CORRELATIONS OF SOMATOPHYSIOLOGICAL, BIOCHEMICAL, PSYCHOSOCIAL AND BEHAVIORAL RISK FACTORS OF CARDIOVASCULAR DISEASES IN A SAMPLE OF EMPLOYEES OF PRAGUE ENTERPRISES AND INSTITUTIONS

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SUMMARY

The study is aimed at the detection and intervention of risk factors for cardiovascular diseases (CVD) and at the part played by stress in their development. The methods applied are designed to eliminate the risks and, simultaneously, to identify the function of the two main parts of stress reaction, i.e., in terms of the extent, level and type of the stressors experienced, and in terms of the level of mental resilience and related psychosocial factors which affect the experiencing of and coping with stress. The purpose of medical examination based on the patient's history, subjective complaints and objective tests, including a study of dietary habits and psychological methods was to establish the status praesens and identify the main risk factors and symptoms leading to ischemic heart disease (IHD). Intervention was performed in subjects with increased cardiovalscular risk factors.

Key words: cardiovascular disease, risk factors, stress, mental resilience, somatophysiological, behavioral and psychosocial determinants

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INTRODUCTION

The growing extent and increasingly demanding content of stressors and stressogenic situations in present-day civilised, market-based and globally interconnected society (meaning inadequate claims on the extent and timing of their fulfilment, problems of all kinds encountered in coping with them, frustrations, obstacles on the road to attaining particular objectives, situations of conflict) and the growing rate of other, mainly psychosocial risk factors in the society of today, place increased somatophysiological and psychosocial demands on man's behaviour and experienced as well as effective management of those situations.

Occupational stress is now one of the major problems facing adults; its impact on the productivity of labour, on sick leaves, but also on the cost of health care and on morale is very significant. Chronic occupational stress in particular is responsible for enormous economic loss (6, 8).

Assessment of occupational situations often comes across a certain discrepancy between the demands placed on human behaviour by this excessive stress and man's capacity for meeting those demands. Response to stress in the sense of the course of the stress reaction is invariably individual, relative to the specificity of personality characteristics and dispositions, as well as to the nature of and changes in working conditions and environment.

Exposed to stress at work are, in part, persons of a higher social status open to a higher level of demands and responsibility, in part, people of a lower social status noted for a high level of requirements and lower levels of occupational autonomy. The risk of CVD is further increased by stressors from outside the sphere of occupation, disorders of sociability, lack of social support and suspect social isolation and, vice versa, decreased by protective factors including a higher level of mental resilience, social support from others, co-operation offered by co-workers and managers. Hence the need to develop and promote the level of mental resilience of workers at risk, and to seek and find the way of helping to overcome adverse situations. The role of comprehensive diagnosis and intervention of CVD risks has long been mentioned in literature (1, 3, 11), though not always duly respected. According to Ornish et al. (13), changes in the way of life (low-fat diet, breaking off or giving up smoking, coping with stress and regular albeit moderate physical exertion) can yield marked improvement within one year even in cases of advanced coronary sclerosis without medication aimed at fat level reduction. Fraser (5) mentions a high degree of psychosocial stress leading to signs of hypertension, atherosclerosis and ischaemic heart disease.

Diseases of the heart and vessels remain the principal cause of early morbidity and mortality in the Czech Republic (CR) and many other developed countries though they can be successfully

prevented using comprehensive diagnostics and intervention of risks. In the CR, CVD caused the death of 47% men and 57.5% women of all the inhabitants of the capital city of Prague who died in 2003.

As part of the Health 21 research project and programme, a study was undertaken for the detection and intervention of IHD risk factors among the economically active population, and for a scrutiny of the part played by stress in the onset and development of cardiovascular diseases.

COHORT OF SUBJECTS UNDER STUDY

The cohort is made up of employees of Prague enterprises and institutions aged 20 to 65 years. For evaluation the CVD risk scoring system was used to determine the risk values for individual variables and the overall risk score for individual participants classified by sex, age and level of exposure to stress. Individuals subject at the workplace to longterm stress of higher intensity had to be engaged and, as a control, persons whose work is not demanding with regard to mental stress.

A total of 743 subjects – 506 women and 237 men – were investigated.

METHODS

Examination of Employees

The purpose was to assess the status praesens and identify the most serious risk factors responsible for the onset and development of IHD based on the patients' medical history, their subjective complaints and objective examination.

In addition to family and personal history and clinical examination, the following values were investigated:

- total cholesterol
- HDL cholesterol
- LDL cholesterol
- triacylglycerols
- glycaemia
- blood pressure
- overweight and obesity
- smoking
- lack of exercise
- level, structure and dynamism of stress experienced and coped with
- spectral analysis of the pulse rate variability – total score (functional age)

Anthropometric Indicators

Body mass index (BMI) = mass (kg)/height (m)².

