Moderating Effects of Psychological Job Strain on the Relationship between Working Hours and Health: An Examination of White-Collar Workers Employed by a Japanese Manufacturing Company

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Abstract: Moderating Effects of Psychological Job Strain on the Relationship between Working Hours and Health: An Examination of White-Collar Workers Employed by a Japanese Manufacturing Company: Kimio Tarumi, et al. Section of Postgraduates Guidance, University of Occupational and Environmental Health—The effects of working hours on health were examined taking psychological job strain into account. White-collar workers employed at the main office of a Japanese manufacturing company provided data for analysis done in 1997. The eligible subjects were 286 workers aged 20–39. Causal relationships between working hours, health, and psychological job strain were examined by covariance structure analyses. The main findings were as follows: Not only working hours but also sleeping hours and vacations affected the workers’ effort to deal with work as a work-related hour factor. Decision authority and skill discretion of Karasek’s psychological job strain items significantly constituted a discretion in the work factor, and this factor moderated the effects of the work-related hour factor on health. The effects of psychological job strain, especially discretion, must always be taken into account in examinations of working hours and health.

Key words: Working hours, Psychological job strain, Covariance structure analysis

As a whole, it seems to be the dominant conclusion that working long hours is hazardous for health, but the relationship between working hours and health is not always consistent. For example, Nakanishi et al. observed the onset of hypertension in office workers at a Japanese construction company and found an inverse relationship: with the number of working hours, the percentage of those having developed hypertension decreased. The authors also examined the relationship between working hours and the onset of mental and circulatory disorders, and could not find detrimental effects of long working hours.

Although some factors have been considered as confounding factors regarding different relationships between working hours and health, psychological job strain may be one of the significant factors. For example, when reviewing papers on long working hours and health, Spurgeon et al. referred to the mediating effect of stress, though ‘stress’ was used as a comprehensive expression for work-related loads, including psychological job strain. Psychological job strain was proposed by Karasek, and significant effects on physical and psychological health have frequently been reported. Theorell and Karasek also suggested the possibility that working hours might confound the relationship between psychological job strain and health. Taking the above into account, we tried to examine whether psychological job strain mediated the relationship between working hours and health.

While examining the association between some factors, it is appropriate to postulate a model. Hobson et al. reported an interesting finding regarding middle-aged managerial workers in a UK company. They found that although working hours were not directly correlated with workers’ psychological illness, they were associated with individual perceived workload, which was related to
psychological illness. If this were the case, it might be valid to assume that psychological job strain mediated the relationship between working hours and health. This association was transferred into a model and was examined by covariance structure analysis\(^\text{11}\).

**Subjects and Methods**

**Model**

In covariance structure analysis\(^\text{11}\), some latent factors constitute a causal relationship based on a theoretical assumption, and each factor consists of measurable characteristics of subjects, termed observed variables. Three latent factors (work-related hours, psychological job strain and health conditions) constituted a primary model based on the findings described above (see Fig. 1). Also, the observed variables described below were actually measured.

Although working hours are literally the number of hours worked, work can be considered not only in terms of working hours but also in terms of various aspects of the workers’ lives. In the model, vacation and sleeping hours were also taken into account together with working hours as observed variables to constitute the work-related hour factor. Observed variables for the psychological job strain factor were derived from those of the Karasek’s demand-control model\(^\text{7}\). Though psychological illness had been monitored in Hobson’s study, physical and psychological health measures were considered in order to evaluate non-specific health problems in this study. Complaints of physical health problems and Zung’s self-reported depression scale\(^\text{12, 13}\) (SDS) were observed (below).

As indicated in Fig. 1, an assumed relationship was that the work-related hour factor and the psychological job strain factor affect the health condition factor. Also, the relationship between the work-related hour factor and the psychological job strain factor was temporarily assumed to be correlative because previously no causal relationship was determined.

**Subjects and Data**

This examination was conducted as part of a work site health project\(^\text{14–16}\) at the main office of a manufacturing company in Osaka, Japan. All of the members of this office staff were white-collar workers. They were regular, daytime, non-manual workers because manual work was entrusted to temporary workers. They were engaged in clerical, sales, engineering, and managerial work. Even those who were engaged in managerial positions had to simultaneously deal with other kinds of work, and thus were so-called “playing managers”. These workers had been successively employed for at least one year prior to the time of the examination.

