronic job stress or satisfactions of sleep demands with the daily and long-term variations in cardiac autonomic activities.

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