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Coping with stress and hypertension-mediated organ damage

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Summary

Aim of the study: Chronic exposure to high blood pressure may lead to the development of hypertension-mediated organ damage (HMOD). This study compares styles and strategies of coping with stress in hypertensive patients with arterial stiffness or left ventricular hypertrophy (LVH) and in individuals with hypertension, but without HMOD.

Material and methods: Each study participant (n=93) underwent the following procedures: clinical assessment, echocardiography, pulse wave velocity measurement and psychological testing. Blood pressure in the study group was measured using ABPM method. Carotid-femoral pulse wave velocity (PWV) was assessed to identify patients with arterial stiffness. Left ventricular mass index was measured to diagnose LVH. Each patient was also assessed using three psychometric tools: PSS-10, CISS and Brief COPE.

Results: Subjects with arterial stiffness (increased PWV) scored significantly lower than patients with normal PWV in three scales: CISS *Avoidance-oriented coping* (median values: 39 vs. 41.5; p=0.042), Brief COPE *Self-distraction* (median values: 1.5 vs. 2; p=0.013) and Brief COPE *Venting* (median values: 1 vs. 1.5; p=0.037). Individuals with LVH had significantly lower results in Brief COPE *Use of emotional support* scale than hypertensive subjects with normal left ventricular mass index (median values: 1.5 vs. 2; p=0.041).

Discussion: In our study group, hypertensive patients with HMOD preferred different coping styles and strategies than individuals with hypertension, but without vascular and cardiac damage. The mechanism underlying these differences is probably complex.

Conclusions: HMOD may be associated with coping styles and strategies, but further research is necessary to fully understand the results of this study.

arterial stiffness; coping with stress; hypertension; hypertension-mediated organ damage; left ventricular hypertrophy

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INTRODUCTION

Chronic exposure to high blood pressure may damage major organs in the body (e.g. heart, kidneys or brain [1]) and increase the risk of stroke, coronary heart disease, heart failure, renal failure, retinopathy and other medical conditions

[2]. Subtler damage to certain organs (hypertension-mediated organ damage – HMOD, also known as target organ damage – TOD) can be detected in hypertensive patients early in the disease, even before overt clinical events occur [3,4].

Pathogenesis of HMOD is complex. According to British scientists, many different pathophysiological processes are involved in the development of HMOD. These include: endothelial activation, platelet activation, increased thrombogenesis, changes in the renin-angiotensin-aldosterone system and collagen turnover [4].

The search for asymptomatic HMOD improves prediction of overall cardiovascular risk in hypertensive patients [5] and helps to identify high-risk individuals in whom a more intense treatment is necessary [3].

Coping with stress

Coping with stress may be defined as constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person [6].

Some scientists believe that each person has their own coping style, which is relatively stable over time and across different stressful situations [7]. According to Endler and Parker, there are three basic coping styles: task-oriented, emotion-oriented and avoidance-oriented. People who prefer task-oriented coping usually try to solve a problem, reconceptualize it or minimize its effects [8]. Subjects who choose emotion-oriented coping alleviate distress by minimizing, reducing or preventing the emotional components of a stressor [9]. Individuals who employ avoidance-oriented coping often seek out other people or engage in a substitutive task in stressful situations [8].

Research reports on the association between coping styles and arterial hypertension (HT) are ambiguous. Some scientists claim that high emotion-oriented coping may be associated with increased risk of hypertension [10]. Others show that task-oriented coping is the most prevalent coping style among hypertensive patients [11,12].

Another group of theorists claims that stress responses are highly situation-dependent and subject to constant change over the lifetime [6]. These scientists focus more on specific coping strategies rather than coping styles. They try to identify different stress responses, which may be related to age, sex, education and other personal and environmental factors. For example, Carver suggests that there are 14 conceptually distinct coping strategies, which may be assessed using the Brief COPE inventory [13] (in Poland this tool is known as Mini-COPE [14]).