Measured body perimeters: WHR index – waist perimeter divided into hips perimeter.

The waist perimeter was measured at the narrowest body dimension seen from the front.

The hips perimeter was measured at the place of the largest buttocks extension. A controlled interview followed by filling-in a month dietary questionnaire was used to examine dietary habits and frequency of intake of specific nutrients.

Psychological Examination

The degree of psychosocial stress was determined by the rate of demand in different occupations and on the basis of psychological methods. Psychosocial stress is classified in four categories where categories 1 and 2 serve as controls for subjects exposed to increased psychosocial stress in categories 3 and 4. Psychological methods also helped to classify subjects by the consequences of stress, i.e., stress experiencing proper and individual perception of stress.

Included in category 4 are mainly senior executives, in category 3 – medium management workers, independently working higher-responsibility officials, but also, e.g., telephonists, tellers, etc.

Psychological Methods

- Multimodal personality inventory, developed for this survey, was employed to identify the basic personality structure including the risk scores of neuroticism (N) and proneness to depression (D). It consisted of 25 items evaluated on the 7-points self-rated scale with opposite points "strongly agree" – "strongly disagree".
- Survey and analysis of stressors, to which the patients are exposed, make use of the Czech version of the SRLE questionnaire (Survey of Recent Life Experiences) as regards the impact of stressors experienced over the past 30 days (11).
- Czech version of the Social readjustment scale (Holmes-Rahe) designed to ascertain the impact of life events over the past calendar year (8).
- A-type of behaviour (A_1, A_2) and related risk factors – hostility (Hos), frustration (Fru), irritability (Irr), tension (Ten), interpersonal sensitivity (Ips) and importance of life events (Evs) are ascertained with the Czech extended version of the Bortner scale (9).
- The level of negative emotivity – with the SHAN scale (19).
- The level of social support – with the Czech version of Blumenthal's Personal Social Support Scale (PSSS) (4).
- The level and quality of mental resilience – with the Czech version of the Kobasa' Personal Views Survey (PVS) (10).
- The degree of the burnout syndrome symptoms – with the Czech version of the BM questionnaire (15).

As far as the outcome of the psychological methods is concerned, the score of the results obtained so far appears to be age-independent. With respect to the relatively low number of subjects in the cohort and to the considerable variability of the results there is no proof yet of the score correlation with the occupational risk rate except for category 4 where such correlation has been proved.

INTERVENTION

Intervention of risk factors was used in all risk-exposed subjects with respect to the relevant American and European recommendations (2, 3).

- All subjects were acquainted with the outcome of examinations and with the level of risk factors once the results have been evaluated. All available forms of individual and group intervention were put to good use.

Table 1. *Dependence between individual biochemical indicators on level of mental stress (women)*

Load level	Cholesterol	HDL	LDL	Triacyglycerols	Systolic BP	Diastolic BP	BMI	WHR
1	5.18	1.55	3.11	0.986	110	75.6	23.5	0.756
2	5.32	1.5	3.15	3.15	119	77	25.5	0.782
3	5.44	1.65	3.22	1.2	120	76.3	25.3	0.78
4	6.09	1.75	3.73	1.28	121	77.9	26	0.797
F-ratio	**3.97**	**7.63**	**3.12**	**287**	**1.06**	**0.521**	**0.686**	**0.791**
P-value	*0.008*	*0*	*0.026*	*0*	*0.366*	*0.668*	*0.561*	*0.499*
Signif.	***	***	**	***	–	–	–	–

Load level	Functional age deviation	Pulse rate	Systolic BP under load	Diastolic BP under load	Blood sugar	Score I
1	-2.44	135	142	78.9	5.28	8.56
2	-0.0487	137	151	80.2	5.28	11.5
3	-0.103	137	153	80	5.28	10.9
4	-1.03	139	158	85.6	5.6	15.8
F-ratio	**0.0629**	**0.557**	**1.8**	**1.54**	**1.53**	**5.65**
P-value	*0.979*	*0.644*	*0.147*	*0.204*	*0.207*	*0.001*
Signif.	–	–	–	–	–	***

Statistical processing: analysis of variance. P-value means the minimum significance level at which one can refute the hypothesis of independence of the variable involved on the level of load.
– indicates p-value > 0.10, *indicates p-value from the interval (0.05; 0.10), ** indicates p-value from the interval (0.01; 0.05), *** indicates p-value < 0.01

Table 2. *Dependence between individual biochemical indicators on level of mental stress (men)*

