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Job stress and cardiovascular risk factors in male workers

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Abstract

Background. This study examined whether job stress (work demand and decision latitude) is associated with smoking, blood pressure, lipid level (total cholesterol, triglyceride, HDL cholesterol), and homocystein as risk factors for cardiovascular disease in Korean male workers.

Methods. Study subjects of this study were recruited from a sample of 1,071 workers in 20 companies of W city and H counties, and they were grouped into four categories (high strain group, active group, passive group, and low strain group) based on the postulation of Karasek's Job Strain Model. Of them, we invited 160 male workers (40 people each subgroup) using a stratified sampling, and finally, 152 eligible participants were analyzed.

Results. In multivariate analyses, we found that decision latitude was associated with cholesterol, triglyceride, and homocystein and that work demand was related to smoking and systolic blood pressure. Job strain (the combination of high work demand with low decision latitude) was significantly related to higher levels of homocystein after controlling for age, BMI, smoking, and social support at workplace.

Conclusions. These results indicate that job stress is associated with cardiovascular risk factors and might contribute to the development of cardiovascular disease. Some considerations for the future research were discussed.
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Keywords: Job stress; Job strain; Work demand; Decision latitude; Cardiovascular risk factors; Smoking; Blood pressure; Homocystein; Cholesterol

Introduction

For the past few decades, a growing body of research has documented that jobs or organizational roles which are associated with overload, excessive demands, and many responsibilities lead to a high risk of adverse health outcomes, especially cardiovascular. Among the models which have tried to find the association between job stress and its adverse outcomes, the Job Strain Model proposed by Karasek [1] is well known to be the most frequently used in explaining the effects of job stress on cardiovascular diseases [2–4]. This model postulates that the combination of high work demand with low decision latitude at work results in job strain, which leads to an increased risk of cardiovascular diseases. Work demand refers to work load, for example, deadline and output per unit of time, and decision latitude refers to a person's ability to control his or her own work activities.

It has been suggested that heightened cardiovascular and neuroendocrine stress reactivity may be responsible [2,3]. It seems plausible then to examine whether heightened cardiovascular reactivity and greater lifetime exposure to stressful work environment (for example, job strain) have synergistic effects on cardiovascular diseases. Cardiovascular disease events like myocardial infarction and cardiovascular mortality occur late in the natural history of the disease and are a combination of underlying arteriosclerotic processes and various triggering factors [5,6]. Melamed et al. [7] demonstrated that some of the pathways linking psychosocial factors (job stress) and cardiovascular disease incidence are

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(1) elevation of physiological/hematochemical variables (e.g., blood pressure and serum lipid lipoprotein levels [8,9], (2) direct and indirect effects of adverse risk behaviors such as smoking, lack of physical exercise, and poor diet and health care habits [10], and (3) heightened emotional states, such as anger, tension, and anxiety [11,12], implicated in cardiovascular disease development through neuroendocrine mediation.

Standardized mental stress-testing studies indicate that people suffering from high job strain are more reactive to behavioral tasks in general than are low strain subjects [13,14]. Some investigators found that the relationship between job strain and an increase of cardiovascular risk factors is mediated by blood coagulation factors such as fibrinogen concentration and tissue plasminogen activator (t-PA) [15,16]. In addition, recent works have demonstrated that homocystein which takes an important role in the construction of hematoma in the arteries is a relevant risk factor for cardiovascular disease [17–19], the mechanism of which would be explained such that hematoma accelerates blood clot and deteriorates the function of blood coagulation factors, and those, in turn, result in arteriosclerosis and thrombosis in the vein [20–22].

However, the associations of job stress with cardiovascular disease risk factors documented in the literature have been inconsistent [23–28]. Recently, the job strain model has come under scrutiny, as the work demand dimension was not shown to increase the risk of disease in several studies, whereas low decision latitude was consistently related to ill health [29].

The aim of the present study is to clarify whether job stress is associated with increased risk of smoking and with lipid level (total cholesterol, triglyceride, HDL cholesterol), blood pressure, and homocystein as risk factors for cardiovascular disease in Korean male workers.

Methods

Study subjects

Study subjects of this study were recruited from a sample of 1,071 workers employed in 20 companies of W city and H counties. They were grouped into four categories (high strain group, active group, passive group, and low strain group) based on the postulation of Karasek's Job Strain Model. Median was used as a cut point in grouping into high versus low of two dimensions. Of them, we invited 160 male workers (40 people each subgroup) using a stratified sampling. A self-reported questionnaire was used to assess the respondents' sociodemographics and job stress. Physical examinations were performed to measure participants' weight, height, and blood pressure and biochemical data. Eight people who rejected the test were excluded, and finally, a total of 152 male workers were investigated in this study.