There are some studies on the association between coping strategies and hypertension. Mushtaq and Najam found that people who score high on four scales of the Brief COPE inventory (Active coping, Acceptance, Use of instrumental support and Self-blame) are at greater risk of hypertension than other individuals [15]. To our knowledge, however, there have been no published studies on the relationship between HMOD and stress coping styles and strategies.

The aim of this study was to compare perceived stress level and styles and strategies of coping with stress between individuals with and without hypertensive cardiac and vascular damage defined in accordance with ESC/ESH guidelines [16].

METHODS

The study was performed at the University Hospital in Cracow, Poland. It was approved by the local Research Ethics Committee (KBET/151/B/2012). Informed consent covering all procedures performed during the study was obtained from all study participants.

Study group

Study sample consisted of consecutive patients seen in hypertension outpatient clinic. Inclusion criteria were: 1) Age: ≥ 18 years; 2) Ethnicity: Caucasian; 3) Confirmed diagnosis of primary HT. Exclusion criteria comprised: 1) Documented history of traumatic brain injury; 2) Documented history of mental disorders; 3) High scores in MMPI-2 clinical scales; 4) Treatment with psychiatric medications at the time of inclusion; 5) Chronic kidney disease; 6) Systolic heart failure; 7) Neoplasm; 8) Acute or chronic inflammation at the time of inclusion.

Variables and measurements

All study participants underwent clinical assessment, echocardiography, pulse wave velocity measurement and psychological testing.

Clinical assessment

A detailed social, medical and lifestyle history was taken from each patient. Study participants were asked about their health behaviors (including tobacco, drug and alcohol use), medication use, current and past chronic diseases and family history of cardiovascular disease. Each interview was supplemented with analysis of medical records submitted by the patient. Basic demographic data were collected using a specially designed survey. Subjects' weight and height were measured using calibrated devices.

24-hour ambulatory blood pressure monitoring was performed in each patient using validated Spacelabs 90207 device (Spacelabs Healthcare, Snoqualmie, WA, USA). The ABPM readings took place on weekdays, and patients were advised to work and behave as usual.

Blood samples were collected on the day of clinical assessment. All biochemical analyzes were performed by the same laboratory.

Echocardiography

Echocardiographic measurements were performed (in 89 out of 93 patients) by an experienced physician using a Toshiba Xario XG device (Toshiba, Tokyo, Japan), equipped with a 2.5–3.5 MHz array transducer probe. Left ventricular mass index (LVMI) values were calculated according to the guidelines issued by the American Society of Echocardiography [17].

The following LVMI values were classified as increased [16]:

LVMI > 95 g/m^2 in women

LVMI > 115 g/m^2 in men

Patients with high LVMI were diagnosed with left ventricular hypertrophy (LVH).

Pulse wave velocity measurement

Subjects' pulse wave velocity (PWV) was measured using COMPLIOR device (Colson, Garges les Genosse, France). It was calculated by dividing 80% of the direct carotid-femoral distance by pulse wave transit time [18]. Statistical analysis of the collected data was based on the mean of 10 consecutive PWV measurements, performed in a quiet room with a stable room temperature after 10 minutes of rest in a supine position [19].

Independently of patients' sex, PWV values > 10 m/s were classified as increased [16]. PWV was used as a marker of arterial stiffness.

Psychological testing

Study participants were diagnosed using three psychometric tools: 1) the **PSS-10** by Cohen, Kamarck and Mermelstein [14]; 2) the **CISS** by Endler and Parker [20]; 3) the **Brief COPE** by Carver [14]. All instruments were translated into Polish and standardized by the Polish Psychological Association. Psychological testing was performed by a licensed psychologist, trained at the Department of Psychotherapy of the Jagiellonian University Medical College.

Subjective stress-related feelings were assessed using the PSS-10 scale. This tool consists of 10 items, which form one scale: Perceived Stress Level. Each item is rated on a 5-point scale from 0 (never) to 4 (very often). Raw scores range from 0 to 40 points. Testing results may be compared to standardized scores, which are identical for males and females of different ages. The psychometric qualities of the Polish version of the PSS-10 are good, with Cronbach's α of 0.86 and two-week test-retest reliability of 0.90 [14].

