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Sense of coherence and hypertensive target organ damage

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Summary

Aim. This study was designed to compare the level of sense of coherence in hypertensive patients with arterial stiffness or left ventricular hypertrophy and in hypertensive individuals

Methods. The study group consisted of 93 participants. All of them were asked to undergo the following procedures: clinical assessment, echocardiography (to diagnose hypertensive cardiac damage), pulse wave velocity measurement (to assess vascular damage) and psychological testing (to measure their level of comprehensibility, manageability, meaningfulness, and sense of coherence).

Results. Patients with hypertensive vascular damage (high pulse wave velocity) had higher levels of comprehensibility and sense of coherence than other hypertensive subjects. At the same time, there were no significant differences in the level of sense of coherence (and all of its dimensions) between individuals with and people without hypertensive left ventricular hypertrophy.

Conclusions. The findings of this study suggest, that the sense of coherence may not be strongly associated with good somatic health. They may also contribute to the discussion about diagnostic usefulness of the SOC-29 method as a single tool. We believe that the level of sense of coherence should be taken into consideration in further studies on the development of hypertensive TOD.

Key words: hypertension, sense of coherence, hypertensive target organ damage

Introduction

Chronic exposure to high blood pressure may lead to the development of target organ damage (TOD) [1]. To date, many different factors associated with the development of TOD have been identified (e.g., subjects' age, blood pressure, body fat or the presence of concomitant diseases, such as diabetes mellitus [2, 3]). To our knowledge, there were no attempts to find psychological variables that differentiate hypertensive patients who develop TOD from those who do not. This study compares the level of sense of coherence in hypertensive patients with arterial stiffness or left ventricular hypertrophy and in hypertensive individuals without such health complications.

Sense of coherence

The concept of sense of coherence (SOC) was developed by Aaron Antonovsky to explain why some people become ill under stress, while others, put in the same situation, stay emotionally healthy. According to Antonovsky's theory, people who are able to survive and adapt in the face of even the most punishing life-stress experiences have high level of sense of coherence. It means that they have pervasive and, at the same time, dynamic feeling of confidence that: (1) the stimuli deriving from their internal and external environments in the course of living are structured, predictable and explicable (comprehensibility); (2) they have enough resources available to meet the demands posed by these stimuli (manageability); and (3) these demands are challenges, worthy of investment and engagement (meaningfulness) [4].

The level of sense of coherence may be related to individuals' gender. Results of the studies on gender differences in the SOC level are ambiguous. Some researchers, like Larsson and Kallenberg [5], believe that men score significantly higher than women on the SOC-29 scale. Others, like Nilsson et al. [6] or Lundberg et al. [7], show that in general population there are no gender differences in the level of SOC.

Many scientists agree that socioeconomic status of the person may be associated with their level of sense of coherence [7–9]. For example, Antonovsky [4] himself suggests that high social class can promote strong SOC. Other researchers go even further and claim that a high sense of coherence may be appropriate pattern of attitudes for professionals, executives and for the upper middle class, who comprise only a small proportion of the entire population [10].

Many different studies have showed that the level of sense of coherence may be related to individuals' health status. Some of these studies explored associations between the sense of coherence and different mental disorders (e.g., depression [11], bipolar disorder [12] or schizophrenia [13]). Other investigations assessed the level of comprehensibility, manageability and meaningfulness in patients with somatic diseases, such as: cancer [14], diabetes mellitus [15], rheumatoid arthritis [16], fibromyalgia [17], and various circulatory system conditions [18].

Potential associations between the level of SOC and cardiovascular health have been studied by Lundberg and Peck [7]. These scientists showed that people with a strong SOC have lower diastolic blood pressure, serum triglycerides and heart rate at rest than other individuals. What is interesting – results obtained by Finnish investigators in *the Helsinki Heart Study* may be treated as complimentary to these findings. According to Poppius et al. [9] stronger SOC may be associated with lower incidence of coronary heart disease.