Workers in this company undergo health examinations every year, and at this time workers are asked to answer questions about work conditions and environment in questionnaires for the purpose of health care management. These data are stored in the company computer. Questionnaire surveys are naturally conducted with the agreement of all responders. Workers are also allowed to refuse answering. The data used for the analysis were taken in 1997, and contained all of the observed variables described above.

For the work-related hour factor, the following are the items examined in the survey and used as observed variables: average working hours a day during the last month and average daily hours of sleep. Vacation opportunities each year were also investigated with the following response categories: none, one, two and three time or more a year.

Job demands, decision authority, skill discretion and social support were the variables for the psychological job strain factor. Job demand items include the following: Work fast; lack of time to complete work. Decision authority: Can choose how to perform work; can make decision on my own; have a lot of say on the job. Skill discretion: Continually learning new things; requiring high level of skill; not repetitious; can develop skills. Social support consists of three types of support from supervisors and co-workers, and includes items about atmosphere in the workplace and reliable relationship with co-workers. The scores for these items consisted of the sum of the following responses on the Likert scale: strongly agree (4); agree (3); disagree (2); strongly disagree (1). Those who felt more strain scored high.

The total number of complaints comprised the physical health condition and the SDS scores for health condition factor. The former comprises 26 items relating to major physical symptoms such as headache, nausea, and so on. The latter was developed by Zung and comprises 20 items. This\(^\text{13}\) is useful in quantifying the severity of current depression, and also is available as a screening instrument. In the case of higher scores, health conditions were recognized as poor.

At the time of the survey in 1997, the number of workers was 594. The age of workers for analysis was restricted to those 20 to 39 yr old because workers younger than 40 yr of age could not take managerial positions at the time of the study. Data records also contained missing values. Due to these restrictions, the number of eligible workers was 286.

**Statistical Methods**

First, correlation coefficients between the observed variables were calculated. Next, in order to test the model assumed (Fig. 1), a covariance structure analysis\(^\text{11, 17}\) was conducted. In order to identify model equations, the variance of structure variables was restricted to one. Maximum likelihood indices such as GFI (goodness of fit), AGFI (adjusted goodness of fit), and AIC (Akaike’s
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Information criteria) were used to test overall adaptability of the model to the data. After the best-fit model equation was determined, \( t \)-values for each standardized coefficient between the variables and the factors were evaluated. If the \( p \)-values for the coefficients were lower than 0.05, they were recognized as significant.

All of the calculations were conducted with the SAS program on a personal computer (SAS Institute Inc., Cary).

Results

Observed variables

The characteristics of the variables examined are shown in Table 1. The number of male workers was 178 and comprised 62.2% of all subjective workers. The mean age was 30.7 (standard deviation: 4.3).

The average number of working hours a day was 9.2 (1.4). Although not indicated in the table, 14.7% of the workers examined worked 11 h or more a day. The workers took 1.6 (0.7) vacations a year on average. The average number of hours of sleep a day was 6.3 (0.7).

The mean job demand score was 5.8 (1.0). The mean scores for decision authority and skill discretion were 6.9 (1.6) and 9.4 (2.4), respectively, and that for social support was 16.9 (3.0).

The mean physical complaints score was 0.6 (0.9), and that for the SDS was 5.4 (3.0).

Correlation coefficients

As shown in Table 2, working hours were significantly and negatively correlated with vacation opportunities (\( r = -0.24, p < 0.001 \)) and sleeping hours (\( r = -0.18, p < 0.01 \)). The
Correlation coefficient of vacation opportunities and sleeping hours was also significant ($r=0.14$, $p<0.05$).

Working hours were significantly correlated with job demands ($r=0.42$, $p<0.001$) and skill discretion ($r=-0.39$, $p<0.001$). Vacation opportunities showed significant correlation with job demands ($r=-0.17$, $p<0.01$) and social support ($r=-0.15$, $p<0.05$). Hours of sleep showed no significant correlations with the psychological job strain variables.

Working hours showed no significant correlation with physical complaints or the SDS. Vacation opportunities were significantly correlated with the SDS ($r=-0.21$, $p<0.01$). Sleeping hours were significantly correlated with physical complaints ($r=-0.16$, $p<0.01$) and the SDS ($r=-0.15$, $p<0.05$).