Load level	Cholesterol	HDL	LDL	Triacyglycerols	Systolic BP	Diastolic BP	BMI	WHR
2	5.36	1.42	3.3	1.44	126.27	78.35	25.65	0.888
3	5.45	2.09	3.21	1.65	125.26	79.96	26.4	0.892
4	5.76	1.47	3.28	1.93	125.74	81.85	27.98	0.915
F-ratio	**2.73**	**10.66**	**0.26**	**2.37**	**0.0638**	**1.72**	**6.8**	**3.5**
P-value	*0.067*	*0*	*0.77*	*0.096*	*0.938*	*0.18*	*0.001*	*0.032*
Signif.	*	***	–	*	–	–	***	**

Load level	Functional age deviation	Pulse rate	Systolic BP under load	Diastolic BP under load	Blood sugar	Score I
2	-0.856	136	153	78.5	5.53	10.8
3	-0.488	138	157	80.9	5.46	11.2
4	3.27	141	158	83.3	5.63	13.1
F-ratio	**3.78**	**2.62**	**0.543**	**1.82**	**1.55**	**3.23**
P-value	*0.023*	*0.075*	*0.582*	*0.164*	*0.214*	*0.041*
Signif.	**	*	–	–	–	**

Statistical processing: analysis of variance. P-value means the minimum significance level at which one can refute the hypothesis of independence of the variable involved on the level of load.
– indicates p-value > 0.10, *indicates p-value from the interval (0.05; 0.10), **indicates p-value from the interval (0.01; 0.05), ***indicates p-value < 0.01

- Intervention started by learning the results of examination.
- Individual persons were invited to regular control visits and the following intervention forms were employed:
- Handing over results along with a written indication of relevance.
- Individual analysis of psycho-social factors in indicated instances printed guides were delivered dealing with individual risk factors and summarising the principles of intervention measures; recipients having queries were invited to a consultation accomplished by means of a visit or by telephone.

The results of intervention applied to persons subject to risk are only known for the first group of participants since interventions and control examinations are still in progress. The enclosed tables show the dependence of individual biochemical indicators on the level of mental stress in women (Table 1) and men (Table 2).

Table 3. *Dependence between individual psychological factors and level of mental stress (women)*

Load level	A_1	A_2	Irr	Ten	Hos	Ips	Evs	Fru	N	D
1	-1.6	3.22	-3.33	-8.17	-9.5	2.67	3.5	2	1	0.5
2	3.06	1.34	1.42	-2.85	-7.07	7.97	0.214	-3.78	1.09	0.477
3	5.96	5.16	0.474	-0.59	-6.45	7.62	3.44	-1.27	1.06	0.51
4	7.38	13.6	-1.25	-3.42	-9.21	6.84	0.529	-4.01	1	0.563
F-ratio	**0.974**	**2.03**	**0.462**	**1.18**	**0.225**	**0.331**	**2.05**	**0.871**	**0.106**	**0.104**
P-value	*0.405*	*0.11*	*0.709*	*0.318*	*0.879*	*0.803*	*0.107*	*0.456*	*0.957*	*0.957*
Signif.	–	–	–	–	–	–	–	–	–	–

Load level	SRLE	PVS	SHAN1	SHAN2	PSS1	PSS2	MBI	LE	Score II	Score C
1	83.8	80	29.3	3.67	71.2	20.3	0.333	198	0	7.5
2	97.3	80.4	30.1	4	66.9	28.3	0.576	159	3.9	15
3	90.3	81.1	29.8	3.53	69.3	28.8	0.596	151	5.82	17
4	101.2	80.8	26.8	3.35	56.3	15.1	0.412	138	3.88	18.7
F-ratio	**2.78**	**0.286**	**0.892**	**1.2**	**6.39**	**1.96**	**0.673**	**0.398**	**1.06**	**1.66**
P-value	*0.041*	*0.835*	*0.445*	*0.311*	*0*	*0.119*	*0.569*	*0.754*	*0.367*	*0.175*
Signif.	**	–	–	–	***	–	–	–	–	–

Statistical processing: analysis of variance. P-value means the minimum significance level at which one can refute the hypothesis of independence of the variable involved on the level of load.
– indicates p-value > 0.10, *indicates p-value from the interval (0.05; 0.10), **indicates p-value from the interval (0.01; 0.05), ***indicates p-value < 0.01
For acronymes in the heading see "Psychological Methods", p. 192.

