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Original Article

Long Working Hours and Subjective Fatigue Symptoms

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Abstract: Presuming that overtime work may associate with chronic fatigue and then decrease cardiovascular function, this report was prepared to find out the definite positive relationship between long working hours and subjective fatigue complaints. We analysed the data of a field survey of 238 men who were working at the department of research & development of three electronics manufacturing companies in S. Korea. The field survey consisted of self-report questionnaires on the working hours, health conditions, and fatigue. For data analysis, the subjects were divided into 3 groups on the criteria of 60 and 70 working hours per week: less longer (LLWH), longer (LWH), and more longer (MLWH) working hour groups. We compared the age-adjusted mean % scores of fatigue complaints among LLWH, LWH, and MLWH. The rate of complaints of subjective fatigue before going to work for LWH and MLWH tended to be significantly higher than those for LLWH. Hence, we conclude that the questionnaire on the subjective fatigue complaints is a good screening tool for early detection of cumulative fatigue due to chronic job stress such as long working hours.

Key words: Long working hours, Chronic fatigue, Subjective fatigue symptom

Introduction

The overtime work can be defined as the elongation of the working time designated by law. According to a report in Japan, 'the work over 60 hours per a week' and 'the work 49 to 59 hours per a week' had been named 'extreme overtime work' and 'overtime work' respectively[1)].

From literature review Spurgeon *et al.* concluded that there was sufficient evidence about a possible link between long working hours and the risk of significant health outcomes, including cardiovascular disease[2)].

Based on the ILO Labor Statistics in 1997, the weekly working hour for Korea was 48.8 compared to 38.2 for Japan and 37.4 for Germany[3)].

Long working hours is one of main factors in work overload[4)], and can be readily evaluated quantitatively. If there were any simple measurement tool for discriminating cumulative fatigue due to overtime, the detrimental effect of long working hours could be minimized.

In our previous paper[5)] we reported the relationship between long working hours and cardiovascular functions that is objective health outcome indices. In the present paper we will report the relationship between long working hours and subjective fatigue symptoms using data from the same field survey.

This paper was prepared to determine if the subjective fatigue symptoms could be used a screening instrument for early detection of cumulative fatigue due to chronic job stress such as the repeated overtime work in the population with mental work.

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Subjects and Methods

Study subjects

The analyzed subjects were the same as our previous report[5].

Study methods

Surveys were made on each five working days in April, July and September of 1998 according to the situation of each company.

We surveyed (1) weekly working hours (WWH) and health conditions etc. during the last month (2) subjective fatigue before-work at home in the morning and during-work at office in the afternoon, and (3) stress during the last month by self reported questionnaire. "Working hours" was defined as "hours from arrival at to leaving the office". We used the subjective fatigue questionnaire proposed by the Japanese Association for Industrial Health (JAIH) in 1971[6] and the stress questionnaire proposed by Haratani in 1996.

The working hours and health conditions, and stress experienced during the previous one month were asked. The subjective fatigue was asked twice before going to work and while on duty (in the morning and in the afternoon), respectively.

The questionnaire on working hours and health conditions consists of working hours, sleeping hours, exercise, alcohol drinking, smoking, past and present medical histories, medicine intake, etc.

The questionnaire on the subjective fatigue consists of 3 dimensions: Fatigue I (drowsiness and dullness), Fatigue II (difficulty in concentration), and Fatigue III (projection of disintegration). Each dimension has 10 statements. The percentage of complaints was calculated by the following formula: [(The numbers of statements checked in each dimension) / 10] $\times$ 100. Also, overall percentage of complaints in the three dimensions was calculated by the following formula: [(The total numbers of statements checked in three dimensions) / 30] $\times$ 100.

The questionnaire on the job stress consists of 2 components: 12 items for job stress and 8 items for stress response.

Data analysis

For data analysis, the subjects were divided into three groups on the cutting points of 60 and 70 working hours per week: less than 60 hours (less longer: LLWH), more than 60 hours and less than 70 hours (longer: LWH), and more than 70 hours (more longer: MLWH) groups.

One way analyses of covariance (ANCOVA) was used to adjust for differences in age of the three groups. Besides, the multiple comparisons between each subgroup were done by DUNCUN method. The simple correlations between each variable were analyzed by the Pearson's correlation coefficients.

Table 1. Descriptive statistics on all variables of study subjects

VAR	Statistics
Mean age (yrs)	32 (22–46)
Meaan weekly working hours (hrs)	69.3 ± 6.7 (52.1–88.8)*
Mean daily sleeping hours (hrs)	6.2 ± 0.6 (4.5–8.0)
Proportion of smoker (%)	68.0
Proportion of regular** exercise (%)	16.5
Mean stress response score	7.7 ± 4.2 (0–22)
Mean % score of subjective fatigue complaints	
before going to work	22.0 ± 18.6 (0–100)
while on duty	16.7 ± 16.2 (0–100)

*Mean ± S.D. (Minimum − Maximum).
**over than 3 times per week.