Arterial hypertension

Arterial hypertension (HT) is a long-term medical condition in which the blood pressure in the arteries is abnormally elevated (the disease may be diagnosed when systolic blood pressure reaches 140 mmHg or more and/or when a diastolic blood pressure reaches 90 mmHg or more [19]). According to some researchers, high blood pressure affects 30–45% of the general population in Europe, with a steep increase with ageing [19]. In Poland, arterial hypertension may be diagnosed in about 9.5 million people, that is 32% of the country's adult population [20]. In general, hypertension is more common in men than in women. Its prevalence is also higher in people with low socioeconomic status [21].

Arterial hypertension may be classified as either primary or secondary. Primary HT, also known as essential HT, idiopathic HT, has no identifiable cause. It affects about 90–95% of hypertensive patients and tends to develop gradually over many years as a consequence of an interaction between various genetic and environmental factors. Secondary hypertension has an underlying, potentially correctable cause [22]. It may be induced by: specific drugs (e.g., corticosteroids), kidney diseases, endocrine disorders (e.g., hyperthyroidism), and obstructive sleep apnea. This type of disease may be diagnosed in about 5–10% of people suffering from HT [23].

HT is often diagnosed on the basis of conventional office blood pressure measurements [19]. Unfortunately, some patients exhibit abnormally elevated blood pressure only in a clinical setting, though they do not exhibit it in other settings [24]. This phenomenon is called 'white-coat hypertension'. According to Fagard and Cornelissen [25], the overall prevalence of white-coat hypertension among hypertensive individuals ranges from 25% to 46%. Interestingly, there is a group of patients in whom the opposite phenomenon is observed. In the case of these patients, blood pressure may be normal in the office and abnormally high out of medical environment. This phenomenon is known as 'masked hypertension' [26]. According to Belgian scientists, the prevalence of masked hypertension averages about 13% in population-based studies [25]. Both white-coat hypertension and masked hypertension may be confirmed or excluded by ambulatory blood pressure monitoring (ABPM) and/or home blood pressure monitoring (HBPM) [19].

Chronic exposure to high blood pressure may damage the walls of patient's arteries [1]. Damaged arteries cannot deliver adequate blood flow to major organs fed by the circulatory system and the patient may develop stroke, coronary heart disease, heart failure, chronic renal failure, or vascular dementia [27]. Fortunately, nowadays we are able to detect subtle changes in certain organs of patient's body even before overt clinical events occur [28]. These subtle changes are grouped under the term 'target organ damage' [1, p. 1581].

According to the guidelines created by the European Society of Cardiology and the European Society of Hypertension in 2013, subclinical organ damage may be manifested as: left ventricular hypertrophy, increased pulse wave velocity, carotid wall thickening or the presence of atherosclerotic plaque, microalbuminuria, decreased eGFR, decreased ankle-brachial index and increased pulse pressure in the elderly [19].

Material and methods

This study was performed at the University Hospital in Krakow, Poland. It has been approved by the Bioethics Committee of the Jagiellonian University (KBET/151/B/2012). Written informed consent covering all procedures that were performed during the study was obtained from all study participants. This paper is a partial report of the results that were revealed during the study.

Study group

The study population consisted of consecutive patients seen in the Hypertension Outpatient Clinic. All subjects enrolled into the study met the following inclusion criteria: (1) age: 18 years or older; (2) ethnicity: Caucasian; (3) confirmed diagnosis of essential hypertension. Patients fulfilling any of the following criteria were excluded from the study group: (1) documented history of traumatic brain injury; (2) documented history of mental disorders (including: dementia, schizophrenia, mood disorders, substance dependence); (3) high scores in clinical scales of the MMPI-2; (4) current treatment with psychiatric medications; (5) systolic heart failure; (6) chronic kidney disease; (7) acute or chronic inflammation; (8) neoplasm.

Variables and measurements

Each individual enrolled into the study has undergone clinical assessment. All patients have also been offered to participate in the following procedures: echocardiography, pulse wave velocity measurement and psychological testing.

Clinical assessment

All patients underwent a face-to-face interview in order to obtain a detailed socioeconomic, medical and lifestyle history. Each interview contained questions about: personal history of hypertension; tobacco, drug and alcohol use; current and past chronic diseases; the use of prescription and off-label medications and family history of hypertension and cardiovascular disease. Each structured interview was supplemented with the analysis of medical records submitted by the patient. Subjects' basic demographic data were gathered with the use of specially designed questionnaire (which was fulfilled by investigators). All members of the study group were also weighed and measured using calibrated devices.