Table 4. *Dependence between individual psychological factors and level of mental stress (men)*

Load level	A_1	A_2	Irr	Ten	Hos	Ips	Evs	Fru	N	D
2	-5.28	-7.55	2.88	-3.14	-7.86	5.34	-1.31	-2.63	0.708	0.333
3	4.49	5.086	-3.86	-5.11	-10.5	2.01	-1.9	-7.51	0.77	0.376
4	7.06	9.53	-5.74	-2.19	-10.6	-1.21	-2.56	-10.3	0.578	0.156
F-ratio	**3.33**	**4.7**	**3.49**	**0.901**	**0.279**	**2.07**	**0.113**	**1.8**	**1.15**	**2.45**
P-value	*0.038*	*0.01*	*0.032*	*0.408*	*0.757*	*0.129*	*0.893*	*0.168*	*0.319*	*0.089*
Signif.	**	***	**	–	–	–	–	–	–	*

Load level	SRLE	PVS	SHAN1	SHAN2	PSS1	PSS2	MBI	LE	Score II	Score C
2	84.4	84.4	30.3	3.58	64.5	17.4	0.542	155	0.833	11.4
3	89.3	83.5	30	3.43	68	19.6	0.504	144	-0.667	10.6
4	91	84.2	28.8	3..19	69.2	21.1	0.255	128	-3	9.4
F-ratio	**1.13**	**0.22**	**0.625**	**0.504**	**1.59**	**5.06**	**2.8**	**0.495**	**1.02**	**0.24**
P-value	*0.325*	*0.803*	*0.536*	*0.604*	*0.206*	*0.007*	*0.063*	*0.61*	*0.34*	*0.787*
Signif.	–	–	–	–	–	***	*	–	–	–

Statistical processing: analysis of variance. P-value means the minimum significance level at which one can refute the hypothesis of independence of the variable involved on the level of load.
– indicates p-value > 0.10, *indicates p-value from the interval (0.05; 0.10), **indicates p-value from the interval (0.01; 0.05), *** indicates p-value < 0.01

Dependence of individual psychological indicators on the level of mental stress in women and men is presented in Table 3 and 4. The next tables show the effect of intervention on individual biochemical indicators for women (Table 5) and men (Table 6) and the effect of intervention on individual psychological indicators for women (Table 7) and men (Table 8).

RESULTS

The results of all investigations are entered in special record sheets and subsequently computerised.

Results were processed by one-dimensional analysis of variance; significance of a factor (age, level of load) was found to

Table 5. *Effect of Intervention on Individual biochemical Indicators (women)*

	Cholesterol	HDL	LDL	Triacyglycerols	Systolic BP	Diastolic BP	BMI	WHI
Average before	5.54	1.61	3.3	1.18	121	77.1	25.5	0.781
Average after	5.5	1.74	3.2	1.24	120	77.3	25.5	0.787
Population	179	177	172	179	176	176	174	174
t-stat	**0.698**	**-3.79**	**1.8**	**-1.39**	**0.464**	**-0.431**	**-0.538**	**-0.707**
P-value	*0.243*	*0*	*0.037*	*0.083*	*0.322*	*0.333*	*0.23*	*0.24*
Significance	–	***	**	*	–	–	–	–

	Functional age deviation	Pulse rate	Systolic BP under load	Diastolic BP under load	Blood sugar	Scorel
Average before	-7.1	137	154	80.6	5.26	11.6
Average after	2.76	136	155	79.1	5.23	11.2
Population	177	134	133	132	177	179
t-stat	**-5.6**	**0.946**	**-0.895**	**2.39**	**0.674**	**1.08**
P-value	*0*	*0.173*	*0.186*	*0.009*	*0.251*	*0.14*
Significance	***	–	–	***	–	–

Statistical processing: analysis of variance. P-value means the minimum significance level at which one can refute the hypothesis of independence of the variable involved on the level of load.
– indicates p-value > 0.10, *indicates p-value from the interval (0.05; 0.10), **indicates p-value from the interval (0.01; 0.05), ***indicates p-value < 0.01

Table 6. *Effect of Intervention on Individual biochemical Indicators (men)*

	Chol.	HDL	LDL	Trig.	Sys.	Dias.	BMI	WHR
Average before	5.6	1.44	3.26	1.68	125	80	26.7	0.896
Average after	5.42	1.41	3.23	1.6	121.5	80.5	26.7	0.89
Population	135	135	131	134	129	131	125	124
t-stat	**2.97**	**0.75**	**0.43**	**0.85**	**3.23**	**-0.722**	**-0.324**	**2.08**
P-value	*0.002*	*0.227*	*0.334*	*0.199*	*0*	*0.236*	*0.373*	*0.02*
Significance	***	–	–	–	***	–	–	**

	Functional age deviation	Pulse rate	Systolic BP under load	Diastolic BP under load	Blood sugar	Scorel
Average before	-7.95	139	154	80.8	5.44	11.27
Average after	3.57	136	161	78.4	5.44	11.7
Population	134	98	97	97	134	134
t-stat	**-5.54**	**2.69**	**-3.23**	**1.91**	**0.125**	**-1.05**
P-value	*0*	*0.004*	*0*	*0.03*	*0.45*	*0.149*
Significance	***	***	***	**	–	–

Statistical processing: analysis of variance. P-value means the minimum significance level at which one can refute the hypothesis of independence of the variable involved on the level of load.
– indicates p-value > 0.10, *indicates p-value from the interval (0.05; 0.10), **indicates p-value from the interval (0.01; 0.05), ***indicates p-value < 0.01

increase with increasing value of the F-ratio indicator. No relationship between age and the level of load was established.