The Coping Inventory for Stressful Situations (CISS) was used to assess patients' stress-coping styles. This 48-item tool includes 3 main scales (Task-oriented coping, Emotion-oriented coping, Avoidance-oriented coping) and 2 subscales (Distraction and Social diversion). The main scales are composed of 16 items. Distraction subscale, which is a part of Avoidance-oriented coping scale, consists of 8 items. Social diversion subscale (a part of Avoidance-oriented coping scale) is made of 5 items. Each item is rated on a 5-point scale from 1 (never) to 5 (very often). Testing results may be compared to standardized scores, which are similar for both sexes, but different for various age groups. Psychometric properties of the Polish version of the CISS are satisfactory, with Cronbach's α ranging from 0.78 to 0.90 for the three main scales of the inventory [20].

The Brief COPE was the third psychometric method used in the study. This tool, designed to measure stress coping strategies, is composed of 28 items, forming 14 different scales. Each item is rated on a 4-point scale from 0 (I haven't been doing this at all) to 3 (I've been doing this a lot). Raw scores range from 0 to 3 points for each scale. Psychometric qualities of the Brief COPE are acceptable, with six-week test-retest reliability reaching 0.94 for Religion and 0.82 for Substance use scales [14].

Statistical analysis

Statistical analysis of the collected data was performed using STATISTICA 12.0 PL software (StatSoft, Tulsa, OK, USA), licensed to the Jagiellonian University. The significance level (alpha) was set as two-sided p-value of 0.05. Statistical distribution of each variable was assessed using the Shapiro-Wilk test. Mean values of normally distributed variables were compared using t-Student tests. Mann-Whitney U tests were applied to detect significant differences between median values of non-normal variables. Proportions were compared using chi-squared tests. Spearman's rank correlation coefficients were calculated to measure statistical relationships between the assessed variables. Logistic regression models were used to adjust obtained results for age.

RESULTS

The study population consisted of 93 subjects (46 females) diagnosed with essential hypertension. Basic characteristics of the study group are shown in Table 1.

Table 1. Baseline characteristics of the study group

	N=93
Age, years, median (IQR)	49 (41-57)
Women, n (%)	46 (49.46%)
BMI, kg/m2, median (IQR)	28.09 (25.01-31.25)
Current smoking, n (%)	47 (50.54%)
Blood pressure	
ABPM SBP, mmHg, mean (SD)	127.86 (12.70)
ABPM DBP, mmHg, mean (SD)	79.25 (9.20)
Nocturnal SBP dipping, mmHg, median (IQR)	15.70 (10.20-18.90)
Nocturnal DBP dipping, mmHg, mean (SD)	19.01 (7.25)
Comorbidities	
Stroke, n (%)	0 (0%)
Myocardial infarction, n (%)	0 (0%)
Valvular heart disease, n (%)	0 (0%)
Diabetes mellitus, n (%)	9 (9.68%)
Dyslipidemia, n (%)	28 (30.11%)
Laboratory measures	
CRP, nmol/L, median (IQR)	11.90 (6.57-28.76)
Markers of target organ damage	
PWV, m/s, median (IQR)	12.07 (10.68-14.45)
LVMI, g/m2, median (IQR)	95.88 (77.66-110.82)*

*n = 89

ABPM – ambulatory blood pressure monitoring; BMI – body mass index; DBP – diastolic blood pressure; HDL – high density lipoproteins; IQR – interquartile range; LDL – low density lipoproteins; LVMI – left ventricular mass index; PWV – pulse wave velocity; SBP – systolic blood pressure; SD – standard deviation

Enrolled patients were treated with the following antihypertensive drugs: diuretics (>46% of the study population), calcium channel blockers (almost 40%), angiotensin-converting-enzyme inhibitors (almost 38%), beta-blockers (about 33%), angiotensin II antagonists (>18%) and alpha-blockers (>8%). Other administered medications included: statins (31.18%), low-dose acetylsalicylic acid (11.83%) and oral antidiabetic drugs (9.68%).

