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The Association of Job Strain with Coronary Heart Disease and Metabolic Syndrome in Municipal Workers in Turkey

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Abstract: The Association of Job Strain with Coronary Heart Disease and Metabolic Syndrome in Municipal Workers in Turkey: Yucel DEMIRAL, *et al*. Department of Public Health, Dokuz Eylül University School of Medicine, Turkey—To explore the association of job strain with CHD and metabolic syndrome in municipal workers. A cross-sectional study was completed of 450 male workers. Coronary heart disease was defined as: physician diagnosed ischemic heart disease; and/or, ischemic findings in the ECG. Metabolic syndrome was defined according to the criterion set by the National Cholesterol Education Panel. The demand-control model was used to assess job strain. Self administered questionnaires were completed after a face to face interview. Logistic regression models were constructed to assess the association of job strain with CHD and metabolic syndrome. The prevalence of metabolic syndrome and CHD were 17.8% and 8.0% respectively. Both CHD and metabolic syndrome were found to be significantly higher in higher income groups. Job demand and job control were not found to be associated with either CHD or metabolic syndrome. Metabolic syndrome was significantly more prevalent among the high job strain workers, but the significance was lost when controlled for age. The findings suggest that there is no significant association between job strain and metabolic syndrome and CHD in this sample of Turkish workers. Job strain may possibly be perceived differently in different cultures and occupations. Future studies may benefit from using a combination of different stress models and more diverse study populations.
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The multifactorial nature of coronary heart disease (CHD) is well known[1]. The field of occupational health has recognized several factors that affect the development of CHD. For instance, the specific nature of each workplace environment poses unique risk factors, such as potential exposure to hazardous chemicals, shift work, night work, job dissatisfaction, job insecurity, and job strain, all of which may contribute to the development of illnesses, including CHD. Moreover, these risk factors are not usually found as isolated occurrences in the workplace but, rather, in combination. In addition, differing social and behavioural factors have also been shown to affect the development of CHD in diverse ways.

It has been well documented in a number of studies that the psychosocial work environment is associated with the development of CHD[2, 3]. Several useful and well-structured models have been designed to describe the psychosocial work environment[4]. One of the most promising of these models is known as the job strain model, developed by Karasek *et al*[5]. According to this model, job strain is defined as an excessive workload combined with both diminished control over work duties and skill underutilization[3, 6]. Studies from the most industrialized countries have shown that high job strain plays an important role in the development of CHD and its risk factors[2–4, 6–8]. Most of the studies from these developed countries have provided a large body of evidence that job strain and different CHD indicators, such as the incidence of myocardial infarction[2, 9, 10], and some other modifiable risk factors, like hypertension[11, 12] and smoking[13, 14], are related. In developing countries however, there have been far fewer studies investigating the relationship between the psychosocial work environment such as job strain and CHD. In addition, recent studies have reported that the presence of metabolic syndrome (MS) (which is composed of five CHD risk factors: obesity, high triglyceride (TG) and low high-density lipoprotein cholesterol (HDL) concentration,

elevated blood pressure, and impaired glucose tolerance) is a risk factor for cardiovascular disease[15].

In general, the Turkish population has been reported as having low levels of total or LDL cholesterol and a high prevalence of low HDL cholesterol. Additionally, the Turkish population possesses a high prevalence of hypertension (46% of adults aged 30 or over)[16]. Therefore, the associations between job strain with CHD and MS within the Turkish working population was investigated in this study.

Methods

Study design, settings and procedures

A cross sectional study was conducted at the municipal garbage collection department of the Konak District of Izmir, Turkey in 2004. The population of Izmir is approximately 2.5 million people, and the Konak Municipality served 867, 825 inhabitants at the time of the study. The study was completed using 450 (92.6%) out of a possible 486 male workers. All the workers were informed about the study and instructed to visit the workplace health centre the morning after a designated 10-h overnight fasting period. Face to face interviews were performed by physicians (at the workplace health centre). Two consecutive blood pressure measurements were taken by trained nurses after a 5 min period of rest. A twelve-lead electrocardiogram was recorded. A venous blood sample was taken and serum concentrations of cholesterols, triglyceride, and glucose were measured (in milligrams per decilitre) using an automated analyzer. Also, measurements were taken for weight and height, as well as for waist and hip circumference.