From the Tables it is apparent the potential dependence of biochemical and psychological indicators on the level of mental stress. The statistical significance was found for numerous important variables from the point of view of CVD risk. But it does not go for all examined variables/relations. Findings in this field published in world literature show that this ambiguity of results is standard in this area owing to the complex, multi-causal conditional character and to high inter- and intra-individual (reflecting time variation) variability of individual examined parameters. In all probability the differences between sexes cannot be interpreted as causal relationship and can be rather attributed to the effect of a number of variables concerning developmental specifics and socio-economic influences that are difficult or even impossible to control.

Considering the changes in biochemical indicators the results confirmed the expected significance of the lipid spectrum, in particular of the total, HDL and LDL cholesterol and triacylglycerols

Table 7. *Effect of intervention on individual psychological factors (momen)*

	A_1	A_2	Irr	Ten	Hos	Ips	Evs	Fru	N	D
Average before	4.34	8.6	-4.12	-3.92	-9.02	5.77	1.93	-0.508	1	0.362
Average after	8.14	6.86	0.84	2.99	-6.37	8.32	5	-1.32	1.02	0.404
Population	52	52	52	52	52	52	52	52	48	47
t-stat	**-1.34**	**0.574**	**-2.25**	**-3.36**	**-0.95**	**-1.09**	**-1.81**	**0.351**	**-0.139**	**-0.33**
P-value	*0.094*	*0.568*	*0.014*	*0*	*0.173*	*0.14*	*0.038*	*0.363*	*0.445*	*0.371*
Significance	*	–	**	***	–	–	**	–	–	–

	SRLE	PVS	SAHN1	SAHN2	PSS1	PSS2	BMI	LE	Score II	Score C
Average before	103	77.9	30.2	3.61	63.7	17.2	0.5	178	3.06	14.5
Average after	86.2	79.9	27	2.86	67.9	19.4	0.583	160	7.46	18.6
Population	52	48	49	49	49	49	48	52	52	52
t-stat	**3.67**	**-0.704**	**1.99**	**1.54**	**-1.27**	**-1.73**	**-0.663**	**0.687**	**-2.27**	**-2.04**
P-value	*0*	*0.242*	*0.026*	*0.065*	*0.105*	*0.045*	*0.255*	*0.248*	*0.014*	*0.023*
Significance	***	–	**	*	–	**	–	–	**	**

Statistical processing: analysis of variance. P-value means the minimum significance level at which one can refute the hypothesis of independence of the variable involved on the level of load.
– indicates p-value > 0.10, *indicates p-value from the interval (0.05; 0.10), **indicates p-value from the interval (0.01; 0.05), ***indicates p-value < 0.01
For acronymes in the heading see "Psychological Methods", p. 192.

Table 8. *Effect of intervention on individual psychological factors (men)*

	A_1	A_2	Irr	Ten	Hos	Ips	Evs	Fru	N	D
Average before	2,96	4,84	-4,88	-1,74	-15	3,06	-1,41	-8,3	0,732	0,283
Average after	5,31	4,56	-3,42	-2,9	-10,4	1,96	-1,86	-6,96	0,804	0,34
Population	59	59	59	59	59	59	59	59	56	53
t-stat	**-1,08**	**0,119**	**-1,04**	**0,736**	**-2,11**	**0,768**	**0,316**	**-0,694**	**-0,531**	**-0,504**
P-value	*0,143*	*0,453*	*0,15*	*0,232*	*0,02*	*0,223*	*0,376*	*0,245*	*0,299*	*0,308*
Significance	–	–	–	–	**	–	–	–	–	–

	SRLE	PVS	SHAN1	SHAN2	PSS1	PSS2	BMI	LE	Score II	Score C
Average before	94	84,5	29,4	3,22	69,3	19,6	0,373	130	-2,34	8,27
Average after	89,4	84,4	28,3	2,98	69,4	20,6	0,322	132	-1,32	10,27
Population	59	59	59	59	59	59	59	59	59	50
t-stat	**2,59**	**0,11**	**1,86**	**0,939**	**-0,104**	**-2,25**	**0,554**	**-0,173**	**-0,726**	**-1,31**
P-value	*0,006*	*0,457*	*0,034*	*0,176*	*0,459*	*0,014*	*0,291*	*0,432*	*0,235*	*0,098*
Significance	***	–	**	–	–	**	–	–	–	*