Results

The general characterisrics of the study subject

Based on the self reported questionnaire data and measurements, Table 1 gives the descriptive statistics of demographic, clinical, and laboratory features of study subjects. According to Table 1, the study subjects tend to work long (over than 52 hours per week at the minimum) and sleep short (less than 8 hour a day at the maximum) in general. There was no significant difference on the statistics of all variables according to whether a study subject smoke or not / do exercise regularly or not.

Percent scores of subjective fatigue complaints and the length of weekly working hours

Table 2 shows that there were significant differences in the mean values of the the variables related with work-related fatigue among 3 comparison groups. We controlled for the effect of age with ANCOVA.

Mean weekly working hour is different significantly among 3 comparison groups: 55.5 for LLWH, 65. 7 for LWH, and 74.3 for MLWH, respectively. Mean daily sleeping hour is also significantly different among 3 groups: 6.4 for LLWH, 6.2 for LWH, and 6.0 for MLWH, respectively. Thus, the study subjects tend to work longer and sleep shorter. There was no significant difference on the mean daily amount of cigarette smoking and the mean weekly drinking frequency

Table 2. The age-adjusted mean values of all variables by the length of weekly working hours

VAR		LLWH[1)] (N=48)	LWH[2)] (N=137)	MLWH[3)] (N=65)	p-value
Mean weekly working hours (hrs)		55.5 [A]	65.7 [B]	74.3 [C]	0.0001
Mean daily sleeping hours (hrs)		6.4 [A]	6.2 [A]	6.0 [B]	0.0010
Mean number of daily cigarette smoking		11	12	14	n.s.
Mean number of weekly drinking		2.0	1.5	1.7	n.s.
Mean score of job stress		15 [A]	17 [B]	19 [C]	0.0001
Mean score of stress response		7 [A]	8 [A/B]	9 [B]	0.0613
Mean % score of subjective fatigue complaints before going to work					
	I	19.3 [A]	33.9 [B]	42.7 [C]	0.0001
	II	9.4 [A]	18.1 [B]	21.6 [B]	0.0081
	III	9.8 [A]	12.6 [A]	18.0 [B]	0.0214
	Overall	13.8 [A]	22.1 [B]	26.8 [B]	0.0007
Mean % score of subjective fatigue complaints while on duty					
	I	14.7 [A]	23.2 [B]	26.5 [B]	0.0140
	II	8.7	15.1	15.9	n.s.
	III	10.8	12.2	13.9	n.s.
	Overall	15.7	17.0	20.3	n.s.

[ ]: Duncan grouping. [1)] LLWH: less longer, [2)] LWH: longer, [3)] MLWH: more longer.

Table 3. The simple correlation coefficients between each variable

VAR	1	2	3	4	5	6
1. Age						
2. Weekly working hour	.1167					
3. Sleeping hour	− .0007	**− .2519****				
4. Stress	− .1076	**.3685****	**− .2370****			
5. Stress response	− .0221	**.1889****	− .1077	**.1639****		
6. Subjective fatigue (before going to work)	**− .2835****	**.2004****	**− .1821****	**.2994****	**.4536****	
7. Subjective fatigue (while on duty)	**− .1506***	**.1258***	**− .1666****	**.1363***	**.5874****	**.6276****

**: p<.01, *: p<.05

among 3 subgroups.

The mean scores on job stress are 15 for LLWH, 17 for LWH, 17 for MLWH, respectively. The difference is not significant between LWH and MLWH, but significant between LLWH and (LWH + MLWH).

The mean scores on stress response are different significantly among the three groups: 7 for LLWH, 8 for LWH, and 9 for MLWH, respectively.

The percentages of complaints on fatigue before going to work are as follows:

In Fatigue I (drowsiness and dullness), there is a significant difference on the mean percentages among 3 comparison groups: 19.3% for LLWH, 33.9% for LWH, and 42.7% for MLWH, respectively. In Fatigue II (difficulty in concentration), there is a significant difference on the mean percentages between LLWH and (LWH + MLWH): 9.4% for LLWH, 18.1% for LWH, and 21.6% for MLWH, respectively. In Fatigue III (projection of disintegration), there is a significant difference on the mean percentages between (LLWH + LWH) and MLWH: 9.8% for LLWH, 12.6% for LWH, and 18.0% for MLWH, respectively.

The percentages of complaints on fatigue while on duty are as follows:

In Fatigue I (drowsiness and dullness), there is a significant

difference on the mean percentages between LLWH and (LWH + MLWH): 14.7% for LLWH, 23.2% for LWH, and 26.5% for MLWH. In Fatigue II (difficulty in concentration) and Fatigue III (projection of disintegration), there are no significant differences among 3 comparison groups.

Correlation coefficients between each variables

Table 3 shows the simple correlation between each variable used in this study.