Correlation analysis

Correlation analysis revealed significant associations between the measured variables. PWV was negatively correlated with the following Brief COPE scales: Self-distraction ($r_s = -0.27$; p=0.013) and Venting ($r_s = -0.23$; p=0.036). LVMI values were linked to the Brief COPE Use of emotional support scale ($r_s = -0.32$; p=0.003).

PWV was associated with patients' age ($r_s = 0.49$; p<0.001). Correlation between LVMI and age was not significant. PWV and LVMI were not correlated.

Comparison of patients with normal and increased values of PWV

There were no significant differences between people with normal and increased PWV values in the distribution of different variables related to blood pressure, anthropometric measures, laboratory measures or the use of antihypertensive medications (Table 2). Median age of patients with high PWV was significantly higher than median age of people with normal PWV (Table 2). Individuals with arterial stiffness (increased PWV) were significantly more often treated with angiotensin-converting-enzyme inhibitors (ACEI) than subjects with normal PWV (40% vs. 11.11%; p=0.021).

Table 2. Baseline characteristics of the study group according to normal/high PWV values and normal/high LVMI values

	Pulse wave velocity (PWV)			Left ventricular mass index (LVMI)		
	Normal PWV (n=18)	Increased PWV (n=75)	p	Normal LVMI (n=58)	Increased LVMI (n=31)	p
Age, years, median (IQR)	45 (34-50)	50 (41-59)	0.023	48.5 (41-57)	49 (41-57)	0.966
Women, n (%)	9 (50.00%)	37 (49.30%)	0.959	32 (55.17%)	13 (41.94%)	0.234
Current smoking, n (%)	8 (44.44%)	39 (52.00%)	0.591	30 (51.72%)	15 (48.39%)	0.744
BMI, kg/m2, median (IQR)	26.67 (24.15-31.25)	28.65 (25.01-31.49)	0.789	27.86 (24.68-31.20)	29.35 (26.04-32.47)	0.089
Blood pressure						
ABPM SBP, mmHg, mean (SD)	127.28 (14.85)	128.00 (12.23)	0.830	126.05 (13.16)	130.90 (11.86)	0.090
ABPM DBP, mmHg, mean (SD)	82.00 (11.54)	78.60 (8.50)	0.160	78.48 (8.36)	80.13 (10.98)	0.431
Nocturnal SBP dipping, mmHg, median (IQR)	16.65 (11.80-17.70)	14.80 (10.00-18.90)	0.616	15.90 (10.20-18.80)	14.10 (6.90-18.90)	0.411
Nocturnal DBP dipping, mmHg, mean (SD)	19.56 (6.48)	18.87 (7.46)	0.723	19.97 (7.22)	16.83 (7.11)	0.052
Comorbidities						
Diabetes mellitus, n (%)	2 (11.11%)	7 (9.33%)	0.819	7 (12.07%)	2 (6.45%)	0.402

Dyslipidemia, n (%)	4 (22.22%)	24 (32.00%)	0.417	17 (29.31%)	10 (32.26%)	0.773
Laboratory measures						
CRP, nmol/L, median (IQR)	11.52 (6.57-40.29)	11.90 (6.57-27.62)	0.720	11.90 (6.67-28.95)	11.81 (6.10-28.76)	0.858

Data are median values compared using Mann-Whitney U test/mean values compared using t-Student test or proportions compared using Chi-squared test.