Measures

Job stress

Two dimensions of job stress, work demand (2 items) and decision latitude (10 items), were used by modifying Job Content Questionnaire (JCQ) [30] For each question, the respondents rated (on a scale of zero to two) the degree to which they agreed or disagreed with statements describing their job or job environment. A high score represents a high level of perceived work demand and/or a high level of perceived decision latitude over the job. The Cronbach alpha levels remained within an acceptable range, with coefficients of 0.61 for work demand and 0.87 for decision latitude, respectively.

Cardiovascular risk factors

We included three classical risk factors like smoking, blood pressure and lipid levels, and homocystein as a possible risk factor in our analyses.

Smoking status was dichotomized as current smoker ($\geq$1 filter per day) and nonsmoker. Blood pressure was taken as the average of two measurements after a 5-min rest in a sitting position using a standard mercury manometer. Blood samples were drawn in the work site by a registered nurse in the morning before work had started. Respondents were subjected to fasting at least 10 h. Blood (3 mL) was sampled from the venae brachiales of subjects and transferred to two different tubes with or without anticoagulants such as sodium citrate/EDTA. Total cholesterol and HDL cholesterol were measured in serum.

Sociodemographics and others

Sociodemographic variables (e.g., age, education, marital status, income, and alcohol consumption) and the possible confounding variables (e.g., BMI and social support at workplace) were obtained through both a self-reported questionnaire and physical examinations during the survey. Ten items of social support were measured using the JCQ [30].

Statistical analysis

Univariate and multivariate analyses (logistic regression and linear multiple regression analysis) were performed to estimate the relations of job stress to risk factors for cardiovascular disease. Age, marital status, and BMI were included in multivariate analysis as control variables. SPSS for Windows (Version 11.0) was used to analyze data in this study.

Results

The study consists of 152 men with a mean age of 35.13 (SD = 7.04; range, 20–57). They were the full-time workers of the manufactured industry, transportation busi-

Table 1
Mean values and distributions of cardiovascular risk factors by work demand and decision latitude

Dependent variables	Work demand			Decision latitude		
	Low (n = 72)	High (n = 79)	P value	Low (n = 70)	High (n = 81)	P value
Smoking (current smoker) (%)	51.9	77.2	0.031	57.1	65.4	0.296
Systolic blood pressure (mmHg)	124.9 (12.5)	123.9 (12.9)	0.638	124.1 (13.8)	124.6 (11.7)	0.828
Diastolic blood pressure (mmHg)	76.5 (7.7)	74.4 (8.3)	0.101	75.0 (8.7)	76.0 (7.5)	0.466
Cholesterol (mg/dL)	176.9 (39.5)	184.1 (32.7)	0.228	187.2 (31.7)	174.5 (39.4)	0.032
Triglyceride (mg/dL)	163.7 (86.5)	167.6 (96.1)	0.792	179.5 (98.7)	153.6 (82.3)	0.081
HDL cholesterol (mg/dL)	50.8 (13.8)	50.0 (13.4)	0.727	52.3 (14.7)	48.7 (12.3)	0.103
Homocystein (μmol/L)	7.9 (2.6)	8.8 (2.2)	0.021	8.6 (2.6)	8.1 (2.3)	0.219

ness, and communication service, and 44% of them were graduated college and 78% were married.

Univariate analysis

Table 1 represents mean values and distributions of cardiovascular risk factors by work demand and decision latitude. Smoking and homocystinuria were more in the respondents who reported high work demand compared to those who reported low work demand. Decision latitude was related to serum cholesterol. Systolic and diastolic blood pressure, triglyceride, HDL cholesterol, and BMI were not related to any job dimensions.

We analyzed the relation between job strain (the combination of high work demand with low decision latitude) and cardiovascular risk factors by four job strain groups based on the postulation of the job stress model. As shown in Table 2, there were significant differences in the prevalence of smoking among four groups. Cholesterol and homocystein showed mild associations with job strain (P = 0.060 and P = 0.064, respectively). No associations were found between job strain and systolic and diastolic blood pressure, triglyceride, HDL cholesterol, and BMI.

Multivariate analysis

The results of multiple linear and logistic regression analyses are shown in Table 3. There was in part evidence of relation between job stress and adverse cardiovascular risk factor levels after controlling for control variables like age, BMI, and marital status. The relation between decision latitude and adverse cardiovascular risk factors such as cholesterol, triglyceride, and homocystein was consistent with the job strain hypothesis, but the relations between work demand and cardiovascular risk factors were not (Model I). Two risk factors, smoking and systolic blood pressure, were significantly related to work demand, but the direction of the association between systolic blood pressure and work demand was opposite to what was expected (b = −1.97, SE = 0.95, P < 0.05).