Dependent variables

Coronary heart disease was defined by the existence of one of the following two findings: previously diagnosed ischemic heart disease that was confirmed by a physician; and/or, ischemic findings in the ECG. ECG evaluations were performed by a senior cardiologist using the Minnesota criterion[17]. Men with 3 or more of the following attributes were defined as having the metabolic syndrome (MS) according to the National Cholesterol Education Panel (NCEP)[15]: (1) triglycerides ≥150 mg/dL; (2) HDL cholesterol <40 mg/dL; (3) blood pressure ≥130/85 mm Hg; (4) central obesity as defined by a waist circumference >102 cm; and (5) fasting glucose ≥110 mg/dL.

Questionnaire

A Turkish-language version of the Swedish demand-control questionnaire (T-DCQ) was used to assess job strain (see in appendix). T-DCQ has 14 items in four domains: There are three items for work demand, three items for skill discretion, two items for authority over decision, and six items for social support. Response choices for an item are "often, sometimes, seldom and never/almost never" in the job demand and job control domains. Response categories for social support items corresponded to a four item Likert scale, ranging from 'strongly agree' to 'strongly disagree'. Responses to each item were scored between 1 and 4. The total score for a domain equals the total sum of the item scores in that scale. Summation of scores in skill discretion and in authority over decision corresponds to job control. The higher scores indicate high demands, high job control and high social support. Median values were used as the cut points for grouping into high versus low job demand, job control and social support. Cronbach's coefficients for each domain were as follows: job demand, 0.68; skill discretion, 0.48; authority decision, 0.78; and social support, 0.77. To define job strain, a ratio of job demands to job control was calculated as described in previous studies[18, 19]. The higher values of this ratio were indicative of higher job strain. Workers in the upper third tertile were designated as having high job strain.

The questionnaire also sought information on age, education, marital status and working life variables, including work duration in years, tasks, monthly income, and perception of equity at the workplace, as well as perception of job insecurity. Income was dichotomized by the median values of monthly wages.

Statistical analysis

Participants with any missing data (N=36, 7.4%) on independent or dependent variables were excluded from the study. Of the 36 workers, 23 were excluded because of an absent blood sample and 13 were excluded because there were missing items on their sociodemographic and/or DCQ questionnaires. Point prevalence of CHD and metabolic syndrome risk factors were expressed in percentages. The associations between job strain components, job strain and CHD and metabolic syndrome were firstly assessed using the chi square test. P values less than 0.05 were accepted as the significance level in the univariate analysis. All the statistically significant variables were used as covariates to adjust the associations between job strain and CHD/MS.

Two logistic regression models were constructed to evaluate the association of job strain and metabolic syndrome and CHD. In the first model, age, education and job strain were included. In the second model, in addition to age, education and job strain, work duration, income, contract type and smoking were included to adjust job strain and CHD/MS association. The adjusted odds ratio (OR) of job strain for CHD/MS with 95% confidence intervals (CI) were presented. The SPSS 11.0 software statistic program was used for the data analysis.

Results

The mean age was 41.1 ± 6.6 (ranged 24–60). Fixed-

Table 1. Work characteristics of the study population

	N	%
Contract type		
Fix-term	167	37.1
Permanent	283	62.9
Task		
Collection	266	59.1
Driver	129	28.7
Maintenance/Support	55	12.2
Job insecurity perception	154	34.3
Inequity perception	203	45.5
Hazardous work	384	85.3
Union membership	345	76.7
Job strain		
High demand	213	47.3
Low control	218	48.4
Social support	211	46.9

Table 2. Metabolic syndrome risk factors

	n	%
Blood glucose ≥110 mg/dl	60	13.3
Blood pressure		
systolic ≥130 / diastolic ≥85 mmHg	136	30.2
HDL <40 mg/dl	166	36.9
Triglyceride ≥150 mg/dl	212	47.1
Hip circumferences >102 cm	84	18.7
Number of criterion		
None of the criteria	97	21.6
1 criteria	159	35.3
2 criteria	114	25.3
3 criteria	55	12.2
4 criteria	21	4.7
5 criteria	4	0.9
Metabolic syndrome (3 and more criterion)	80	17.8

