SHORT REPORT

Working hours and mental and physical fatigue in Japanese workers

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Background  Establishing a threshold number of working hours is very important when making recommendations to protect people from the potentially harmful health effects caused by long working hours.

Aim  To clarify the influence of working hours on both mental and physical symptoms of fatigue and use the data obtained to determine permissible working hours.

Methods  Cross-sectional survey of male day-shift workers using the Self-Rating Depression Scale (SDS) and the Cumulative Fatigue Symptoms Index (CFSI). Working hours were subdivided into six groups and odds ratios were calculated for positive outcomes on the SDS and CFSI using logistic regression analysis.

Results  A total of 715 workers participated. In the group working 260–279 h/month, the odds ratios for SDS and ‘irritability’, ‘anxiety’ and ‘chronic tiredness’ of the CFSI were significantly increased. In the group working ≥280 h/month, the odds ratios on CFSI for ‘general fatigue’, ‘physical disorders’, ‘anxiety’ and ‘chronic tiredness’ were likewise significantly increased.

Conclusions  The present results clarified that working hours should be <260 h/month in order to minimize fatigue symptoms in male day workers.

Key words  Chronic fatigue; epidemiological study; long working hours; mental health.

Introduction

The health effect of excessive workload has attracted considerable interest from society as a whole, and various investigations have been undertaken to clarify the associations between various job stresses, including working hours and stress reactions [1,2]. Several studies have investigated subjective fatigue as an outcome of long working hours. Although significant relationships were found in Korean [3] and Japanese workers [4,5], other studies failed to find a significant effect of long working hours [6,7]. As a result of this discrepancy, we considered that the effect of long working hours on fatigue should be investigated further in a larger population. In addition, only one of these earlier studies referred to the threshold amount of working hours [3] which is very important when making recommendations to protect people from the potentially harmful health effects caused by long working hours. The aim of the present study was to clarify the influence of working hours on both mental and physical symptoms of fatigue and use the data obtained to determine permissible working hours.

Methods

In December 2003, self-administered questionnaires were distributed to all 843 male day workers aged ≤60 years employed at a chemical factory. The study protocol was approved by the ethical review board of the Graduate School of Medicine, Chiba University. We investigated symptoms of mental and physical fatigue using the Self-Rating Depression Scale (SDS) of Zung [8] and the Cumulative Fatigue Symptoms Index (CFSI) [9]. Data were also collected on working hours and lifestyle variables including marital status and smoking, drinking and exercise habits. The SDS consists of 20 variables related to the common characteristics of depression, while the CFSI consists of 81 variables selected from a variety of clinical and psychological symptoms. The details of the CFSI are explained elsewhere [10]. The CFSI variables...
are divided into eight subscales: decreased vitality, general fatigue, physical disorders, irritability, decreased willingness to work, anxiety, depressive feelings and chronic tiredness. Monthly working hours were calculated based on replies in the questionnaire, as the mean number of hours worked on weekdays × 22 + the number of holidays worked × the mean number of hours worked on holidays.

The second column in Table 1 and the first column in Table 2 show the classifications for categorical variables. Weekly alcohol consumption was calculated by multiplying the number of days on which alcohol was consumed by the number of units of alcohol consumed per day (1 ‘gou’ is equivalent to 25 g ethanol).

The odds ratios of working hours for each positive finding of the SDS and eight subscales of the CFSI were calculated using logistic regression adjusted for age, marital status, smoking habit, volume of alcohol consumed and exercise habits. We adopted a value of 45 for SDS and the mean complaint rates for the CFSI recorded for men in a previous study [9] as the cut-off values for each dependent variable shown in Table 2. By applying various cut-off values for working hours and fatigue, and comparing the obtained results, we confirmed that the present cut-off values were the most sensitive and appropriate. These analyses were performed with SPSS, version 12.0 (SPSS Japan Inc., Tokyo, Japan). P-values < 0.05 were considered to be statistically significant.

Results

The study group consisted of 843 male day workers. Although all the workers returned the questionnaires, a total of 128 subjects provided incomplete replies and were therefore excluded from the analysis, leaving a total of 715 in the study (i.e. valid response rate: 85%). Between the excluded and included subjects, we confirmed that there was no difference in baseline characteristics that could yield biased results. Those incomplete data were not included in any of the following analyses.

The results of the SDS, the complaint rates in the eight subscales of the CFSI and the other continuous and categorical variables are summarized in Table 1. Table 2 shows the results of the logistic regression analyses. The Hosmer and Lemeshow goodness-of-fit statistics for each logistic model were distributed between 3.8 \( (P = 0.87) \) and 13.5 \( (P = 0.10) \), which indicated that the model was adequately fitted to the data. The significant odds ratios in the group working 260–279 h/month were 2.75 (SDS), 2.28 (irritability), 2.28 (anxiety) and 3.57 (chronic tiredness). The significant odds ratios in the group working ≥280 h/month were 2.32 (general fatigue), 2.43 (physical disorders), 2.51 (anxiety) and 2.85 (chronic tiredness). There was a negative association between the group working 220–239 h/month and the positive finding on decreased willingness to work (odds ratio: 0.45).