Job demands showed significant correlation with decision authority ($r=-0.16$, $p<0.01$) and skill discretion ($r=-0.28$, $p<0.01$), but did not with social support. Decision authority was significantly correlated with skill discretion ($r=0.44$, $p<0.001$) and social support ($r=0.31$, $p<0.001$). No significant correlation was found between skill discretion and social support.

No psychological job strain variables showed significant correlation with physical complaints. Decision authority, skill discretion, and social support showed significant correlation with the SDS ($r=0.30$, $p<0.001$; $r=0.19$, $p<0.01$; $r=0.34$, $p<0.001$).

Physical complaints and the SDS showed significant correlation ($r=0.27$, $p<0.001$).

**Model adopted**

The final model determined is shown in Fig. 2. The GFI, AGFI, and AIC were 0.97, 0.92 and 12.28, respectively. The GFI and the AGFI were larger than 0.9. Though results are not indicated as figures, the GHI, AGFI and AIC of the model which contained job demands and social support were 0.92, 0.84 and 64.88, respectively.

For the final model, all of the standardized coefficients between the observed variables and the latent factors were significant with a level of $p<0.05$.

The work-related hour factor consisted of working hours, vacation opportunities, and sleeping hours. Their standardized coefficients were 0.73, –0.35 and –0.22, respectively. For the psychological job strain variables, only decision authority and skill discretion were chosen to constitute a latent factor. This factor meant discretion at work, not the psychological job strain factor. Standardized coefficients of decision authority and skill discretion were 0.63 and 0.71, respectively. Both physical complaints and the SDS were included as the health condition factor with standardized coefficients of 0.37 and 0.74, respectively.

**Causality**

Work-related hours directly and positively affected health conditions with the standardized coefficient of 0.67 (Fig. 2). In the case of increasing work-related hours, the health condition factor became high, indicating a decline in health conditions.

Despite the correlative assumption between work-related hours and the psychological job strain (Fig. 1), the work-related factor affected the level of discretion at work with the standardized coefficient of –0.53. Also, discretion at work was positively related to health conditions with the standardized coefficient of 0.83.

As shown in Fig. 2, the work-related hour factor was directly associated with an increase in the health condition factor, and was indirectly associated with a decrease in the health condition factor mediated by the discretion at work factor with a coefficient of –0.44 (–0.53 multiplied by 0.83). Overall, the work-related hour factor was associated with the health condition factor with a coefficient of 0.23 (sum of 0.67 and –0.44).

**Discussion**

**Work-related hours**

As indicated in Fig. 2, along with an increase in working hours and a decrease in vacation opportunities and sleeping hours, the work-related hour factor increased. This factor, therefore, reflected overall hours devoted to work. It may be important to recognize that workers’ efforts to deal with work are achieved not only by hours of work but also by their overall lives including vacations and hours of sleep.

Various reports[18-21] have examined the relationship between shortage of hours of sleep and health problems. Linton and Bryngelsson[21] conducted a survey of 3,000 people aged 20–60, and reported that sleep was related to mental, physical and social health complaints. Vacation time was another factor which was associated with working life and health. Schor[22] described the tendency to a decline in leisure time at present to an increase in

![Fig. 2. Resultant relationships between the factors examined.](image-url)
work time. Westman and Eden\textsuperscript{23} examined the effects of taking vacations on burnout, and reported ameliorating effects of vacations. Etzion\textit{ et al}.,\textsuperscript{24} also referred to the effects of taking satisfactory vacations on burnout. The authors\textsuperscript{25} formerly examined the relationship between vacations and health, and found ameliorating effects of vacations on workers’ health problems. The relationship between work and health can be made clearer after considering overall hours devoted to work, including hours of sleep and vacations.

\textit{Discretion at work}

Although there could be various combinations of the variables considered, the model finally adopted included only decision authority and skill discretion of the four psychological job strain variables as the discretion at work factor (Fig. 2). The adaptability of the model which contained job demands and social support was not good (see Results). Although the GFI was 0.92 and sufficiently large, the AIC was 64.88 and much larger than that of 12.28 in the final model. The AIC assesses the degree of explaining a data set and of stability of a model equation. When there are two possible models, that of a smaller AIC\textsuperscript{17} should be adopted.