term workers (mean 36 ± 6.6) were found to be significantly younger than the permanent workers (mean 43.7 ± 5.2) ($p<0.0001$). The majority of the study group finished primary education (90.4%) but 10 workers (3.1%) never attended school at all. There were 167 (37.1%) workers who had been working with fixed-term contracts and 283 (62.9%) who had been working in permanent positions. There were three tasks groups: garbage collection (n=266, 59.1%), lorry driving (n=129, 28.7%) and maintenance/support services (n=55, 12.2%). The mean for the number of years worked among the workers was 12.5 ± 1.5 yr. The shift work participation rate was 37.8%. Within the group, there were 154 (34.3%) workers who perceived their job security as insecure, and 85.3% perceived their job as being hazardous to their health. Almost half of the workers (45.5%) perceived some form of inequity at the workplace. The unionization rate was 76.7%. Of the workers, 213 (47.3%) were exposed to high job demand and 218 (48.4%) were exposed to low job control. There were 211 (46.9%) men with low social support (Table 1). Also among the workers, 346 (77.1%) had at some point been smokers and 286 (63.6%) were currently smokers.

The distribution of each metabolic syndrome criterion is shown in Table 2. According to these criteria, 60 (13.3%) of the workers had high blood glucose and about one third of the workers had high blood pressure (30.2%). Low HDL prevalence was found to be 36.9% (n=166) and high triglyceride 47.1% (n=212) among the workers. Finally, 84 of the workers (18.7%) qualified as having central obesity. The overall prevalence of metabolic syndrome among all the workers, e.g. three of the above risk factors together, was 17.8% (n=80). There were 97 workers (21.6%) who did not have any of the metabolic syndrome risk factors. CHD prevalence was 8.0% (n=36).

Univariate analysis

Table 3 summarizes the results of a univariate analysis of independent and dependent variables. Age was strongly associated with metabolic syndrome ($p<0.0001$). While metabolic syndrome prevalence under 35 years of age was 4.4%, it rose gradually through increasing age groups, finally reaching 44.4% in the ≥55 yr of age group. CHD was also more prevalent among the older age groups but the difference was not found to be significant ($p=0.097$) (Table 3). The prevalence of CHD increased dramatically in the 45 yr of age and older groups, reaching 22.2% in the 55 and older age group. Both CHD and metabolic syndrome were found to be significantly higher in the high income groups ($p=0.002$ and $p=0.024$, respectively) than in the other groups. While CHD was 3.6% in the lower income group, it was 11.5% in the high income group.

CHD was found to be more prevalent among the garbage collection workers (9.4%) while metabolic syndrome was more prevalent among the drivers (20.2%) than among others. However, these differences were not found to be significant (Table 3). The prevalence of metabolic syndrome was 23.0% among the permanent workers and 9.0% among the fixed-term workers ($p=0.000$). CHD was also found to be significantly more prevalent among permanent workers (10.2% vs. 4.2%, $p=0.022$) than among others. The prevalence of CHD gradually increased with the number of years worked in

Table 3. Association of independent variables and CHD and metabolic syndrome

N=450	CHD N (%)	Metabolic syndrome N (%)
Age (yr)		
≤35	6 (6.6)	4 (4.4)
35–44	12 (5.7)	40 (19.1)
45–54	16 (11.3)	32 (22.7)
≥55	2 (22.2)	4 (44.4)
p	0.097	<0.0001
Income		
High	29 (11.5)	54 (21.4)
Low	7 (3.6)	26 (13.2)
p	0.002	0.024
Task group		
Collection	25 (9.4)	44 (16.5)
Driver	7 (5.4)	26 (20.2)
Maintenance	4 (7.3)	10 (18.2)
p	0.385	0.676
Contract type		
Permanent	29 (10.2)	65 (23.0)
Fix term	7 (4.2)	15 (9.0)
p	0.022	<0.0001
Work duration (yr)		
≤10	10 (5.5)	20 (11.0)
11–19	16 (8.2)	44 (22.7)
≥20	10 (13.3)	16 (21.3)
p	0.110	0.009
Perceived job security		
Secure	28 (9.5)	59 (20.0)
Insecure	8 (5.2)	21 (13.6)
p	0.111	0.094
Job demand		
High	19 (8.9)	35 (16.4)
Low	17 (7.2)	45 (19.0)
p	0.495	0.479
Job control		
High	21 (9.1)	42 (18.1)
Low	15 (6.9)	38 (17.4)
p	0.396	0.852
Job strain		
High	10 (6.6)	35 (23.2)
Low	26 (8.7)	45 (15.1)
p	0.444	0.033

