Preventive Medicine Reports 4 (2016) 61–67

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: http://ees.elsevier.com/pmedr

Occupational status and job stress in relation to cardiovascular stress reactivity in Japanese workers

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ARTICLE INFO

Article history:
Received 24 November 2015
Received in revised form 11 April 2016
Accepted 16 May 2016
Available online 19 May 2016

Keywords:
Occupational status
Job stress
Cardiovascular stress reactivity
Heart rate variability
Peripheral blood flow

ABSTRACT

This study aimed to investigate the effects of occupational status and job stress factors on cardiovascular stress reactivity in Japanese workers. In this baseline assessment between 2001 and 2009 in Osaka, Japan, we examined 928 healthy Japanese employees (330 men, 598 women) from two occupational statuses: managers/professionals and general workers. A brief job stress questionnaire was used to evaluate job stress levels. Systolic and diastolic blood pressure (SBP, DBP), heart rate, heart rate variability (high-frequency [HF], low-frequency [LF], LF/HF], and peripheral blood flow were measured at rest and during two stressful tasks. Changes in stress reactivity were calculated as the difference between the measured variables during the tasks and the rest period. Men showed inverse associations between quantitative job overload and DBP, heart rate, and LF/HF, between physical demands and blood pressure (SBP, DBP), and between a poor physical environment and HF. Men also had positive associations between qualitative job overload and heart rate, and between physical demands and peripheral blood flow (all $p < 0.05$). Women showed inverse associations between qualitative job overload and SBP, and showed positive associations between qualitative job overload and peripheral blood flow, and between a poor physical environment and SBP (all $p < 0.05$). When stratified by occupational status, significant associations between job stress and changes in stress reactivity were observed in male managers/professionals and female general workers ($p < 0.05$). Job stress levels are associated with changes in cardiovascular stress reactivity in men and women. Occupational status may modify these associations.

1. Introduction

There are inverse associations between socioeconomic status and the incidence of cardiovascular disease and cardiovascular disease mortality (Davey Smith et al., 1992, 1998). Psychological job stress is postulated to mediate/modify the effects of socioeconomic status on health (Hallqvist et al., 1998). Workers with low occupational status are more vulnerable to job stress than those with higher occupational status (Wege et al., 2008). A prospective study showed that women with lower occupational status and job control had a significantly higher risk of stroke mortality than those with higher occupational status and job control (Toivanen and Hemström, 2008). A study in Japan also showed that job stress was associated with a higher risk of stroke incidents among men with low occupational status (Tsutsumi et al., 2011).

Cardiovascular stress reactivity is a predictor of atherosclerosis and cardiac events (Gianaros et al., 2005). Heart rate variability is a widely used method for studying autonomic modulation of heart rate (Taylor, 2010). Findings regarding associations between socioeconomic status and cardiovascular stress reactivity have been inconsistent. In one study, women with higher socioeconomic status had less marked systolic blood pressure (SBP) and diastolic blood pressure (DBP) reactions to stressful tasks than those with lower socioeconomic status; however, these reactions did not differ by socioeconomic status in men (Steptoe et al., 2002). Heart rate reactions to stressful tasks are greater among participants with high socioeconomic status, whereas participants with low socioeconomic status have a more delayed recovery in heart rate variability after stressful tasks than those with a high socioeconomic status (Steptoe et al., 2002). In a cohort study, persons with higher socioeconomic status showed greater heart rate reactivity

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http://dx.doi.org/10.1016/j.pmedr.2016.05.010

and DBP reactions to a stress task than those with lower socioeconomic status (Carroll et al., 2000).

Reported cardiovascular reactions to chronic and acute stress are inconsistent. High levels of chronic stress might be associated with increased cardiovascular reactions to acute stress (Roy et al., 1998; Lepore et al., 1997). However, high levels of chronic stress are inversely associated with cardiovascular reactions to acute stress (Schaubroeck and Ganster, 1993). A recent prospective study showed that heart rate reactivity to a stress task was negatively associated with deterioration in physical ability over the following 5 years (Phillips et al., 2011). Accordingly, the number of life events, including work-related events (an index of chronic stress levels), is negatively associated with cardiovascular reactivity to stress tasks (Schaubroeck and Ganster, 1993; Phillips et al., 2005; Ohira et al., 2011).

There are sex differences in the effects of socioeconomic status on health (Kopp et al., 2007). Furthermore, in Japan, there are greater sex differences in associations between socioeconomic status, stress levels, and health outcomes than in Western countries (Kawachi and Knodo, 2007). Women with a high occupational status who are exposed to high job stress have a higher risk of stroke incidents than those who are exposed to low job stress, but this association does not hold for men (Tsutsumi et al., 2011). Japanese men with lower occupational status perceive themselves to have poorer health and physical functioning than men with higher occupational status, which is also the case in men in Western countries. However, there is little socioeconomic difference in perceived health status among Japanese women (Martikainen et al., 2004). A large proportion of Japanese women are still homemakers. Employed Japanese women may be exposed to higher stress related to home and work than homemakers (Kawachi and Knodo, 2007).