The assessment of blood pressure in the study group was performed with the use of two different and independent methods: office blood pressure measurement and ambulatory blood pressure monitoring. Office blood pressure was taken twice (in 1–2 minute intervals), after 10 minutes of rest in a supine position, using validated OMRON M6 COMFORT HEM-7000-E device (Omron Global, Kyoto, Japan) [19]. 24-hour ambulatory blood pressure monitoring (ABPM) was performed with the use of Spacelabs 90207 device (Spacelabs Healthcare, Snoqualmie, WA, USA). The ABPM readings took place on weekdays. Patients undergoing the measurement procedure were asked to work and behave as usual at the day of blood pressure assessment.

Blood samples were taken from all study subjects on the day of clinical assessment. Each sample was analyzed by the same certified medical laboratory.

Echocardiography

Echocardiography was performed in 89 patients (95.7% of the study group). Each procedure was performed by an experienced physician using a Toshiba Xario XG device (Toshiba, Tokyo, Japan) equipped with a 2.5–3.5 MHz array transducer probe. Calculations of left ventricular parameters (especially: left ventricular mass index – LVMI) followed the rules that were issued by the American Society of Echocardiography [29].

Women with LVMI values > 95 g/m^2 and men with LVMI values > 115 g/m^2 were included in the group with left ventricular hypertrophy.

Pulse wave velocity measurement

Carotid-femoral pulse wave velocity was assessed in all study participants using a COMPLIOR device (Colson, Gerges les Genosse, France). It was calculated by dividing 80% of the direct carotid-femoral distance by pulse wave transit time [30]. Each measurement was performed by qualified physician, who followed a standardized protocol. In the case of all patients, 10 consecutive PWV measurements were performed after 10 minutes of rest in a supine position in a quiet room with a stable temperature [31]. Results of these 10 measurements were averaged and then used in statistical analysis.

PWV values > 10 m/s were classified as increased independently of subjects' gender. PWV was used as a marker of arterial stiffness.

Psychological testing

The level of sense of coherence in the study population was assessed with the use of self-report instrument called the SOC-29 questionnaire. This tool consists of 29 items, which form 3 scales: 'Comprehensibility' (11 items), 'Manageability' (10 items) and 'Meaningfulness' (8 items). The sum of points obtained by the subjects on these three scales together determines their individuals' sense of coherence. Each item may be rated according to a 7-point scale (from 1 to 7). The total SOC-29 score may reach as low as 29 or as high as 203 points. The average score of the questionnaire may range from 100.5 to 164.5 points [18].

The method has been evaluated positively according to its validity and reliability in many independent studies [e.g., 32, 33 or 34]. According to findings of Eriksson and Lindström [35] (based on analysis of 124 different studies), internal consistency of the SOC-29 questionnaire, measured by Cronbach's alpha, ranged from 0.70 to 0.95 [35]. In the case of Polish version of the method, Cronbach's alpha was as high as 0.78 [36]. Test-retest reliability measured by scientists from different countries reached 0.92 over a one-week period [34] and 0.78 over a one-year period [35].

Statistical analysis

Data gathered during the study were analyzed using StatSoft's STATISTICA 12.0 PL software (StatSoft, Tulsa, OK, USA) licensed to the Jagiellonian University. Shapiro-Wilk tests were applied to assess the normality of distributions of all analyzed variables. Mean values of normally distributed variables were compared using Student's *t*-tests. Mann-Whitney *U* tests were applied to detect significant differences between variables that were not normally distributed. Linear relationships between variables were assessed using Spearman's rank correlation coefficients. Proportions were compared with the use of Chi-squared tests. In each case the significance level (α) was set at 0.05.

Results

The study population was composed of 46 women and 47 men with primary hypertension. Baseline characteristics of the study group are shown in Table 1.

