International Journal of Occupational Medicine and Environmental Health, Vol. 12, No 3, 273–284, 1999

THE ASSESSMENT OF BIG FIVE PERSONALITY FACTORS AND TEMPERAMENT DOMAINS AS MODIFIERS OF CARDIOVASCULAR RESPONSE TO OCCUPATIONAL STRESS

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Key words: Personality, Temperament, Psychosocial stress, Cardiovascular reactivity

Abstract. The aim of the study was to explore the role of Big Five Personality Factors and Temperament Domains as the factors influencing cardiovascular response to work, and their moderating effect on the relationship between occupational stress and cardiovascular reactivity. The self-reported data on occupational stress and filled in NEO-Five Factor Inventory by Costa, and McCrae and Pavlovian Temperament Survey by Strelau et al. were collected from 97 bank clerks employed in large bank branches. The subjects also responded to the questionnaire on personal and professional background factors. A 24 hour monitoring of cardiovascular reactivity (heart rate and blood pressure) was also provided. Conscientiousness was found to be the only modifier of cardiovascular response to occupational stress reflected by systolic blood pressure. Several main, independent of stress effects of personality and temperament domains were also found. The ratio of heart rate at work to heart rate during sleep was associated with the strength of excitatory process, the percentage of maximum heart rate index with Conscientiousness, and systolic blood pressure at work was influenced by the strength of inhibitory process. However, generally speaking, physiological indicators of the cardiovascular system functioning were not very sensitive to changes in values of personality and temperament variables at the level of occupational stress reported by the bank clerks who participated in the study.

INTRODUCTION

The role of psychosocial factors such as chronic stress, personality traits, anxiety, and ways of coping with stress in the process of developing cardiovascular disturbances continues to attract the attention of researchers. There are three main approaches that incorporate psychosocial factors into the mechanism of pathophysiology. The etiologic trait approach suggests that personality factors, and temperament play a casual role in the etiology and progression of diseases (7).

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The example of this approach are the studies on Type A behaviour pattern, anger or hostility and coronary disease (2,5,12,23). The second approach represents the idea of stress moderating role of personality/temperament traits. It is presumed here that these factors can moderate the relationship between stress and adverse health outcome. The studies on optimism (17,18), and coping style (8,9,10) may serve as the examples of this approach in the psychosomatic medicine research. Another point of view on the interplay between personality traits, stress and ill-health is called 'illness behaviour approach' (7). Here personality/temperament is supposed to be responsible for individual differences in health promoting life styles via producing a specific level of sensitivity or attentiveness to abnormal symptoms which may be the precursors of disturbances in well-being (4,16).

In the present study the attention was focused on both casual relationship between personality, temperamental traits and reactivity of the cardiovascular system, and stress moderating effect (especially protective one) of these phenomena. The main objectives of the study were to explore the role of Big Five Personality Factors, Pavlovian Temperament Domains and psychosocial stress at work in the process of developing cardiovascular disturbances, and to examine if any of these psychological characteristics play a protective role against adverse health outcome understood in the terms of cardiovascular disturbances.

MATERIALS AND METHODS

Subjects

A group of 97 bank clerks employed in large bank branches situated in the city of Łódź participated in the study. Most of the subjects were women (n = 90), that is why we did not decide to dichotomize the group with respect to a gender criterion. The group under study embraced 13.5% of very young (under 25) and 16.3% of older (over 45) subjects. Table 1 presents the demographic characteristics of the subjects.

Table 1. Sociodemographic characteristics of the bank clerks under study (n = 97)

Variable	Mean	SD
Age	36.9	8.8
Professional experience (yrs)	16.4	9.0
Period of employment at the present post (yrs)	3.9	2.1
Education:	%	
primary	3.8	
secondary	90.5	
university	5.7	
Marital status:	%	
single	10.6	
married	78.8	
widow/widower	10.6	
divorced	–	

Measures

1. **Big Five Personality Factors** – NEO-Five Factor Inventory (NEO-FFI) by Costa and McCrae is a 60-item self-report scale which measures the following personality domains comprising the Big Five model of personality:

Neuroticism as the tendency to experience emotional distress; Extraversion – disposition toward positive emotions, sociability and high activity; Openness – a receptive orientation toward varied experiences and ideas; Agreeableness – the inclination toward interpersonal trust and consideration of others; and Conscientiousness – the tendency toward persistence, industriousness, and organisation.