ABPM – ambulatory blood pressure monitoring; BMI – body mass index; DBP – diastolic blood pressure; HDL – high-density lipoproteins; IQR – interquartile range; LDL – low-density lipoproteins; LVMI – left ventricular mass index; NS – not significant; PWV – pulse wave velocity; SBP – systolic blood pressure; SD – standard deviation

Compared to persons with increased PWV, patients with normal PWV scored significantly higher in two Brief COPE scales (Self-distraction and Venting) and in one CISS scale (Avoidance-oriented coping). In case of other psychological variables, no significant differences between people with normal and high PWV values were found (Table 3).

Table 3. Psychological testing results in the study group

	Pulse wave velocity (PWV)			Left ventricular mass index (LVMI)		
	Normal PWV (n=18)	Increased PWV (n=75)	p	Normal LVMI (n=58)	Increased LVMI (n=31)	p
PSS-10						
Perceived Stress Scale, median (IQR)	22.5 (17.0-25.0)	18.0 (13.0-23.0)	0.092	18.5 (13.0-24.0)	20.0 (14.0-23.0)	0.976
CISS						
Task-oriented Coping, median (IQR)	57.5 (51.0-61.0)	59.0 (52.0-63.0)	0.569	59.0 (53.0-62.0)	59.0 (52.0-62.0)	0.832
Emotion-oriented Coping, median (IQR)	53.5 (40.0-57.0)	43.0 (37.0-51.0)	0.060	43.0 (37.0-55.0)	46.0 (36.0-51.0)	0.700
Avoidance-oriented Coping, median (IQR)	41.5 (40.0-46.0)	39.0 (33.0-43.0)	0.042	41 (36.0-45.0)	37.0 (33.0-43.0)	0.158
Distraction, median (IQR)	18.0 (14.0-16.0)	16.0 (13.0-19.0)	0.208	18.0 (14.0-21.0)	14.0 (12.0-18.0)	0.124
Social Diversion, median (IQR)	16.0 (15.0-18.0)	14.0 (12.0-17.0)	0.086	15.0 (13.0-18.0)	15.0 (13.0-16.0)	0.436
Brief COPE						
Self-distraction, median (IQR)	2.0 (1.0-2.0)	1.5 (0.5-1.5)	0.013	1.5 (1.0-2.0)	1.25 (0.5-2.0)	0.696
Active coping, median (IQR)	2.0 (2.0-2.5)	2.0 (2.0-3.0)	0.740	2.0 (2.0-3.0)	2.0 (1.75-2.5)	0.114
Denial, median (IQR)	0.0 (0.0-1.5)	0.5 (0.0-1.0)	0.430	1.0 (0.0-1.5)	0.5 (0.0-1.0)	0.123
Substance use, median (IQR)	0.5 (0.0-1.0)	0.0 (0.0-1.0)	0.530	0.0 (0.0-1.0)	0.0 (0.0-1.0)	0.719
Use of emotional support, median (IQR)	2.0 (1.5-2.0)	2.0 (1.0-2.0)	0.673	2.0 (1.5-2.0)	1.5 (1.0-2.0)	0.041
Use of instrumental support, median (IQR)	2.0 (1.5-2.0)	2.0 (1.5-2.0)	0.854	2.0 (1.5-2.0)	1.75 (1.25-2.0)	0.239
Behavioral disengagement, median (IQR)	1.0 (0.5-1.0)	0.5 (0.0-1.0)	0.180	0.5 (0.0-1.0)	1.0 (0.25-1.5)	0.308
Venting, median (IQR)	1.5 (1.0-2.0)	1.0 (0.5-1.5)	0.037	1.0 (0.5-1.5)	1.0 (0.75-1.5)	0.751

