

THE RELATIONSHIP BETWEEN PSYCHIC WORKLOAD AND CARDIOVASCULAR RESPONSE IN INDUSTRIAL MEN MANAGERS

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Abstract. The aim of the present study was to estimate the relationship between high-strain work and heart rate. The study was carried out in 23 managers from a big industrial plant. Evaluation of work demands and the ability to cope with them as regards mental difficulty, monotony, risk, responsibility, interpersonal conflicts and time pressure was regarded as an indicator of psychic workload. Heart rate (HR) was recorded according to the Holter method. Mean HRs were calculated for periods of work (HR work); outside work (HR home) and sleep (HR sleep). HR during work suggested the occurrence of substantial psychic load. This was supported by subjective evaluation, especially as regards responsibility, interpersonal conflicts, time pressure and mental difficulty. Work demands and the ability to cope with them could be regarded as the predictors of HR in all three periods of time considered, but especially during sleep. The prolonged influence of psychic workload on cardiovascular system reflects its intensity and may be the cause of the common occurrence of cardiovascular diseases in managerial staff.

INTRODUCTION

The influence of psychic workload on health is not clearly established. It is known that for instance in the United States 11% of all occupational diseases are caused by accumulative work-related emotional problems. Among these ailments, cardiovascular diseases are in the fifth position (9). It seemed thus very important to determine work-stress-related risk of initiation and development of cardiovascular diseases. Epidemiological studies indicate that work monotony, lack of freedom in decision-making, rush, lack of control over work

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process and the feeling of being underestimated increase the risk of myocardial infarction following myocardial ischemia (6, 7). Stressful life style usually associated with managerial position is the commonly accepted, classic risk factor of ischemic heart disease. Individual cardiovascular response to stress may constitute a further risk factor, e.g. persons suffering from ischemic heart disease and hypertension, and also their offspring, react to stress with greater blood pressure increase than normal controls (12). However, not many data are available on the effect of strictly occupational stress on physiological reaction of the cardiovascular system (4, 5, 8). The majority of studies were focused on determining cardiovascular response to stress as associated with various experimental tasks (12, 13, 15). But certain investigation disclosed that the correlation between the magnitude of response to stressful experimental tasks and to real-life stress is very weak (14). It was thus necessary to determine the influence of occupation-related psychic load on cardiovascular response. This was the aim of the present study, which was concerned with men only. The results obtained in female subjects have already been published (10).

MATERIALS AND METHODS

The study was performed in 23 men, managers from one of the big textile plants. The group included the members of the board of directors, heads of departments and lower rank managers. The detailed characteristics of the group is presented in Table 1.

TABLE 1. Characteristics of the tested group

Number of subjects		Age [years]	Employment period [years]		Number of subordinates	Level of education
			Total	As an executive		
23	1 manager 19 heads of departments 3 foremen	45,6 ± 6,6	24,2 ± 8,7	12,7 ± 8,2	81,7 ± 110,8	14 University graduates 8 High school 1 Technical school

The study was carried out according to the method described in detail in the previous paper (10). The method involved: 1) estimation of perceived psychic workload by the application of subjective evaluation of work demand, and the ability to cope with them according to six workload measures: mental difficulty, monotony, risk, responsibility, interpersonal conflicts and time pressure; 2) 24 h Holter monitoring with the assistance of Medilog 3000 apparatus.



The duration of the periods of work, house chores, rest and sleep was estimated on the basis of subjects activity diaries. Detailed description of activities allowed to estimate energy expenditure. The values of energy expenditure for each activity were taken from literature (2). Subjective evaluation of strenuousness, difficulty and neuro-emotional tension which was applied in the previous study was given up, since it seemed very difficult and thus not reliable.

RESULTS

On the days of ECG registration the subjects worked for 8 h 25 min on the average and slept for almost 7 hours. The remaining time was devoted to travel to work (about 1 h), house chores (about 2 h) and to rest. The data of these

TABLE 2. Weekly balance-sheet of leisure time

Kind of leisure time activity and habits		Mean value for the whole group (23 persons)	Number of subjects
Commute			
Time [min]	total	52.8 ± 35.5	23
	on foot	11.6 ± 9.8	23
Means of conveyance	car		8
	tram, bus, train		14
	bicycle		1
Spare time [h/week]			
– light housework		10.5 ± 9.8	19
– heavy housework		3.6 ± 4.3	18
– gardening			15
– hobbies		8.8 ± 4.8	23
– leisure time physical activity			
	light	3.8 ± 3.7	17
	moderate	.5 ± .9	6
	heavy	3.0 ± 1.2	22
Sleep [h]			
– night before working day		6.8 ± .8	23
– night before day off		7.9 ± .9	23
Smoking – cigarettes per day		9.7 ± 9.4	11
– duration [years]		13.5 ± 11.4	11
Coffee – never			2
– seldom			14
– once a day			5
– more			2



days did not significantly differ from those of the weekly time balance charts (Table 2), what proves these days to be the typical working days. The activities of subjects included: construction and analysis of work schedules for subordinate departments and control of their execution, approval of documents and invoices, talks with foreign and Polish business partners, attending to current correspondence, participating in meetings and reading profession-related literature. At work-posts directly associated with the production process, work additionally involved supervision of repairs, overhauls, performing technological tests and work safety control.