We next examined whether workers with high job strain had greater values for cardiovascular risk factors than all other workers (low strain, passive, and active group) (Model II). When this hypothesis was analyzed using a dummy variable (1 = workers who reported high strain, 0 = all others), job strain was significantly related to higher levels of homocystein after controlling for age, BMI, and smoking. In addition, we entered the ratio of work demand to decision latitude (work demand/decision latitude) in a multiple regression model (Model III). As shown in Table 4 (right column), the results were similar to those in Model II, with the exception of homocystein.

We analyzed these regression models after controlling for social support because social support (supervisor and coworker support) at the workplace has been recognized as a crucial stress modifier to reduce the effect of job stress on cardiovascular risk factors (not shown in table). But the results were not shown to be different from the previous models.

Discussion

Studies on the relation of job characteristics with cardiovascular risk factors have been inconsistent. There is also a debate whether job strain is associated with cardiovascular disease mortality through the known cardi-

Table 2
Mean values and distributions of cardiovascular risk factors by four job strain groups

Dependent variables	High strain (n = 32)	Active (n = 40)	Passive (n = 38)	Low strain (n = 41)	P value
Smoking (current smoker) (%)	62.5	80.0	52.6	51.2	0.031
Systolic blood pressure (mmHg)	121.88 (14.36)	125.48 (11.48)	126.05 (13.15)	123.73 (11.90)	0.511
Diastolic blood pressure (mmHg)	73.75 (8.83)	74.90 (7.95)	76.05 (8.61)	77.00 (6.90)	0.346
Cholesterol (mg/dL)	187.69 (33.83)	181.28 (31.86)	186.79 (30.29)	167.80 (44.92)	0.060
Triglyceride (mg/dL)	171.28 (104.43)	164.73 (90.16)	186.42 (94.53)	142.68 (73.41)	0.193
HDL cholesterol (mg/dL)	53.09 (15.87)	47.50 (10.62)	51.68 (13.79)	49.90 (13.85)	0.324
Homocystein (μmol/L)	9.17 (1.97)	8.46 (2.37)	8.05 (2.99)	7.69 (2.13)	0.064

Table 3
Regression coefficients (standard errors) for work demand and decision latitude

Dependent variables	Model I	
	Work demand	Decision latitude
Smoking(current smoker)[a]	0.41 (0.18)*	0.03 (0.04)
Systolic blood pressure (mmHg)[b]	−1.97 (0.95)*	−0.17 (0.21)
Diastolic blood pressure (mmHg)[b]	−0.57 (0.65)	0.12 (0.14)
Cholesterol (mg/dL)[b]	4.08 (2.80)	−2.59 (0.61)**
Triglyceride (mg/dL)[b]	7.50 (6.86)	−3.18 (1.51*
HDL cholesterol (mg/dL)[b]	−0.77 (1.09)	−0.30 (0.24)
Homocystein (μmol/L)[b]	0.16 (0.20)	−0.12 (0.04)**

[a] Controlling for age and BMI by multiple logistic regression model.
[b] Controlling for age, BMI, and smoking by multiple linear regression model.
* $P < 0.05$.
** $P < 0.01$.

ovascular risk factors. In multivariate analyses, work demand was found to be positively associated with smoking, but decision latitude and job strain were not. This finding is consistent with Rosenman et al's study [31], but is not consistent with other studies [27,32,33].

Although several studies in the United States and Sweden have documented significant relationship between job strain, elevated workplace diastolic blood pressure, a higher left-ventricular mass index in a case control study of employees from several occupations [23], and an increased risk of coronary heart disease [2,34], the empirical evidence linking job strain to hypertension is weak [35], or even controversial [24,27,36,37]. For example, Pieper et al. [26] in a metaanalysis on the relation of psychosocial dimensions of work with coronary heart disease risk factors documented that systolic blood pressure was related to the level of personal decision latitude inversely, but not to job strain itself. Recently, Theorell et al. [38] reported that job strain of female caregivers was associated with systolic and diastolic blood pressure during work hours and also with diastolic blood pressure at rest, but not with blood pressure during leisure time. They pointed out the importance of time in examining the association between job strain and blood pressure, and demonstrated that the discrepancies in the previous studies have occurred because of this problem. Our finding supports the weak association between job strain and hypertension during work hours, although we did not measure blood pressure during leisure time.

Cholesterol and triglyceride were shown to be associated with lack of decision latitude, but not with work demand, job strain, and the ratio of work demand to decision latitude. Null results were reported for job strain and serum cholesterol in the previous studies [26,39,40].