Discussion

The findings of our study suggested that working ≥260 h/month had adverse effects on the SDS and a number of CFSI subscales.

The important features of this study included the fact that the data were collected from >700 subjects and were analyzed by multiple logistic regressions in order to examine the influence of a wide range of confounding variables. The majority of previous studies were carried out on ≤278 subjects [3,5–7], while other studies incorporated univariate analyses only [5,6] or were adjusted only for age [3,7].

In one study [3], the subjects were divided into three groups according to the working hours. The prevalence of subjective fatigue symptoms was compared and found to be significantly different when working >60 h each week, which corresponds to 260 working hours per month. This result supports the findings of the present study. However, the subjects working <60 h each week (<260 h/month) were treated as one category in the earlier study. In contrast, in our study, we divided these subjects into four categories. Therefore, our study had the potential to evaluate the effect of working hours at a lower level and in greater detail.

A limitation of the present study was that it was cross-sectional and did not consider the accumulation of fatigue over the long term. In future, longitudinal studies enrolling larger numbers of subjects are necessary. Other limitations of the study were that the sample of workers consisted only of men working during the day and excluded women and shift workers. More precise quantification of working hours, from rosters or daily diaries would therefore have strengthened the findings of our study.
Table 2. Logistic regression analyses for the influence of working hours on symptoms of mental and physical fatigue

<table>
<thead>
<tr>
<th>Dependent variable (cut-off value)</th>
<th>SDS (≥45)</th>
<th>General fatigue (≥22.7%)</th>
<th>Physical disorders (≥17.4%)</th>
<th>Irritability (≥17.7%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>P</td>
<td>OR (95% CI)</td>
<td>P</td>
</tr>
<tr>
<td>Monthly working hours (&lt;199 h/month)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200–219 h/month</td>
<td>1.20 (0.73–1.97)</td>
<td>0.483</td>
<td>0.90 (0.57–1.42)</td>
<td>0.651</td>
</tr>
<tr>
<td>220–239 h/month</td>
<td>0.63 (0.31–1.29)</td>
<td>0.205</td>
<td>0.81 (0.45–1.46)</td>
<td>0.485</td>
</tr>
<tr>
<td>240–259 h/month</td>
<td>1.03 (0.50–2.09)</td>
<td>0.944</td>
<td>1.07 (0.59–1.97)</td>
<td>0.818</td>
</tr>
<tr>
<td>260–279 h/month</td>
<td>2.75 (1.39–5.46)</td>
<td>0.004</td>
<td>1.89 (0.98–3.62)</td>
<td>0.056</td>
</tr>
<tr>
<td>≥280 h/month</td>
<td>1.45 (0.66–3.19)</td>
<td>0.360</td>
<td>2.32 (1.21–4.46)</td>
<td>0.012</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependent variable (cut-off value)</th>
<th>Decreased willingness to work (≥17%)</th>
<th>Anxiety (≥18%)</th>
<th>Chronic tiredness (≥32%)</th>
</tr>
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<tr>
<td></td>
<td>OR (95% CI)</td>
<td>P</td>
<td>OR (95% CI)</td>
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<tr>
<td>Monthly working hours (&lt;199 h/month)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200–219 h/month</td>
<td>1.00 (0.63–1.60)</td>
<td>0.988</td>
<td>1.11 (0.71–1.74)</td>
</tr>
<tr>
<td>220–239 h/month</td>
<td>0.45 (0.22–0.92)</td>
<td>0.028</td>
<td>0.91 (0.51–1.63)</td>
</tr>
<tr>
<td>240–259 h/month</td>
<td>0.52 (0.24–1.13)</td>
<td>0.098</td>
<td>1.21 (0.66–2.22)</td>
</tr>
<tr>
<td>260–279 h/month</td>
<td>1.47 (0.73–2.96)</td>
<td>0.280</td>
<td>2.28 (1.20–4.35)</td>
</tr>
<tr>
<td>≥280 h/month</td>
<td>0.78 (0.34–1.79)</td>
<td>0.555</td>
<td>2.51 (1.29–4.90)</td>
</tr>
</tbody>
</table>

OR: odds ratio adjusted for age, marital status, smoking habit, volume of alcohol consumed and exercise habit. The reference categories for categorical variables were ‘working ≤199 h/month’, ‘married’, ‘smoker’ and ‘exercise >4 times per week’. 95% CI: 95% confidence interval.
In conclusion, these results indicated that working hours should be <260 h/month, corresponding to 80 h of overtime, in order to minimize fatigue symptoms in male day workers.

**Key points**
- The present results clarified that working hours should be <260 h/month in order to minimize fatigue symptoms in male day workers.

**Acknowledgements**
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**Conflicts of interest**
None declared.

**References**