Physical energy expenditure "at home" was quite significant, greater than during work. This is justified by the usually "scanting" occupation and relatively high leisure time activity. The majority of subjects devoted their leisure time to gardening and/or long walks and to strenuous manual work at home. This difference in physical activity during and outside work was not reflected by a difference in heart rate; it was nearly the same in both these periods. It could be thus supposed that a relatively high heart rate during work is associated with a significant psychic load (11). There was also no marked difference in HR_{work}/HR_{sleep} and HR_{home}/HR_{sleep} indices (Table 3). Responsibility, possibilities of interpersonal conflicts and time pressure were the highest-rated work demands. Mental difficulty was given a lower, but still high rating. Risk was the only measure which was stated to be average, while monotony received a low rating.

TABLE 3. Physiological indices of load during work and leisure time

Variables	At work	At home	During sleep
Duration [min]	504.8 $\pm$ 125.4	496.0 $\pm$ 99.7	417.0 $\pm$ 58.9
Energy expenditure [kcal/min]	.86 $\pm$.22	1.16 $\pm$.49*	
Heart rate [beats/min]	88.3 $\pm$ 7.6	88.6 $\pm$ 9.5	68.0 $\pm$ 7.0
Ratio of heart rate at work and at home and sleeping heart rate	1.30 $\pm$.1	1.31 $\pm$.12	

*) $t = 2.649$

$0.02 > p > 0.01$

Mean values derived from the evaluation of the ability to cope with work demands always exceeded the level of mean values of work demands. The highest abilities reported by the subjects were with respect to responsibility, coping with time pressure and interpersonal conflicts (Table 4).



TABLE 4. Profile of perceived psychic workload

Load indices	Mental difficulty	Monotony	Risk	Responsibility	Conflicts	Time pressure
Work demands	6.0 $\pm$ 1.3	2.9 $\pm$ 1.3	4.5 $\pm$ 1.2	6.8 $\pm$ 1.1	6.7 $\pm$ 1.5	6.7 $\pm$ 2.1
Ability to cope with demands	6.2 $\pm$ 1.4	4.6 $\pm$ 1.9	6.8 $\pm$ 1.5	7.1 $\pm$ 1.5	8.0 $\pm$ 1.0	7.8 $\pm$ 1.4

TABLE 5. Regression equation describing dependence of circulatory load indices during work and leisure time on age, employment period, working time, energy expenditure and on estimations of work demands and abilities to cope with them

Independent values	Dependent values				
	HR work	HR home	HR sleep	HRwork /HRsleep	HRhome /HRsleep
Age			.696	-.009	-.009
Employment period as an executive	-.291		-.551		
Sleep time	-.066				
Energy expenditure					
at work			-20.097	.172	
at home	-4.945				
Leisure time heavy physical activity	4.233				
Work demands					
Mental difficulties			2.077		
Monotony	3.358	3.431			
Risk			-2.199		
Responsibility			2.540		
Abilities to cope with					
Mental difficulties			-2.440		
Conflicts	1.802	3.040	3.094		
Constant	100.48	56.915	34.267	1.552	1.724
Multiple correlation coefficient	.881	.579	.924	.696	.505
p value	.0002	.0168	.0001	.0013	.0141

In order to assess the relationship between the perceived psychic load (work demands and abilities to cope with them) and its physiological consequences multiple regression analysis was applied, where both kinds of estimations, age, number of subordinates, employment period as an executive, time and energy expenditure at work and at home, sleep time, and leisure time heavy physical activity were regarded as independent variables (Table 5). Work demands, more frequently than the abilities to cope with them, were those factors which constituted psychic load evoking a significant cardiovascular response. Work demands concerned with mental difficulty, risk and responsibility only modified the heart rate during sleep, while those concerned with monotony affected the heart rate during work and at home. The ability to cope with conflicts was found to be a predictor of heart rate in all time periods considered while the ability to cope with mental difficulty influenced heart rate during sleep only. It could be thus concluded that sleep is the period during which heart rate is correlated with the highest number of psychic load measures.