Table 1. **Baseline characteristics of the study group**

Variables	Minimum	Median (IQR)	Maximum
Age, years	21	49 (41–57)	70
BMI (kg/m^2)	18.29	28.09 (25.01–31.25)	42.42
WHR	0.69	0.93 (0.83–0.99)	1.17

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Office SBP (mmHg)	105	138 (126–150)	188
Office DBP (mmHg)	60	90 (81–100)	120
ABPM SBP (mmHg)	101	126 (119–136)	157
ABPM DBP (mmHg)	58	79 (73–85)	110
Nocturnal SBP dipping (mmHg)	1.9	14.9 (10.2–18.8)	27.5
Nocturnal DBP dipping (mmHg)	0.1	18.7 (14.3–18.7)	35.8
	Laboratory measures		
Fasting blood glucose (mmol/L)	3.66	5.12 (4.61–5.81)	16.73
HbA1c (%)	4.7	5.6 (5.4–5.8)	11.5
Total cholesterol, mmol/L	2.7	5.3 (4.6–6.0)	7.3
LDL (mmol/L)	0.9	3.0 (2.4–3.7)	5.6
HDL (mmol/L)	0.80	1.50 (1.23–1.86)	3.48
Triglycerides (mmol/L)	0.53	1.38 (0.99–1.71)	4.96
Creatinine (µmol/L)	45	73 (67–81)	123
	Markers of target organ damage		
PWV (m/s)	7.33	12.07 (10.68–14.45)	28.07
LVMI (g/m^2)	48.02	95.88 (77.66–110.82)	170.76

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; WHR – waist to hip ratio

Antihypertensive drugs were used by the majority of enrolled patients. Members of the study group were treated with the following groups of medications: diuretics (more than 46% of the study population), calcium channel blockers (almost 40%), angiotensin-converting-enzyme inhibitors (more than 37%), beta-blockers (about 33%), angiotensin II antagonists (almost 19%), and alpha-blockers (more than 8%). All subjects enrolled into the study were treated according to the recent ESC/ESH guidelines for the management of arterial hypertension. In the case of each study participant treatment scheme was adequate to patients' clinical state.

About 31% of research participants were treated for dyslipidemia with statins. About 12% used low doses of acetylsalicylic acid every day. Less than 10% of subjects received oral antidiabetic medications. Only one person was treated with oral anticoagulants.

Correlation analysis

The analysis of gathered data did not reveal any significant correlations between pulse wave velocity and the following psychological variables: ‘Comprehensibility’, ‘Manageability’, ‘Meaningfulness’ and ‘Sense of coherence’. No linear associations were also found between left ventricular mass index and results obtained by patients on all scales of the SOC-29 questionnaire (Table 2).

Table 2. **Spearman’s rank correlation coefficients**

Variables	PWV	p	LVMI	p
SOC-29 Comprehensibility	0.06	NS	0.07	NS
SOC-29 Manageability	0.04	NS	0.11	NS
SOC-29 Meaningfulness	0.01	NS	0.02	NS
SOC-29 Sense of Coherence	0.06	NS	0.06	NS

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

Markers of target organ damage in the study group (PWV and LVMI) were not intercorrelated. PWV was age-dependent ($rs = 0.49$; $p < 0.001$).

Patient’s age was positively correlated with the level of sense of coherence ($rs = 0.24$; $p = 0.022$), the level of comprehensibility ($rs = 0.22$; $p = 0.043$) and the level of meaningfulness ($rs = 0.22$; $p = 0.038$). Patient’s level of manageability was not associated with age.

Comparison of patients with normal and increased values of PWV

Patients with increased PWV were significantly older and significantly more often treated with angiotensin-converting-enzyme inhibitors (ACEI) than subjects with normal PWV (Table 3). In the case of other variables, which are showed in Table 3, no differences between these two groups of patients were found.