The NEO-FFI possesses satisfactory psychometric properties and corresponds well with a full 181-item instrument (4, 24).

2. **Temperament Domains** – Pavlovian Temperament Survey (PTS) by Strelau et al. was employed. PTS consists of three scales related to Pavlovian typology of the nervous system: (1) the strength of excitatory process (SEP) – the ability of the nervous system to sustain high or/and long stimulation without passing into protective inhibition state. Persons with high strength of excitatory process tend to act in high stimulation conditions, they are resistant to fatigue during performing long-term and intensive activities; (2) the strength of inhibitory process (SIP) – the ability to sustain conditioned inhibition state. Among persons with high strength of inhibitory process some typical features of behaviour are observed: the easiness of restraint from behaviour which is socially inappropriate or inadequate, the ability to conceal one's emotional states, and the ability to discontinue activities, if necessary, without experiencing unpleasant feelings; (3) the mobility of nervous processes – the capacity to turn from one stimulation to another which means an immediate change in behaviour with changing environmental conditions. High mobility of nervous processes means adequate reactions to unexpected changes in one's environment, fast adaptation to new conditions, easiness of passing from one activity to another, from one emotional state to another. This instrument also allows for evaluating the equilibrium of nervous processes by comparing SEP to SIP. Psychometric assessment of PTS properties done by the authors gave satisfactory results (20).

3. **Psychosocial stress at work** – a 55-item questionnaire developed by B. Dudek was used in the study. It provided the possibility of assessing the level of psychosocial stress due to work. The psychometric value of the questionnaire was found satisfactory (6).

4. **24 hour automatical registration of blood pressure** – Ambulatory blood pressure monitoring during the daily activities was provided in the study. Blood pressure was recorded every half an hour. Two indicators were calculated: the mean diastolic blood pressure (DBP) at work, and the mean systolic blood pressure (SBP) at work.

5. **24 hour ECG registration** – 24 hour Holter monitoring was carried out using the Oxford Medilog 3000 system. During the entire monitoring period the subjects were performing their activity diaries. The activity diaries were the basis for calculating the following indexes: heart rate at work, heart rate during sleep, HR work/HR sleep ratio, and relative heart rate (% HR_{max} – calculated as the

percentage of maximum heart rate for a given individual). The HR work/HR sleep ratio was calculated on the basis of the mean heart rates for the periods of work and sleep. The index % HR_{max} was calculated according to the formula:

$$\% \ HR_{max} = \frac{HR \ work}{HR_{max}} \cdot 100\%,$$

$$HR_{max} = 220 - \text{age in years}.$$

The index is used as an indicator of workload, especially physical one. The limits for low, medium and high load are: 40%, 50% and 65% HR_{max}, respectively (11).

Procedure

The study was performed at three stages. At the first meeting, the information about the purpose of the study and the procedures employed was provided by the personnel of the Work Psychology Department who invited volunteers to participate in the study. All the volunteers were asked to fill out at home the psychological questionnaires and respond to the questionnaire on personal and professional background factors. At the successive meeting, one week later, the questionnaires were collected from the subjects, and checked whether all questions had been answered, and the volunteers had the Holter or Medilog ABP devices adjusted (stage II). After a day and night the devices were exchanged (stage III). For the technical and organisational reasons the blood pressure was monitored only in 50 subjects. After completing all examinations, the participants received the results of the heart rate and blood pressure monitoring together with medical diagnosis.

Table 2. Descriptive statistics for indicators of cardiovascular response to work, and correlations between these indicators and psychological variables

Variable	Ratio HR work/HR sleep	% HR_{max}	HR work	SBP	DBP
Stress at work	.074	.127	.115	−.248*	−.081
Strength of excitatory process	.041	−.183*	−.077	−.017	.019
Strength of inhibitory process	.094	−.061	.004	.200	.051
Mobility of nervous processes	−.003	−.121	−.053	−.045	−.078
Equilibrium of nervous processes	−.043	−.149	−.088	−.197	−.030
Neuroticism	.013	.023	−.002	−.194	−.018
Extraversion	−.042	.029	.072	−.021	−.132
Openness	.172*	.097	.127	−.143	−.178
Agreeableness	−.024	.069	−.016	.334**	.204
Conscientiousness	−.092	.078	.024	−.036	−.201
Mean	135.7	48.6	88.9	111.4	72.8
Standard deviation	15.3	5.9	10.4	11.2	10.7

*$p \leq 0.05$, **$p \leq 0.01$

RESULTS

The mean values of the cardiovascular reactivity indicators presented in Table 2 are not high. However, the mean value of % HR_{max} index seems to be interesting as it is close to the limit for medium workload calculated for physical work load which is assumed to be one of the main factors responsible for the heart rate increase. Since the job as a bank clerk does not involve physical workload, we assume that the value of % HR_{max} index elevated to almost 50% may be due to mental workload.