Age has significant negative correlations with the subjective fatigue before going to work ($r = -0.2835$, $p<0.01$) and while on duty ($r = -0.1506$, $p<0.05$).

WWH has significant negative correlation with the daily sleeping hour ($r = -0.2519$, $p<0.01$), but it has positive correlations with the job stress score ($r=0.3685$, $p<0.01$), the stress response score ($r=0.1889$, $p<0.01$), and the subjective fatigue before going to work ($r=0.2004$, $p<0.01$) and while on duty ($r=0.1258$, $p<0.05$).

The daily sleeping hour has significant negative correlations with the job stress score ($r=-0.2370$, $p<0.01$), the subjective fatigue before going to work ($r = -0.1821$, $p<0.01$) and while on duty ($r = -0.1666$, $p<0.01$).

The job stress score has positive correlations with the stress response score ($r=0.1639$, $p<0.01$) and the subjective fatigue before going to work ($r=0.2994$, $p<0.01$) and while on duty ($r=0.1363$, $p<0.05$).

The stress response score has positive correlations with the subjective fatigue before going to work ($r=0.4536$, $p<0.01$) and while on duty ($r=0.5874$, $p<0.01$).

The subjective fatigue before going to work has positive correlations with the subjective fatigue while on duty ($r=0.6276$, $p<0.01$).

Discussion

Overtime work is commonly thought to be stressful and fatiguing. There are some evidences that the association between long working hour and unhealthy outcomes is mediated by stress. Long working hours act as the direct stressor due to cumulative fatigue. Also, they act as the indirect stressor because the workers have more time for exposure to other job stressor.

The subjective fatigue symptoms before going to work may be a index that shows cumulative chronic job stress whose effect do not disappear after a period of rest. In the present study we found out that there was a dose-response relationship between WWH and the % score for the dimension Fatigue I of the JAIH subjective fatigue questionnaire before going to work. On the other hand, the subjective fatigue symptoms while on duty may reflect "acute fatigue which is characterized by reversibility, task specificity, and the functional use of compensation mechanisms"[7]. It is the reason why people has the best condition for work during daytime especially in the afternoon physiologically.

However, no gold standard exists for fatigue. It means that we will never be able to prove the validity of instruments measuring fatigue[7].

The questionnaire on the subjective fatigue symptoms has been underestimated because the object for measuring is not objective. Fatigue is based on the experience of worker as "be tired", which should not be ignored not to miss the fact[8].

The JAIH subjective fatigue questionnaire was developed based on the subjective symptom questionnaire proposed in 1954 by the Study Group for Work-related Fatigue affiliated JAIH. After that, they found some problems in the item contents and the item classification and reclassified the questionnaire items with the factor analysis. The new questionnaire of all 30 items was made in 1971. At that time they confirmed that subjective fatigue symptoms could be divided into three groups of each 10 items with the factor analysis; Fatigue I (drowsiness and dullness), Fatigue II (difficulty in concentration), and Fatigue III (projection of disintegration)[8].

According to literatures in Japan, the orders of high frequency on the fatigue complaints differ from work to work and they are as follows: for overall the pattern of [I>III>II], for mental work and night work the pattern of [I>II>III], and for physical work the pattern of [III>I>II]. In the present study of which the subjects were mental workers, for LWP and MLWP the patterns of [I>II>III] were also shown, but for LLWP the patterns of [I>III>II] were shown.

Sasaki *et al.* reported that there were significant relationships both between long working hours and short sleeping hours, and between short sleeping hours and high complaint rates of "drowsiness and dullness" in the morning in 30–39 year group[9]. This study also showed that WWH had significant negative correlation with the daily sleeping hour ($r = -0.320$, $p<0.01$). However, our previous study showed that WWH has significant positive correlations with ln % score of subjective fatigue complaints before going to work based on the partial correlation coefficients after adjusting for age and sleeping hour variables[10]. Thus, we thought that chronic fatigue of the study subjects was caused by stress due to long hours itself as well as chronic sleep deprivation due to long working hours.

By doing multiple comparison after controlling aging effect in this study, we found out that 60 working hours per week

was a critical point for cumulating of fatigue. For the three dimensions (Fatigue I, Fatigue II, and Fatigue III) before going to work and for the dimension Fatigue I while on duty the difference on the percentage score between LLWH and (LWH + MLWH) were significant. Especially, for the dimension Fatigue I before going to work the difference on the percentage score even between LWH and MLWH were significant. Hence, the result of this study suggests that 60 working hour per week may be critical point for determining reversibility of the exhausted condition.

In spite of the methodologic limitations due to the cross-sectional nature, we conclude that the dimension Fatigue I (drowsiness and dullness) of the JAIH subjective fatigue questionnaire measured before going to work in the morning is able to discriminate between groups with expected differences in overtime. The JAIH questionnaire on the subjective fatigue seems to be an appropriate screening instrument for early detection of cumulative fatigue due to chronic job stress such as the repeated overtime work in the population with mental work.

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