the municipality. The prevalence of CHD was 5.5% among men who had worked less than 10 yr, increasing to 8.2% in the 11–19 working years group and, finally, was 13.3% among those who worked for more than 20 years. But this difference was not significant (p=0.110). On the other hand, metabolic syndrome was found to be significantly high among those workers who had been working for the municipality for more than 10 years (p=0.009). Perception of job security was not significantly associated with either CHD prevalence or metabolic syndrome (p=0.111 and p=0.094 respectively). Perceived inequity also was not associated with CHD (p=0.126) or metabolic syndrome (p=0.795).

Both job demand and job control were found not to be associated with prevalence of CHD (p=0.495 and p=0.396, respectively). Similarly, metabolic syndrome was not significantly associated with job demand and job control. Metabolic syndrome was, however, found to be significantly higher among the high job strain workers (23.2% vs. 15.1%, p=0.033). CHD prevalence, on the other hand, did not change significantly with job strain (p=0.444).

Table 4a. Association of job strain and CHD and metabolic syndrome: model 1

	CHD OR (CI)	Metabolic syndrome OR (CI)
High vs. low job strain[a]	0.7 (0.3–1.4)	1.5 (0.9–2.5)
High vs. low job demand[a]	1.3 (0.6–2.5)	0.9 (0.5–1.4)
Low vs. high job control[a]	0.7 (0.3–1.3)	0.8 (0.5–1.4)

[a]Adjusted for age and education.

Table 4b. Association of job strain and CHD and metabolic syndrome: model 2

	CHD OR (CI)	Metabolic syndrome OR (CI)
High vs. low job strain[b]	0.8 (0.4–1.7)	0.9 (0.5–1.5)
High vs. low job demand[b]	1.2 (0.6–2.4)	0.7 (0.5–1.3)
Low vs. high job control[b]	0.7 (0.4–1.4)	0.8 (0.5–1.4)

[b]Adjusted for age, education, work duration, income, contraction type and smoking.

Multivariate analysis

Two models were constructed using logistic regression analysis. First, age and education adjusted odds ratios (CI) are given in Table 4a. Neither the job strain components nor job strain itself was associated with CHD or metabolic syndrome. Secondly, adjustment was made for age, education, work duration, income, contract type and smoking. All confidence intervals included 1.0 for both outcomes for the job strain and its components (Table 4b).

Discussion

The findings of the present study reveal that there was no significant association between job strain and CHD.

A significant association was found between job strain and a cluster of CHD risk factors e.g. metabolic syndrome, but the result was found not to be significant when controlled for age.

Several studies have shown a significant association between job strain and CHD in both Sweden and the United States[6, 7]. In addition, there have been several review articles and meta analyses that have comprehensively summarized the relationship between job strain and CHD[6, 8]. These reviews concluded that job strain is a major CHD risk factor. Surprisingly, most of the literature shows an association between job strain and CHD but not necessarily between job strain and CHD risk factors with the exception of ambulatory blood pressure and fibrinogen[20].

The null findings of the present study can be explained several ways. In this investigation the study population consisted almost exclusively of young and middle-aged males. It is very possible that job strain may only raise CHD risk after a long latency. Therefore for this relatively young study population the lag time may not have been long enough to allow any significant effects from job strain to be observed. It is also possible that while the healthy persons have been able to stay on the job, the ill ones have been unable to stay on the job, i.e. the healthy worker effect. In addition to healthy worker effects, Karasek *et al*. also suggested that job demands are more likely to cause people to drift from the working life[9]. Job control, on the other hand, is unlikely to change for such a reason.

Metabolic syndrome is not a life threatening condition that would force a person to leave work. Fifty-eight workers left the work among the fixed term workers and 40 employees retired from the permanent group in the study year. There were no new employees among the permanent workers. Since the fixed term workers were hired annually, renewals and new hiring could not be discriminated among them. On the other hand, the median number of years worked in the study population was twelve years, which suggests that the worker turnover rate was not high. Additionally, the prevalence of metabolic syndrome in the current study was similar, or only slightly lower, than in other population based studies conducted in Turkey[16, 21]. It is therefore unlikely that the null associations of job strain with CHD and metabolic syndrome were completely due to healthy worker effects. On the other hand, selection bias may still have played a role in the findings.