The descriptive statistics for all temperament and personality factors, and psychosocial stress at work together with their intercorrelations are presented in Table 3. The mean values for personality and Temperament Domains in the group studied corresponded with the data obtained in the study on the adaptation of NEO-FFI (24) and PTS (20) in Poland.

The general level of psychosocial stress at work was mostly affected by 21 features of work perceived by the subjects as irritable. Of this number, ten features, most stressful for employees, were listed below in the order of intensity of stress evoked:

(1) financial responsibility;
(2) possibility of making mistakes leading to serious consequences for an employee;
(3) conflicts and arguments with clients and other people outside the company;
(4) work requiring focused attention;
(5) imposed pace of work;
(6) vigilance – being alert and quick in responding to significant stimuli that may appear at any moment;
(7) time pressure;
(8) passing from one activity to another;
(9) repetitive simple tasks that need some attention;
(10) inadequate work conditions.

An initial analysis was conducted to examine if there is any association between the indicators of cardiovascular reactivity and psychological variables controlled in the study. The correlation matrix for physiological variables is presented in Table 2. Only four correlations were found to be statistically significant – two of them were related to heart rate indicators, and two to systolic blood pressure at work. It is presumed that the heart rate is an indicator of general activity state of an organism, and the frequency of heart rate depends on physical effort, emotional strain, and the environment. Many of the researchers are convinced that relative indicators of heart rate such as HR work/HR sleep ratio and % HR_{max} index are better indicators of individual load (11). The significance of correlations obtained showed that only these relative indicators of heart rate were sensitive to the influence of psychological variables controlled in the study – the strength of excitatory processes was associated with a lower, that means better % HR_{max}, and Openness was associated with a higher, namely worse HR work/HR sleep ratio index. Taking into account blood pressure indicators among all psychological variables, only Agreeableness was associated with SBP, and the association was positive – subjects high scored on Agreeableness scale of NEO-FFI had higher SBP. Psychosocial stress at work was correlated with only one indicator of cardiovascular reactivity – systolic blood pressure. Subjects who perceived their work as more stressogenic showed lower SBP. The result obtained is confounding as the positive correlation

Table 3. Descriptive statistics and intercorrelation between Big Five Personality Factors, Temperament Domains and stress at work

Variable	Neuro-ticism	Extra-version	Open-ness	Agree-ableness	Conscien tiousness	Strength of excitatory process	Strength of inhibitory process	Mobility of nervous processes	Equilibrium of nervous processes	Stress at work
Neuroticism	–	.482***	−.187*	−.296**	−.395***	−.497***	−.346***	−.520***	−.260**	.247**
Extraversion	−.482***	–	.372***	ns	.339***	.415***	ns	.599***	.318***	ns
Openness	−.187**	.372***	–	ns.	.220*	.319***	.266**	.407***	ns	.167*
Agreeableness	−.296**	ns	ns	–	ns	ns	.340***	.199*	−.247**	−.195*
Conscientiousness	−.395***	.339***	.220**	ns	–	.343***	.224*	.204*	.203*	ns
Strength of excitatory process	−.497***	.414***	.319***	ns	.343***	–	.462***	.618***	.699***	ns
Strength of inhibitory process	−.346***	ns	.266**	.340***	.224*	.462***	–	.468***	−.296**	ns
Mobility of nervous processes	−.520***	.599***	.407***	.199*	.204*	.618***	.468***	–	.270**	−.202*
Equilibrium of nerv. processes	−.260***	.318***	ns	.247**	.203*	.699***	−.296**	.270**	–	ns
Stress at work	.247**	ns	.167*	−.195*	ns	ns	ns	−.202*	ns	–
Mean	33.7	39.3	42.5	45.3	39.4	47.6	52.7	52.3	.91	113.8
Standard deviation	8.1	7.0	5.3	6.8	5.6	7.5	6.0	7.3	.14	25.8

* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

Table 4. Summary of ANOVA tests of significance results (F values)