Positive reframing, median (IQR)	1.5 (1.5-2.0)	2.0 (1.0-2.0)	0.500	2.0 (1.0-2.0)	2.0 (1.0-2.0)	0.624
Planning, median (IQR)	2.0 (2.0-2.0)	2.0 (2.0-3.0)	0.242	2.0 (2.0-2.5)	2.0 (2.0-2.25)	0.618
Humor, median (IQR)	0.5 (0.5-1.5)	0.5 (0.0-1.0)	0.178	0.5 (0.0-1.0)	0.5 (0.0-1.0)	0.729
Acceptance, median (IQR)	1.5 (1.5-2.0)	2.0 (1.5-2.0)	0.127	2.0 (1.5-2.0)	2.0 (1.5-2.0)	0.819
Religion, median (IQR)	1.0 (0.0-2.0)	1.0 (0.5-2.0)	0.565	1.5 (0.5-2.5)	1.0 (0.25-2.0)	0.212
Self-blame, median (IQR)	1.5 (1.0-2.0)	1.0 (1.0-2.0)	0.150	1.5 (1.0-2.0)	1.25 (1.0-2.0)	0.521

Data are median values compared using Mann-Whitney U test.

IQR – interquartile range; LVMI – left ventricular mass index; NS – not significant; PWV – pulse wave velocity

Comparison of patients with normal and increased values of LVMI

The comparison of subjects with normal LVMI and individuals with LVH did not reveal any significant differences in the distribution of many variables presented in Table 2. People with LVH had significantly higher median levels of triglycerides and significantly lower median levels of HDL than patients with normal LVMI (Table 2). Subjects with LVH were significantly more often treated with ACEI (48.39% vs 25.86%; p=0.032) and diuretics (61.29% vs. 29.31%; p=0.003) than individuals without LVH.

Patients with normal LVMI scored significantly higher than people with LVH in the Brief COPE Use of emotional support scale (Table 3). In case of other psychological variables, no significant differences between people with normal LVMI and patients with LVH were found.

Logistic regression analysis

There was a significant difference in age between our subjects with normal and elevated pulse wave velocity. Consequently, we decided to check whether previously reported differences in psychological tests between these two groups of patients would remain significant after adjustment for age.

Statistical analysis showed that only one coping strategy (self-distraction) remained significantly associated with the risk of arterial stiffness after adjustment for age (Table 4).

Table 4. Odds ratios estimated by logistic regression analysis for the likelihood of arterial stiffness

	Likelihood of elevated PWV after adjustment for age		
	ORa	95% CI	p
PSS-10			
Perceived Stress Scale	0.96	0.89 – 1.04	0.298
CISS			
Task-oriented Coping	1.01	0.96 – 1.08	0.638
Emotion-oriented Coping	0.97	0.92 – 1.02	0.194
Avoidance-oriented Coping	0.94	0.87 – 1.00	0.065
Distraction	0.95	0.86 – 1.04	0.259
Social Diversion	0.88	0.76 – 1.02	0.086
Brief COPE			
Self-distraction	0.36	0.16 – 0.82	0.016
Active coping	0.96	0.41 – 2.29	0.934
Denial	1.30	0.56 – 3.00	0.540

Substance use	0.79	0.34 – 1.87	0.595
Use of emotional support	1.27	0.58 – 2.82	0.553
Use of instrumental support	1.02	0.47 – 2.21	0.963
Behavioral disengagement	0.64	0.28 – 1.51	0.312
Venting	0.42	0.16 – 1.13	0.086
Positive reframing	1.04	0.46 – 2.32	0.930
Planning	1.50	0.68 – 3.29	0.316
Humor	0.52	0.18 – 1.48	0.218
Acceptance	1.74	0.75 – 4.02	0.197
Religion	0.99	0.56 – 1.73	0.964
Self-blame	0.59	0.27 – 1.28	0.181

CI – confidence interval; NS – not significant; ORa – adjusted odds ratio; PWV – pulse wave velocity

DISCUSSION

This study has several findings: 1) An increase in PWV values was associated with a decrease in scores in two Brief COPE scales: Self-distraction and Venting; 2) PWV in the study population increased with age; 3) An increase in LVMI was linked with a decrease in scores in the Brief COPE Use of emotional support scale; 4) Subjects with normal PWV scored significantly higher than people with increased PWV in three scales: Avoidance-oriented coping (CISS), Venting (Brief COPE) and Self-distraction (Brief COPE); 5) Hypertensive patients with normal LVMI scored significantly higher than individuals with LVH in the Brief COPE Use of emotional support scale. 6) Participants with increased PWV were significantly more often treated with ACEI than patients with normal PWV values; 7) Subjects with LVH were significantly more often treated with ACEI and diuretics than individuals with normal LVMI values; 8) After adjustment for age only one coping strategy remained significantly related to arterial stiffness.