Some other issues should be addressed while interpreting the study results. While a higher social position within a developed country is related to a lower risk for CHD, there is a greater risk for CHD among higher socioeconomic groups in the developing countries[22–24]. Some other research conducted in some industrialized, albeit non-Western, countries has also found a null association between job strain and CHD and its risk factors. For instance, job strain and atherogenic lipids were found to be not associated or only slightly associated with CHD in two different studies conducted on Japanese workers[25–27]. It has also been suggested that the relationship between job strain and CHD has been mediated or changed by socioeconomic differences. For example, Alterman *et al*. showed that decision latitude was a stronger predictor for CHD among white collar workers[28].

In our study, income was significantly associated with CHD and metabolic syndrome in univariate analyses, e.g. a higher income indicated a greater risk. When we adjusted job strain by socio-economic determinants including income, the OR of MS changed substantially. This may indicate a relatively strong confounding effect by these variables. These findings suggest that social and economic determinants may have an important "inverse" role in CHD etiology in non-Western countries.

The validity of some parts of the Turkish job-demand questionnaire should also be considered cautiously, especially in our study group. In our sample, Cronbach's coefficient for skill discretion was relatively low compared to other components of the questionnaire. Likewise, questions about skill discretion possibly did not make any sense to the garbage collection department's workers. Workers in the municipal garbage collection department were more prone to high demand and low or no job control in general than most other jobs. Several studies have demonstrated that different components of job strain may play a role in the relationship between job strain and CHD. It has been reported that job control, not job demand or job strain itself, is associated with elevated CHD risk factors, such as cholesterol and triglycerides[2, 29]. It could still be suggested that high demand might possibly play a preventive role to some extent. Our results showed no differences in CHD prevalence or metabolic syndrome according to either job demand or job control suggesting that low diversity among the workers might have contributed to the null findings.

The study has some strengths including a defined study population and a high response rate. This study is also the first in Turkey to focus on assessing job strain association with CHD and metabolic syndrome, the latter, a recently defined clinical entity.

Several limitations need to be taken into account. First of all, cross-sectional studies are weak in showing the temporality between cause and outcome. In our study the causal relationship between job strain and CHD and/or MS could not be assessed properly. However, cross-sectional studies are useful in developing hypotheses for future studies. The second limitation is the relatively small sample size compared to suggestions in the literature. It has been suggested that most positive

findings are reported from studies with large sample sizes, e.g. more than a thousand[20]. Our study consisted of 450 workers, which is not a small sample size; however, it may not have been large enough to observe an association. Given these two limitations, a larger sample size with a follow-up study design would allow the above questions to be better evaluated.

The definition of CHD in this study was based on ECG findings and doctor diagnosed CHD history. This definition might have missed some of the CHD cases without ECG findings. However the number of CHD cases should be quite low and it is unlikely that the workers were more prone to high job strain levels.

Another limitation of our study was that municipal workers are certainly not a representative sample of the Turkish working population as a whole but, rather, are homogeneous both in terms of social and educational background. Therefore, a more diverse study population may shed more light on the relationship between work related stress and CHD in Turkey. Future studies may also benefit from using both a combination of different stress models and more diverse study populations, which would allow the differences between the various social gradients in developing countries to be more accurately analysed. Information derived by using these structured models of the psychosocial work environment may provide useful knowledge on CHD and its risk factors in developing countries. This knowledge could then be used to successfully develop and apply specific preventive measures and procedures.

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Appendix. Turkish version of the Swedish demand-control questionnaire

Demands

1. Do you have to work very fast?
2. Do you have to work very intensively?
3. Does your work demand too much effort?

Skill Discretion

4. Do you have the possibility of learning new things through your work?
5. Does your work demand a high level of skill or expertise?
6. Does your job require you to take the initiative?

Decision Authority

7. Do you have a choice in deciding HOW you do your work?
8. Do you have a choice in deciding WHAT you do at work?

Social Support

9. There is a calm and pleasant atmosphere where I work.
10. We get on well with each other where I work.
11. My co-workers support me.
12. The others understand if I have a bad day.
13. I get on well with my supervisors.
14. I enjoy working with my co-workers.