Statistical processing: analysis of variance. P-value means the minimum significance level at which one can refute the hypothesis of independence of the variable involved on the level of load.
– indicates p-value > 0.10, *indicates p-value from the interval (0.05; 0.10), **indicates p-value from the interval (0.01; 0.05), ***indicates p-value < 0.01

with regard to mental stress (see Tables 1 and 2), and also of the BMI and WHR values in men (see Table 2).

Changes in psychological indicators related to mental stress confirmed statistical significance of social backing (Tables 3 and 4), in women also in respect to recent life events (Table 3), and of type behaviour and depressive symptomatology in men (Table 4).

The effect of intervention was confirmed as statistically significant in case of biochemical indicators in the lipid spectrum and the functional age deviation (individual pulse rate variability) and the diastolic blood pressure under load for both men and women (Tables 5 and 7); for men also for values of total cholesterol, systolic BP and WHR (Table 7), for women also for changes in HDL ad LDL cholesterol and triacylglycerols (Table 5). With regard to psychological indicators the effect of intervention was confirmed in the entire population for recent life events, negative emotivity and social backing (Tables 6 and 8), for women also changes in the type of behaviour, irritability and tension (Table 6), for men values of hostility (Table 8).

Figures describing age-related risk factors (Figs. 1, 3, 5, 7) show that the values deteriorate with age in most of the patients examined, men and women alike. As regards lipids and sugars, deterioration starts towards the end of the third and especially in the fourth decennium and keeps growing with age.

The values of lipid and carbohydrate metabolism are the main precursors of atherosclerosis.

Other Figures focused on biochemical parameters correlate with the degree of psychosocial stress (Figs. 2, 4, 6) also demonstrate persons of categories 4 and 3 exposed to chronically elevated psychosocial stress as having higher values of total cholesterol, LDL cholesterol, partly also of triacylglycerols and, over 50 years of age, glycaemia, too. As the graphs show, increasing level of these health indicators may, to some extent, be due to the effects of chronic stress.

It is diffucult to prove unambiguously a correlation between the effects of stress and blood levels of cholesterol since stress gives rise – in the human body – to inter- and intraindividually different direct and indirect reactions complexly interconnected with feedback mechanismus, which preclude, given the present-day level of our knowledge, reliable control all of the variables in action.

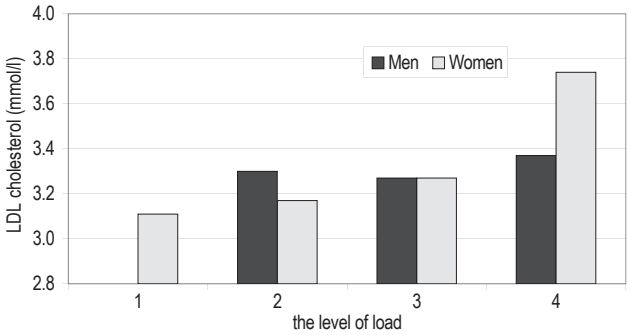

Fig. 4. The level of LDL cholesterol with respect to the level of load.

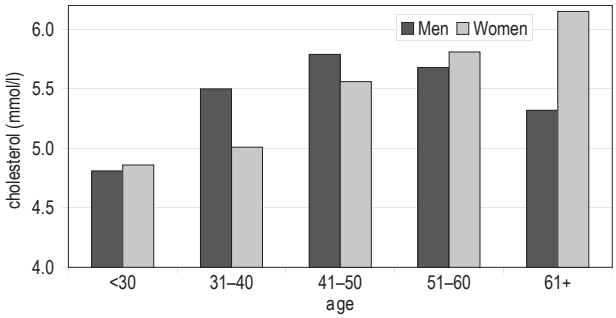

Fig. 1. The level of cholesterol by age and sex.

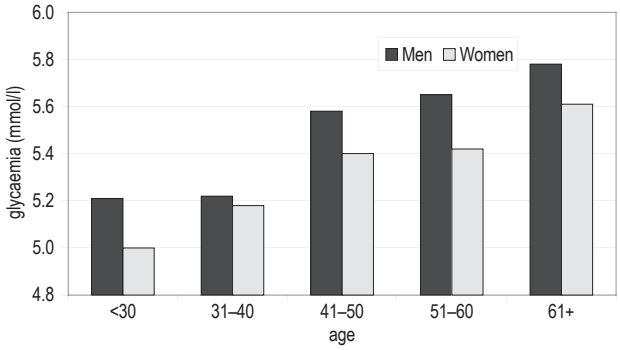

Fig. 5. The level of glycaemia by age and sex.