The present study aimed to investigate the effects of occupational status on associations between chronic levels of perceived job stress and cardiovascular reactivity to mental stress tasks. Specifically, we aimed to determine the following: (1) whether lower occupational status is associated with higher cardiovascular stress reactivity than higher occupational status; (2) whether job stress levels are associated with cardiovascular stress reactivity; and (3) whether occupational status and job stress levels have an interactional effect on cardiovascular stress reactivity. Because there are sex differences in social functioning, we analyzed men and women separately.

2. Materials and methods

2.1. Study participants

This was a baseline assessment of a prospective cohort study. The participants in the present study were 979 Japanese people (338 men and 641 women) aged 16–82 years who underwent mental health checks at the Osaka Medical Center for Health Science and Promotion between 2001 and 2009. The mental health checks were performed to examine associations between mental stress levels and somatic and psychological symptoms. The applicants were obtained from companies around the Osaka area, Japan, as well as via the website of the Osaka Medical Center for Health Science and Promotion. The present study was explained to all applicants and those who gave written consent to the study were enrolled. This study was conducted after obtaining approval from the Ethics Committee of the Osaka Medical Center for Health Science and Promotion.

Most of the participants were employed persons (98% of men and 93% of women). Among the employed participants, the most frequent occupation in this study was teaching (44% of men and 54% of women). Unemployed persons comprised 1.5% of men and 6% of women; of the latter, 65% were housewives. Unemployed persons and those with missing data (0.9% of men and 0.5% of women) were excluded from the analyses. Data for 330 men and 598 women were analyzed. The distribution of participants' occupations is shown in Table 1. Participants were categorized as managers/professionals or general workers based on the preceding studies and vital statistics in Japan (Fukuda et al., 2005; Saeki et al., 2000). No participants had a history of stroke or myocardial infarction.

Table 1
Participants' occupation by sex.

	Men		Women	
	N	%	N	%
Manager	36	10.7	6	0.9
Professional	184	54.4	398	62.1
General: white-collar job	94	27.8	189	29.5
General: blue-collar job	15	4.4	5	0.8
General: unclassified job	1	0.3	0	0
Unemployed	5	1.5	40	6.2
Missing	3	0.9	3	0.5
Total	338	100	641	100

The data were collected between 2001 and 2009 in Osaka, Japan.

2.2. Experimental tasks

The experimental tasks consisted of a modified mirror drawing stress (MDS) task and a maze task (Hirokawa et al., 2014). In the MDS task, a complex pathway was presented to participants on a computer screen for 2 min, and they were asked to trace the pathway with a mouse as accurately and as rapidly as possible. The horizontal and/or vertical axis controls of the mouse were reversed. The maze task (Amthat: The Brain Medical, Japan) was designed to assess perceptual functioning, especially thinking ability. A maze was presented on a computer screen for 2 min and participants were required to plan how to reach a goal by passing through invisible walls with five lines and five columns. The interval of the tasks was 2 min. These tasks were administered in the following sequence: pre-task rest, MDS task, interval, maze task, and post-task rest.

2.3. Measurements

The Brief Job Stress Questionnaire was used to measure participants' job stressors (Shimomitsu et al., 2000). The 57 items are graded on a four-point Likert-type scale to measure job stressors, psycho-physical complaints, and support for workers. In this study, the effects of quantitative (three items: alpha = 0.80) and qualitative job overload (three items: alpha = 0.77), physical demands (one item), interpersonal conflicts (three items: alpha = 0.65), and poor physical environment (one item) were assessed. Sample items are as follows: "You have to do an enormous amount of work" for quantitative job overload, "You have to focus your attention quite a lot" for qualitative job overload, "You do a lot of physical work" for physical demands, "There are differences of opinion within your department" for interpersonal conflicts, and "The environment of your workplace (noise, light, humidity, and ventilation) is not so good" for a poor physical environment.

Cardiovascular reactivity was assessed by measuring SBP (mm Hg) and DBP (mm Hg) by a tonometry method and heart rate (beats/min) was assessed by electrocardiogram (ECG) (BP-508SD: Omron Colin, Japan) during pre-task rest (pre) for 2 min, the MSD task for 2 min, the maze task for 2 min, and post-task rest (post) for 2 min. Participants' ECGs were monitored from electrodes on the left subclavicular area and the right lower chest. The RR intervals were measured by using the MemCalc (GMS Co., Ltd., Japan), which analyzes data while eliminating abnormal cardiac rhythms. When atrial fibrillation and/or greater than 10% of abnormal cardiac rhythms were observed, these data were omitted from the analyses. A power spectral analysis for RR intervals on the ECGs was performed for every 128 beats to ascertain the low-frequency (LF) (0.04–0.15 Hz) and the high-frequency (HF) components (0.15–0.40 Hz) and their ratio (LF/HF).