Dependent variable	Source of variation		Main effect		Interaction A × B
	Factor A	Factor B	Factor A	Factor B	
Ratio HR work/HR sleep	Stress at work	Conscientiousness	ns	4.10*	ns
% HR_{max}	Stress at work	Strength of excitatory process	ns	4.83*	ns
S.B.P. at work	Stress at work	Strength of inhibitory process	ns	5.32*	ns
S.B.P. at work	Stress at work	Conscientiousness	ns	ns	5.85*

* $p \leq 0.05$

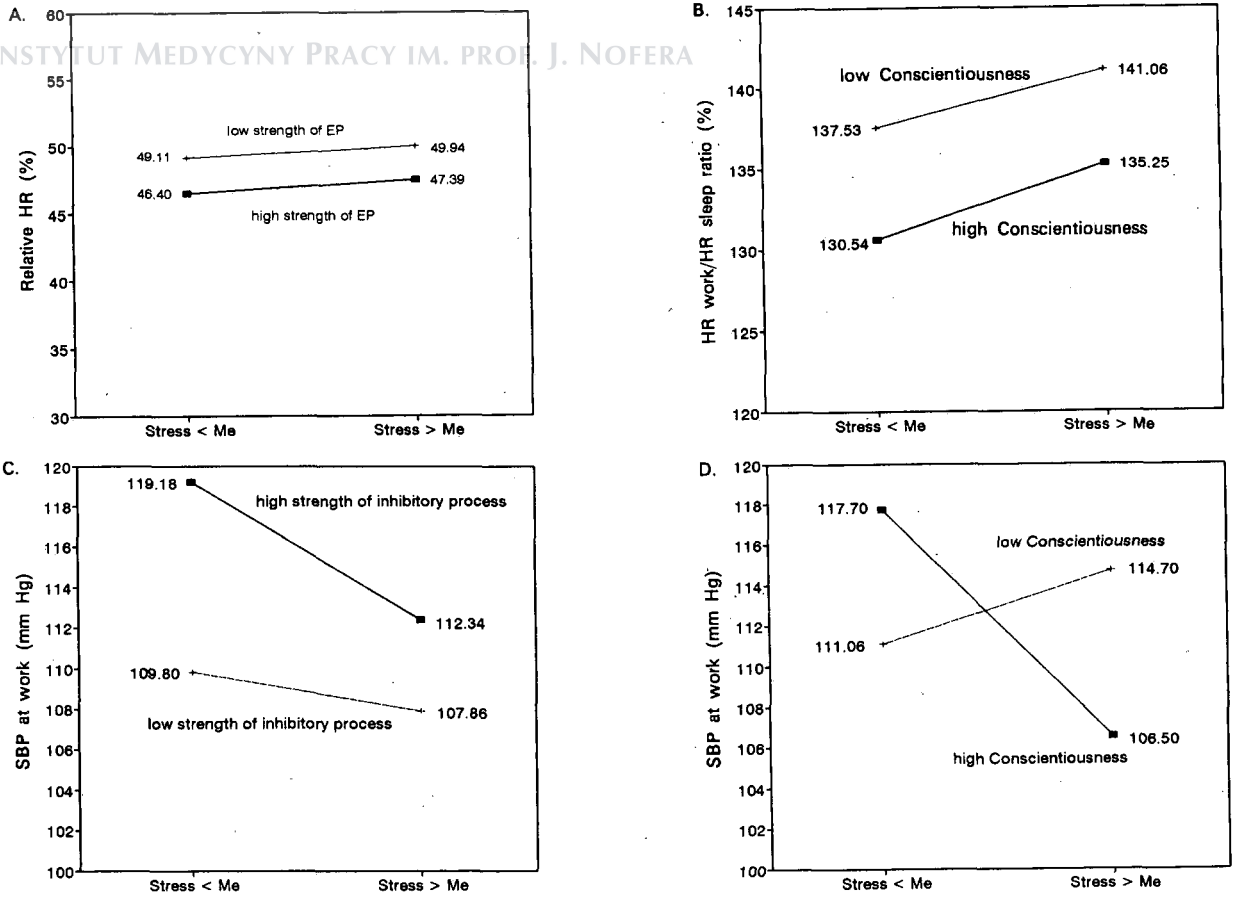

Fig. 1. Main and interactive with occupational stress effects of Personality and Temperament on cardiovascular reactivity at work. A. Main effect of strength of excitatory process on relative heart rate index. B. Main effect of Conscientiousness HR work/HR sleep on ratio index. C. Main effect of strength of inhibitory process on SBP at work. D. Interactive effect of Conscientiousness and psychosocial stress at work on SBP at work.

was expected (3). The available data do not allow for reasonable explanation of this result but in successive analyses performed the relationship described was no longer significant.