Apart from these psychic load measures, other factors such as length of employment at a managerial post and energy expenditure during leisure time were found to affect heart rate during sleep. It seems noteworthy that the direction of influence of the above-mentioned factors on heart rate was sometimes opposite to the expected one. Highly intense physical activity was positively correlated with heart rate during work, while energy expenditure at home and at work was negatively correlated with heart rate during work and sleep. Similarly, correlation of the ability to cope with conflicts and heart rate during work had the direction opposite to that expected at home and during sleep. The same applied to the correlation of demands concerning risk and heart rate during sleep.

DISCUSSION

The investigation performed in now presented group of men and previous reported (10) group of women employed at managerial posts allowed us to analyse gender-related differences in cardiovascular response to occupational stress associated with work of similar level of mental load and neuro-emotional tension. The similar intensity of perceived occupational stress in both subject groups is documented by similar ratings of work demands and abilities to cope with them (Fig. 1). It should be noted, however, that objective indices of workload were different for men and women. For instance, the number of subordinates to men managers was on the average 82 while to women only 17. Despite this fact, the ratings of work demands concerned with interpersonal conflicts were similar in men and women, indicating that conflicts constitute a greater problem for women.

In both groups of subjects, the subjectively-rated abilities were higher than ratings of work demands (the only exception was mental difficulty, which the women rated higher than their ability to cope with it). This, together with the



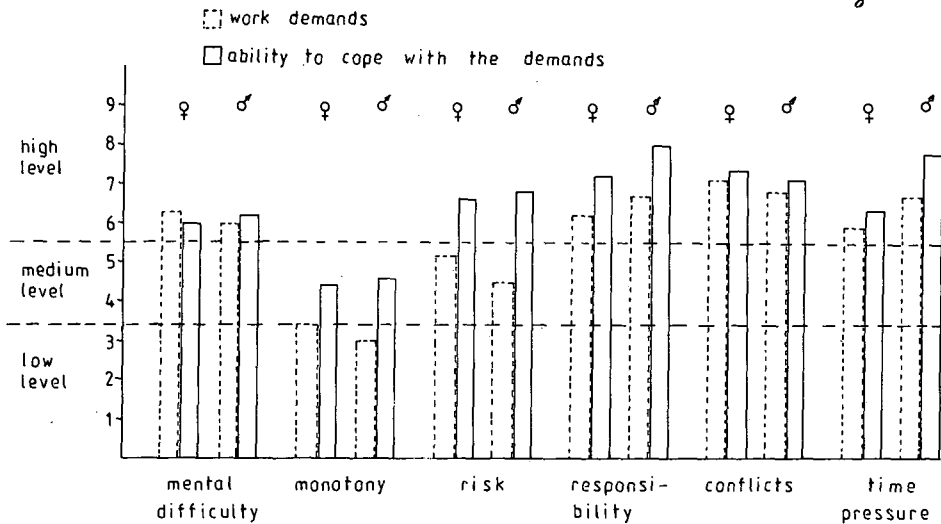


Fig. 1. Profile of perceived psychic workload in male and female industrial managers.

fact that the subjects reported the highest abilities to cope with loads for which the demands were also the highest (responsibility, conflicts, time pressure) may indicate that they have adapted well to work.

The data presented demonstrate that the measures of psychic load, which are the predictors of heart rate are the actual, though not fully realized, load factors. This can be exemplified by ratings of work demands concerned with monotony, which were rated very low by men. It elevated heart rate most prominently during work. The opposite relationship was observed in women: the high-rated ability to cope with conflicts lowered heart rate during work. The results of physiological investigation indicate, thus, that individual measures of load have a different significance in the general picture of workload.

It can be noted that in men cardiovascular response is more affected by work demands, while the ability to cope with them is more important in women. This is the physiological consequence of typical female behaviour i.e. constantly asking themselves the question "how will I cope with that?". For men, it is more typical to fulfil the task without thinking much about it.

Results obtained from male and female subjects allow us to compare stress response in these two groups. Literature data on this problem are quite confusing. According to Saab, women react to stress with an increase in blood pressure and noradrenaline release lower than that of men (12). However, in women having a "masculine" type of career, the reaction to stress, as regards the change in catecholamine level, is similar to men (1). According to Weidner et al. men react to stress with greater blood pressure increase, women with a greater increase in heart rate (15).

Our findings suggest that in men work was objectively more stressogenic. This is supported by a heart rate a little higher during work in men than in women, and that in men the influence of individual measures of psychic load on heart rate was most prominent at night. This is typical for a significant workload which has prolonged influences, even after work is over. A prolonged effect of these negative emotions on the cardiovascular system may be the cause of the high incidence of cardiovascular diseases in managerial staff, mostly in males (3).

The obtained results also suggest that rest activities were not effective. Although they reported high physical activity (3.5 h/week on the average), this did not increase their physical fitness. This type of activity seemed rather to cause even greater fatigue, because those men who spent their leisure time this way, had a higher heart rate during work. It seems necessary to introduce health education concerning suitable forms of leisure time physical activity.

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