It is interesting to find a strong association of lack of decision latitude with homocystinuria. Abundant evidence has been reported connecting thrombogenic processes to the development of chronic atheromatous disease and acute coronary events, like myocardial infarction and mortality [41,42].

In this study, we found stronger association of decision latitude with homocystein compared to those of decision latitude with known risk factors like blood pressure, cholesterol, and BMI. Several pieces of evidence were provided by the relationship between lack of decision latitude and high plasma fibrinogen concentration, suggesting a link with coagulation and, accordingly, atherosclerosis [43]. Chang et al. [44] support this pathway. They found that low decision latitude was positively associated with blood coagulation factors VII and VIII. The result of this study indicates that researchers need to take into account homocystein as risk factors in examining the relation of job stress to cardiovascular risk factors and morbidity.

In this study, job characteristics, especially lack of decision latitude, appear to contribute to increase adverse cardiovascular risk factors after controlling for age, smoking, BMI, and social support, although we did not find a significant relationship between job stress and all cardiovascular risk factors as postulated by the job strain model. Lower decision latitude was related to cholesterol, triglyceride, and homocystein rather than lower levels as expected by the job strain hypothesis. This result supports recent works that decision latitude was a more useful predictor of cardiovascular risk factors than work demand. A metaanalysis of five United States Data Bases conducted by Pieper et al. [26] revealed that psychosocial aspects of work, in particular, the decision latitude of the job, are related to some cardiovascular risk factors. Another study by Astrand et al. [45] demonstrated that job decision latitude, a combined index for job decision latitude, and job support showed significant associations with mortality, but that work demand was not. These results differ from several previous investigations which have tested positive association of work demand and cardiovascular risk factors [1,46,47]. These findings suggest that decision latitude has a more significant effect on increased levels of cardiovas-

Table 4
Regression coefficients (standard errors) for job strain and ratio of work demand to decision latitude

Dependent variables	Model II	Model III
	Job strain (high strain vs. others)	Work demand/ decision latitude
Smoking (current smoker)[a]	−0.12 (0.42)	3.49 (1.93)
Systolic blood pressure (mmHg)[b]	−4.06 (2.23)	−18.15 (9.51)
Diastolic blood pressure (mmHg)[b]	−1.72 (1.57)	−3.75 (6.53)
Cholesterol (mg/dL)[b]	12.38 (7.01)	55.57 (29.04)
Triglyceride (mg/dL)[b]	17.49 (16.75)	107.10 (69.25)
HDL cholesterol (mg/dL)[b]	3.27 (2.61)	3.43 (10.90)
Homocystein (μmol/L)[b]	1.11 (0.48)*	2.23 (2.01)

[a] Controlling for age and BMI by multiple logistic regression model.
[b] Controlling for age, BMI, and smoking by multiple linear regression model.
* $P < 0.01$.

cular risk factors than work demand, and that work demand measured as hectic work is unlikely to be considered a powerful predictor of cardiovascular risk factors and morbidity.

Several limitations of this study may be discussed. First, the research design of this study is cross-sectional. It is well known that the long-term effects of job strain on cardiovascular risk factors were tested in numerous studies, and that cause and effect relationship can be difficult to be examined. We addressed this problem by collecting biochemical data 1–3 months after measuring the job characteristics. Second, there are limitations related to representativeness of the subjects of this study. To minimize this problem, we recruited 152 male workers by job characteristics using a stratified sampling from the base population (N = 1,071). Third, we invited only male workers in this study because there are some differences in work environment between the sexes, and because the number of female workers were too small, therefore it is hard to generalize these results to all Korean workers. Fourth, because measurements of work environment are based on a self-reported questionnaire, the magnitude of them, especially in decision latitude, may be overestimated or underestimated. However, study subjects relatively identified the authority, autonomy, and skill levels of their jobs. More objective measures of job strain are needed in the future study. Finally, participants of this study were younger people with a mean age 35 (SD = 7.0) and could be healthy. Therefore, healthy worker's effect might confound the relationship job stress and cardiovascular risk factors. To address this problem, we included several possible control variables in the regression models.

The most important conclusion from this study is that, in a contemporary industrial population, decision latitude, other than job dimensions, is the outstanding psychosocial factor with effects on cardiovascular risk factors, especially homocystein. Therefore, job redesign is needed to consider the worker's need for discretion and influence in his/her work. This study suggests several strategies to moderate sources of stress in the work environment and to improve the quality of working life. Increasing skill levels and authority over their jobs as well as reducing exposure to hazardous working condition would be useful goals for intervention.

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