A series of two-way ANOVAs was performed to determine the main effect of Big Five Factors, Temperament Domains, psychosocial stress at work, and their interactions. In all two-way ANOVAs, the subjects' scores on psychological questionnaires were dichotomized to 'low' $\leqslant$ Me, and 'high' $>$ Me. The summary of ANOVA tests of significance results are presented in Table 4. The results indicate that physiological indicators are sensitive to the influence of psychological variables to a small extent only. Three main effects and an interactive one were found. Fig. 1a presents the main effect of SEP on % HR_{max} index. The effect is small but positive taking into account functioning of the cardiovascular system. It can be stated that the strength of excitatory process is a factor which decreases the value of % HR_{max} index, which reflects the lower cardiovascular costs of mental workload. The same tendency was observed in the case of Conscientiousness, as the only one of Big Five Personality Factors significant, and independent of psychosocial stress influence on the HR work/HR sleep ratio index (Fig. 1b). The HR work/HR sleep ratio indexes of subjects high scored were lower than those of the low scored on Conscientiousness scale of NEO-FFI. Conscientiousness in interaction with psychosocial stress also significantly affected SBP at work (Fig. 1d). Among the persons high scored on Conscientiousness scale and whose work was evaluated as stressful, the lowest SBP was recorded. However, the high level of Conscientiousness among subjects who perceived their work as less stressogenic led to SBP increase. Among all the Temperament Domains only SIP significantly affected systolic blood pressure at work. Subjects low scored on Strength of Inhibitory Process scale of Pavlovian Temperament Survey had lower SBP at work. The same observation was made in persons who perceived their work as highly stressogenic, and in those with lower scores on the Subjective Assessment of Work Characteristics Questionnaire (Fig. 1c).

The next step of the analysis was to examine whether the effects observed were strong enough to remain significant after introducing to the statistical analysis other psychological variables controlled in the study. The necessity of this approach was derived from the fact that none of the personality and temperament features could function separately. They are associated with each other and different patterns of these associations may result in different effects on cardiovascular system response to work. To reach this aim, multiple regression models were employed in the study. Three groups of regression models were tested. First, all Temperament Domains were included into equations where the dependent variables were all indexes and indicators of cardiovascular response to work. Second, a hypothesis on the main effects of Big Five Personality Factors on cardiovascular reactivity at work was tested. And finally, the third model was the test for a hypothesis on the interactive with stress effect of Conscientiousness on SBP only. At the pilot run, no significant effects of psychological factors on any dependent variable were found. The summary of tested regression models is presented in Table 5. Neither Beta values for psychological factors entered into regression equations nor F values reached the level of statistical significance, which means that following the results obtained neither hypothesis on main effect of personality and temperament on cardiovascular reactivity nor stress moderating effect of these variables could be accepted.

Table 5. Multiple regression results for the association between Big Five Personality Factors, Temperament Domains, stress and cardiovascular response to work

Variables in the equation	Variable explained	R	R^2	F	p
MODEL 1:					
Strength of excitatory process	HR work/HR sleep ratio	.1516	.0230	.409	.84
Strength of inhibitory process	% HR_{max}	.2003	.0401	.719	.61
Mobility of nervous processes	HR work	.0993	.0098	.173	.97
Equilibrium of nervous processes	SBP at work	.3804	.1447	1.447	.21
Stress at work	DBP at work	.2028	.0411	.377	.86
MODEL 2:					
Neuroticism	HR work/HR sleep ratio	.2373	.0563	.855	.53
Extraversion	% HR_{max}	.1647	.0271	.400	.88
Openness	HR work	.1362	.0185	.271	.95
Agreeableness	SBP at work	.4487	.2013	1.806	.12
Conscientiousness	DBP at work	.3285	.1079	.867	.53
Stress at work					
MODEL 3					
Neuroticism					
Extraversion					
Openness	SBP at work				
Agreeableness		.4882	.2383	1.877	.09
Conscientiousness					
Conscientiousness × Stress at work					

Such findings probably resulted from strong interactions between the majority of psychological variables included into the regression equations (Table 3). In view of the fact that F values for multiple regression models tested were very small and insignificant there was no need to retest them once again, taking into consideration demographical data which could be strong confounders of the relationship between dependent and independent variables.