Table 3. **Baseline characteristics of the study group according to normal/high values of PWV and normal/increased LVMI values**

Variables	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)	NS
Women (%)	50	49.3	NS	55.17	41.94	NS
Tobacco smoking (%)	44.44	52	NS	51.72	48.39	NS

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BMI (kg/m^2) median (IQR)	26.67 (24.15–31.25)	28.65 (25.01–31.49)	NS	27.86 (24.68–31.20)	29.35 (26.04–32.47)	NS
WHR, median (IQR)	0.92 (0.84–0.98)	0.93 (0.83–0.99)	NS	0.91 (0.81–0.99)	0.95 (0.88–0.99)	NS
ABPM SBP (mmHg) mean (SD)	127.28 (14.85)	128.00 (12.23)	NS	126.05 (13.16)	130.90 (11.86)	NS
ABPM DBP (mmHg) mean (SD)	82.00 (11.54)	78.60 (8.50)	NS	78.48 (8.36)	80.13 (10.98)	NS
Nocturnal SBP dipping (mmHg) median (IQR)	16.65 (11.80–17.70)	14.80 (10.00–18.90)	NS	15.90 (10.20–18.80)	14.10 (6.90–18.90)	NS
Nocturnal DBP dipping (mmHg) mean (SD)	19.56 (6.48)	18.87 (7.46)	NS	19.97 (7.22)	16.83 (7.11)	NS
	Laboratory measures					
Fasting blood glucose (mmol/L), median (IQR)	4.83 (4.57–5.23)	5.18 (4.76–5.82)	NS	5.06 (4.57–5.82)	5.14 (4.76–5.81)	NS
HbA1c (%),median (IQR), median (IQR)	5.50 (5.40–5.70)	5.60 (5.40–5.90)	NS	5.55 (5.40–5.80)	5.60 (5.40–5.80)	NS
Total cholesterol (mmol/L), median (IQR)	5.05 (4.60–5.70)	5.30 (4.70–6.00)	NS	5.35 (4.70–6.00)	5.25 (4.70–5.90)	NS
LDL (mmol/L), median (IQR)	2.85 (2.30–3.60)	3.00 (2.40–3.70)	NS	3.10 (2.40–3.80)	2.90 (2.50–3.70)	NS
HDL (mmol/L), median (IQR)	1.40 (1.11–1.70)	1.56 (1.25–1.87)	NS	1.58 (1.26–1.92)	1.34 (1.17–1.68)	0.048
Triglycerides (mmol/L), median (IQR)	1.26 (0.94–1.61)	1.42 (1.00–1.78)	NS	1.21 (0.89–1.68)	1.59 (1.23–2.11)	0.019
Serum creatinine (μmol/L), median (IQR)	75.70 (71.0–83.00)	72.00 (67.00–82.00)	NS	72.50 (67.00–79.00)	73.00 (68.00–84.00)	NS
	Hypotensive medications					

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Diuretics (%)	27.78	44.00	NS	29.31	61.29	0.003
CCB (%)	22.22	40.00	NS	32.76	41.94	NS
ACEI (%)	11.11	40.00	0.021	25.86	48.39	0.032
β-blockers (%)	11.11	33.33	NS	24.14	35.48	NS
ARB (%)	16.67	17.33	NS	12.07	25.81	NS
α-blockers (%)	11.11	6.67	NS	3.45	12.9	NS
	Other medications					
Statins (%)	22.22	32.00	NS	29.31	32.26	NS
ASA (%)	0	14.67	NS	12.07	9.68	NS
Oral antidiabetics (%)	11.11	9.33	NS	12.07	6.42	NS

Data are median values compared using Mann-Whitney U test, mean vales compared using Student's t-test or proportions (%) compared using Chi-squared test

ABPM – ambulatory blood pressure monitoring; ACEI – angiotensin-converting-enzyme inhibitors; ARB – angiotensin II receptor blockers; ASA – acetylsalicylic acid; BMI – body mass index; CCB – calcium channel blockers; 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; WHR – waist to hip ratio

Both SBP and DBP were measured using ABPM.

Patients with normal PWV had significantly lower average level of comprehensibility and sense of coherence than people with high PWV. At the same time, no significant differences between these two groups of patients were found in the case of other psychological variables that were measured with the use of the SOC-29 method (Table 4).