The first result may be at least partially mediated by patients' age. According to some scientists, older people tend to use fewer escapist, hostile and avoidant stress coping strategies than the youth [21, 22, 23]. In our study, PWV increased with subjects' age. At the same time, PWV was negatively correlated with scores in two Brief COPE scales designed to measure avoidant (Self-distraction) and potentially hostile (Venting) stress coping strategies.

The second finding remains in line with other reports, which show that PWV tends to increase with patients' age and blood pressure [24, 25].

The third result is not surprising given the ample evidence that social and emotional support can be protective for individuals' health through different mechanisms [26]. In hypertensive patients, emotional support may reduce the feeling of loneliness, which has proven to be related to physiological dysregulation [27]. It may also help to change negative health behaviors (e.g. smoking [28]), which play an important role in the management of HT.

Subjects with normal PWV scored significantly higher than people with increased PWV in three scales: Avoidance-oriented coping (CISS), Venting (Brief COPE) and Self-distraction (Brief COPE).

The observed differences in avoidance-oriented coping are surprising, because this style has been widely associated with various negative health outcomes [29, 30, 31]. However, more thorough investigations in this field showed that some coping strategies aimed at avoiding the source of stress (e.g. exercising to escape from particular thoughts or feelings) may have a positive impact on individuals' health when they are used at the right time and in the right environmental context [32, 33]. The CISS can detect different forms of avoidance-oriented coping, but it does not provide information about: the source of stress, time aspects of the coping process or the environmental context of the stressful situation. Being aware of this, we cannot provide

a simple explanation for the observed differences in the level of avoidance-oriented coping between people with normal and elevated PWV.

The observed differences in the level of venting are in line with the popular belief that emotional ventilation has positive effects on mental and somatic health [34]. Unfortunately, most of available studies do not support this idea. For example, a study by Bushman et al. shows that venting anger usually increases aggressive responses [35] and may lead to dangerous behaviors. Some scientists, however, believe that the relationship between venting and health may be moderated by two factors: context and culture. According to Aldwin and Yancura [36], emotional expression in the workplace usually increases the level of stress (and thus may be harmful to health), but venting to family and friends may decrease the level of stress through the mechanism of social support. Other investigators, like Butler et al. [37], claim that physiological responses to specific forms of emotional venting may depend upon cultural context. They are convinced that emotional expression increases blood pressure in Asian Americans, but may lower it in European Americans.

The observed differences in the level of self-distraction could be associated with the type of activities that people take up when they are under stress (for details, please see the interpretation of the differences in avoidance-oriented coping).

Subjects with normal LVMI scored significantly higher than patients with LVH in one scale: Use of emotional support (Brief COPE). This finding stays in line with our expectations and with the third result of this study. For details on potential mechanisms behind this finding, please see discussion of the third result.

Findings number six and seven are not surprising, since more intensive treatment of hypertension is recommended for patients with HMOD [16, 38, 39].

Our last finding suggests that somatic variables (i.e. age) may have stronger impact on the development of HMOD than psychological factors.

The study has some limitations: 1) It was performed in a single outpatient clinic, so the results should not be generalized to the whole population. 2) Due to possible cultural differences in coping styles and strategies [40], similar results may not be observed among people from a different cultural background. 3) Due to the cross-sectional study design, it was impossible to assess the direction of causality between the measured variables.

Unfortunately, establishing cause-and-effect relationships between the measured variables seems to be crucial to fully understand the obtained results. We are convinced that future research in this field should consider longitudinal data.

Conflict of interest
The authors report no conflict of interest.

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