DISCUSSION

The present study was undertaken with two major objectives. First, to evaluate whether Big Five Personality Factors, Pavlovian Temperament Domains and psychosocial stress accounted statistically for changes in cardiovascular response to work. Second, to examine whether any personality traits and Temperament Domains could have played a protective role against excessive load of cardiovascular system due to stressogenic work. As regards the first objective, we found that indicators of cardiovascular reactivity employed in the study were sensitive to the influence of personality, temperament variables to a small extent only. Psychosocial stress at the level obtained in the study did not affect cardiovascular response. Three main effects of psychological variables on physiological parameters were found. The influence of SEP decreased the level of cardiac response (% HR_{max} index) both in so called low and high psychosocial stress. This result is consistent with the Pavlovian theory of temperamental types. The high level of SEP means that an

individual is resistant to fatigue associated with performing long term and/or intense activities, and needs more stimulation than an individual low scored on this scale, to reach the optimum of activation, and has higher efficiency understood as the ability to work (19,20). It means that the cardiovascular system of subjects with the high level of excitatory process can be less affected by mental workload present at the post of a bank clerk. The same character of relation was observed in the case of Conscientiousness and HR work/HR sleep ratio. High Conscientiousness decreased the value of this index in both the subjects who perceived their work as stressogenic and among those who did not. We assume that Conscientiousness may be the key trait, very important for such professions as a bank clerk. This trait protects the employees against making mistakes when following the uphill bank procedures, and thus helping them, from a psychological point of view, to stave off negative consequences of such mistakes as financial liability, negative evaluation by supervisors, and conflicts. When one is following standard procedures, in most situations, there is no need for him/her to be anxious about the effect of the work performed. As the anxiety is presumed to be responsible for the increase in heart rate (22) via running the adrenaline release to the blood and activating Beta receptors located in the heart, we hypothesise that the high Conscientiousness level through reducing the anxiety reactions influences the cardiac response to work, and this effect is reflected in the decrease of the HR work/HR sleep ratio index. Conscientiousness in interaction with psychosocial stress was also associated with SBP at work. Fig. 1d shows the specific pattern of interaction – so called congruence model (14). This type of association indicates that neither low nor high level of Conscientiousness is necessarily maladaptative, and the increase in SBP at work may be associated with incongruence between this personality factor and psychosocial characteristics of work described by the level of psychosocial stress. The high level of Conscientiousness is preferable in the conditions of high psychosocial stress – the group of subjects high scored on Conscientiousness scale and perceiving their work as more stressful exhibited the lowest SBP at work. The pattern of the results obtained may also be associated with age. However, the linear association between SBP and age was not significant in the study, may be the non-linear was. Then it could be also considered that the group with high Conscientiousness and low psychosocial stress consisted of older subjects, with higher, due to age, SBP, and with higher professional competence.

The main effect of SIP on systolic blood pressure was the final significant relationship between psychological variables and cardiovascular response to work The results obtained were found confusing to some extent. We hypothesise that SIP itself affects the cardiovascular response to work by decreasing its intensity, thus, its high level associated with lower indicators of blood pressure at work was expected. However, these findings provide evidence that SIP exerted an opposite effect on systolic blood pressure at work. It is difficult to interpret the observed direction of association and, in our opinion, it needs further studies.

All the aforesaid relationships between psychological factors and cardiovascular response to work were insignificant in the multiple regression analysis. That could be caused by the intercorrelation of psychological variables included into the models tested. However, taking into account the basic temperament and personality factors, their role as modifiers or mediators of relationship between stress and adverse health outcome could be more evident and stronger in the more stressogenic

conditions of work then those recorded in our study. Strelau (21) also suggests that the role of Temperament Domains in the relationship between stress and outcome measure may by specific according to the kind of stress: occupational or social, chronic, acute or traumatic, and additional studies are still warranted to examine the role of psychosocial variables as additional factors explaining the development of cardiovascular disturbances.

ACKNOWLEDGEMENTS

This study was supported by the SPR projects IV.20.4. Identification of psychological factors modifying the influence of occupational stress on employees' health, with special respect to cardiovascular diseases and mental health disturbances.

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Received for publication: July 26, 1999
Approved for publication: August 20, 1999