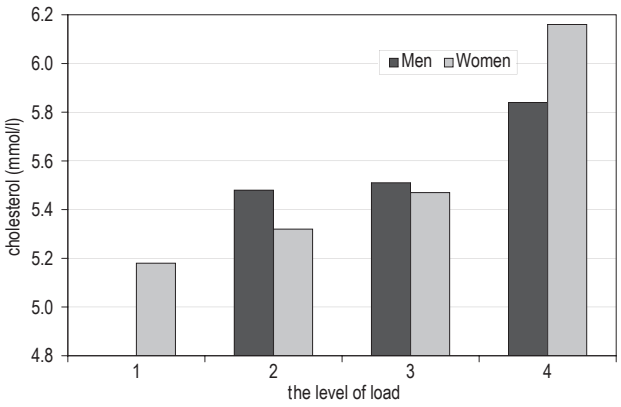

Fig. 2. The level of cholesterol with respect to the level of load.

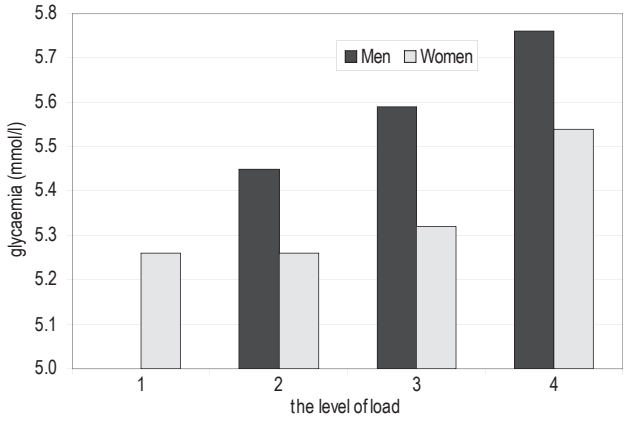

Fig. 6. The level of glycaemia with respect to the level of load.

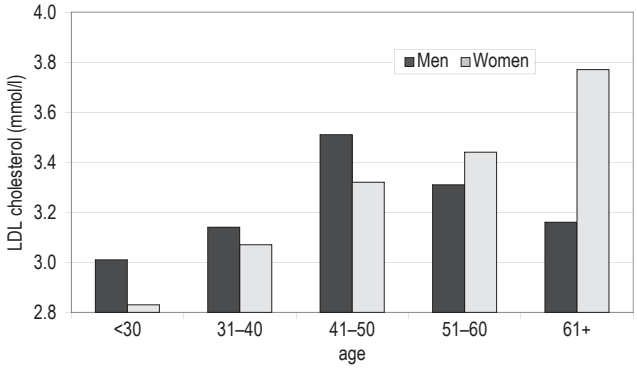

Fig. 3. The level of LDL cholesterol by age and sex.

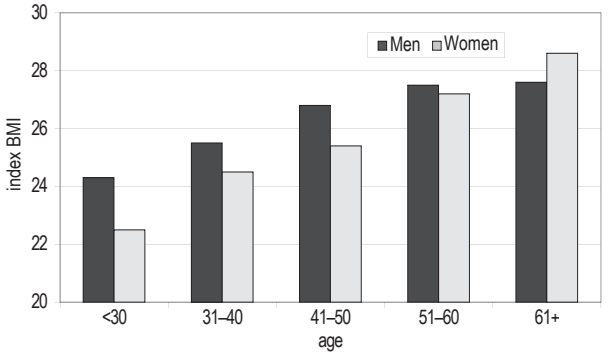

Fig. 7. BMI by age and sex.

In spite of that, the results represented in the graphs are hardly accidental as corroborated also by some literary data (13–17).

The atherosclerotic process keeps developing in the organism for a relatively long period of time before reaching the stage of clinical manifestations of organ ischaemia. The changes occurring in the 3rd and 4th decennia, especially if aggravated by chronic stress and/or other risk factors such as smoking, lack of exercise, increased blood pressure, etc., may well be significantly related to the clinical manifestations of IHD appearing between 45 and 50 years of age in men and between 50 and 55 years in women. All other risk factors beside lipids and glycaemia are known to exert an accelerating effect.

As also brought out by our results, risk factors seldom act in isolation. Toward the end of the third decennium in all of our cohort, and during the 4th decennium in a part of it, we can see already several IHD risk factors at play (see Fig. 8).