The effects of discretion on health were reported in various studies. Mausner\textit{ et al}.,\textsuperscript{26} surveyed 905 working residents in Baltimore and found that decision latitude which consisted of decision authority and skill discretion showed the largest influence on major depressive episodes, depressive syndrome, and dysphoria, but skill discretion had no effect. Karasek\textsuperscript{27} examined Swedish white-collar workers who had experienced job reorganization during the past several years. The rates of those who had suffered from depression decreased from 27.8\% to 13.7\% for males along with an increase in decision authority. And, there were reports in which researchers found that skill discretion was related to atherosclerosis\textsuperscript{28} and coronary heart disease\textsuperscript{29, 30}, especially in men\textsuperscript{28, 29}. Stansfeld\textit{ et al}.\textsuperscript{31} referred to the protective effects of interesting and varied work, which were represented as high skill discretion, on psychological health.

Job demands were not associated with physical complaints or the SDS (Table 2), and did not mediate the relationship between work and health. Because the workplace where the data were provided was a main office, the nature of the work was originally individual and discretionary and lower job demands seemed to be stressful. Furthermore, social support was not consequently included in the model, but it was significantly correlated with vacation opportunities and the SDS (Table 2). It might be useful to examine the role of social support in the association between work and health.

\textit{Direction of relationships}

The direction between the work-related hour factor and the discretion at work factor was from the former to the latter, and the sign of the standardized coefficient was negative (−0.53, Fig. 2). This suggested that along with an increase in work-related hours, complaints of discretion at work became fewer. It is natural that work comes before psychological job strain. On the other hand, as shown in Table 2, the correlation coefficients of working hours with decision authority and skill discretion were negative. Because the workers examined were engaged in clerical, sales, and engineering work, discretion must be indispensable. Even in clerical work, the workers’ own decisions were important because of their non-manual jobs (see Methods). In such work conditions, when work-related hours increase, workers might recognize their discretion levels for arrangement of work time, which may result in a decrease in the discretion at work factor.

\textit{Work-related hours and health}

Work-related hours directly and positively, and indirectly and negatively affected workers’ health, and consequently the effects on health became small (Fig. 2). The work-related hour factor was associated with the discretion at work factor, and this was independently associated with the health condition factor. That is, the discretion at work factor did not confound the association between the work-related hour factor and the health condition factor\textsuperscript{32}, but mediated the association. This suggests that discretion at work can change the relationships between work-related hours and health conditions. This relationship was pointed out by Hobson\textit{ et al}.,\textsuperscript{10} for working hours as described in the Introduction, and also was confirmed in our study. It is, therefore, preferable to always take psychological job strain into account in examining the effects of working hours on health, especially for white-collar workers.

With the correlation between working hours and health, Sparks\textit{ et al}.,\textsuperscript{2} listed age, work environment, and individual control over work hours as confounding factors. They pointed out in this context that there could be different effects on health between voluntary choice of long working hours and required long working hours. The results of our study can be interpreted such that an increase in work-related hours increases workers consciousness of their discretion at work. That is, the workers examined were considered to work for long hours voluntarily due to the nature of their discretionary work. Because the workers examined worked at the main office, a voluntary attitude seemed to be plausible rather than tacit force from bosses. Though there might be other factors which mediated the association between working hours and health, no appropriate reports were found. Nevertheless, it seems to be important to take such a
possibility into account.

As mentioned above, though discretion at work had a moderating effect with the association of work-related hours and health, it was important to recognize that work-related hours still had a direct effect on health. As shown in the Results, the work-related hour factor consequently had a small positive association with the health condition factor with a standardized coefficient of 0.23. Sparks et al. reviewed 21 studies from which a correlation coefficient between working hours and health problems was calculable, and reported that working hours and health problems showed a small and positive correlation. Our finding was concordant with theirs, but in the longer working hour environment of Japan, the positive effects of working hours on health might be more plausible.

The results obtained through analyses showed the significant effects of discretion on the association between working hours and health. When physical or diagnosed mental problems are indicators for health, causal association must be confirmed through prospective survey. Even in such studies, it is appropriate to taken discretion into account.

References