Chronic stress is a major factor markedly potentiating also the presence of the other risk factors. The techniques of long-term stress reduction may well help to reduce also the occurrence and seriousness of IHD risk factors.

Figure 9 shows the per cent rate of risk factors affecting men and women:

- no risk factors are found in 5% of all men and 11% of all women
- one risk factor – in 20% of the men and in 21% of the women
- two risk factors – in 30% of all men and in 28% of all women
- three risk factors – in 30% of all men and 24% of all women
- four risk factors – in 14% of all men and 10% of all women
- five risk factors – in 2% of the men and 1% of the women

Figure 9 shows the per cent rate of different risk factors seen in men and women. No data are given about the risk of excessive psychosocial stress or LDL cholesterol.

Chronic stress leads to changes in people's behaviour, which, according to literary data (2), takes the form of:

- increased cigarette smoking (2)
- excessive alcohol intake (2)
- increased or decreased food intake (2)
- blood pressure elevation (8)
- lack of time for physicial exercise
- level of organism immunity impairment (16)
- increased glycaemia in the middle-aged

DISCUSSION

The results show:

- Values of lipidaemia and glycaemia deteriorate with age.
- Persons exposed to greater psychosocial stress have higher lipid values (total and LDL cholesterol, triacylglycerols and, over 50 years of age, also elevated glycaemia). As B. McCann describes, psychological stress is associated with increased levels of lipids including cholesterol lipoproteins, triacylglycerols (13). "One way in which occupational stress may contribute to the development of cardiovascular diseases is through a deleterious effect on plasma lipoprotein lipids and apolipoproteins including elevations in total and low-density lipoprotein (LDL) cholesterol, elevations in triacylglycerols and decrease in high-density lipoprotein (HDL) cholesterol." C. M. Stoney et al. (19) stated: "Lipid increased during psychological stress. Most lipid parameters were significantly increased during the chronic and acute stressors, although the responses to the different stressors were not consistantly associated." This points to correlation of psychosocial stress with metabolism. In contrast, anti-stress intervention reduces the values of both lipidaemia and glycaemia. In quite a number of studies, Greenwood et al. (7) demonstrated the effects on the onset of ischaemic heart disease. The cause may be in some indirect effects, especially physiological consequences of stress resulting from chronic distress responsible for blood pressure elevation, increased levels of blood fats, platelets, impaired glucose tolerance and related metabolic processes. According to some studies, some correlation exists between high levels of psychosocial stress and the prevalence of hypertension and elevated lipidaemia such as cannot be attributed to diet (5, 18).

  Next, it is necessary to corroborate the hypothesis of a direct connection between impact of stress and the level of a complex of CVD risk factors, to judge whether stress has a bearing on risk factors, whether risk precedes stress or is itself a manifestation of stress, and whether risk adds to the load of stress.
- The potentiation of the rest of CVD risk factors under the effect of stress is obviously very significant as it accounts for a low level of success scored by health promotion programmes at those places of work where no favourable working conditions and surroundings exist and where employees are more exposed to mainly psychosocial risk factors of IHD.

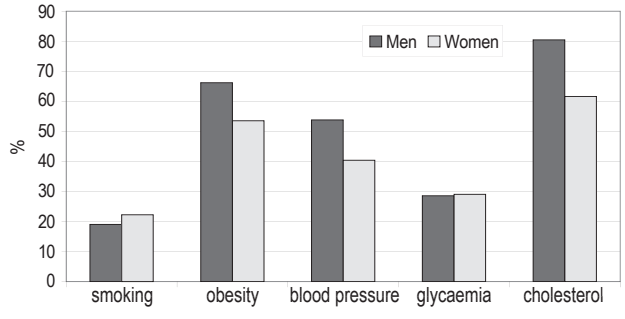

Fig. 8. The occurrence of risk factors (%).

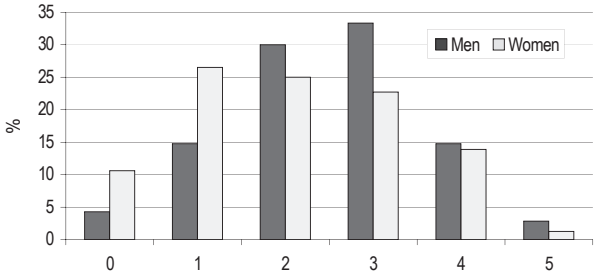

Fig. 9. Proportion of risk factors by sex (%).

CONCLUSION

The study highlights the close correlation that exists between somatophysiological, biochemical, psychosocial and behavioral risk factors and points out that the standard and quality of interpersonal relations and social support coupled with each individual's potential to cope with chronic stress has a significant bearing on the risk of CVD development and, indirectly, on his or her state of health.

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