Table 4. **Psychological variables in the study group according to normal/high values of PWV and normal/increased LVMI values**

Variables	Normal PWV (n = 18)	Increased PWV (n = 75)	p	Normal LVMI (n = 58)	Increased LVMI (n = 31)	p
SOC-29 Comprehensibility, median (IQR)	37.0 (33.5–48.0)	47.0 (39.0–54.0)	0.048	45.0 (36.0–51.0)	47.0 (37.0–55.0)	NS
SOC-29 Manageability, median (IQR)	45.0 (37.5–48.5)	50.0 (43.0–56.0)	NS	49.0 (40.0–55.0)	49.0 (45.0–55.0)	NS

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SOC-29 Meaningfulness, median (IQR)	39.0 (31.0–46.5)	42.0 (37.0–46.0)	NS	42.0 (36.0–46.0)	43.0 (39.0–45.0)	NS
SOC-29 Sense of Coherence, median (IQR)	118.0 (111.5–144.0)	137.0 (121.0–154.5)	0.035	132.0 (118.0–155.0)	134.0 (120.0–154.0)	NS

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

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

Comparison of patients with normal and increased values of LVMI

Statistical analysis of gathered data did not reveal any significant differences between subjects with normal LVMI and individuals with abnormally increased LVMI in the distribution of 21 different variables that are enumerated in Table 3. Patients with normal LVMI had significantly higher average levels of HDL and significantly lower average levels of triglycerides than people with increased LVMI (Table 3).The proportion of participants treated with ACEI and the proportion of subjects treated with diuretics were significantly higher in patients with increased LVMI (in comparison to patients with normal values of LVMI).

Average scores obtained by patients in four scales of the SOC-29 questionnaire were not significantly different in subjects with normal and in people with high values of left ventricular mass index (Table 4).

Discussion

During the project two databases (MEDLINE and Scopus) have been screened in order to find studies focused on differences in sense of coherence between subjects with target organ damage and individuals without TOD. The following key words have been used: blood pressure, comprehensibility, end organ damage, hypertension, hypertensive organ damage, left ventricular hypertrophy, left ventricular mass index, LVH, LVMI, manageability, markers of TOD, meaningfulness, organ damage, psychopathology, pulse wave velocity, PWV, sense of coherence, SOC-29, target organ damage, TOD. No articles on the relationship between hypertensive target organ damage and sense of coherence have been found.

To our knowledge, this cross-sectional study is the first attempt to compare the level of sense of coherence in patients with and subjects without hypertensive target organ damage. The study has several findings:

(1) Patients with increased PWV values scored significantly higher than subjects with normal values of PWV in two SOC-29 scales: 'Comprehensibility' and 'Sense of coherence'.

(2) There were no statistically significant differences in the level of sense of coherence (and its components) between individuals with normal values of LVMI and people with left ventricular hypertrophy.

(3) Subjects with increased PWV were significantly more often treated with ACEI than patients with normal PWV values.

(4) Individuals with increased LVMI were significantly more often treated with ACEI and diuretics than participants with normal LVMI values.

(5) PWV in the study population increased with age.

The first finding is surprising because there is a large body of evidence that strong sense of coherence may be beneficial to individuals' health [37]. However, there is at least one study which shows that strong SOC may be linked to chronic medical conditions [38]. This ambiguity is difficult to explain, but some scientist claim that the SOC-29 questionnaire can only serve as a predictor for health that is measured by incorporating psychological aspects, while it is not capable of explaining physical health that is measured only by means of physical terms [37].

Observed differences in the levels of comprehensibility and sense of coherence between patients with normal and increased PWV values may be explained in two ways. First – they may be at least partially attributed to observed age differences between these two groups of patients (many studies show that the level of sense of coherence tends to increase with individuals' age [35, 39]). And second – it is possible that patients with strong sense of coherence perceive themselves as healthier than other individuals. In consequence, they seek for medical help less often than other people and they are diagnosed with hypertension at a late stage of disease, when TOD may be detected. This line of thought is supported by results of many different studies which show the link between perceived good health (which does not always reflect the real health condition of the individual [40]) and a strong SOC [18].

The analysis of gathered data did not reveal any significant differences in the level of sense of coherence between subjects with normal LVMI values and individuals with left ventricular hypertrophy. This finding may be considered interesting, but in our opinion it should be interpreted very carefully because that in statistical methods used in this study the absence of evidence for differences between the analyzed groups is not evidence of their absence [41].

The third and the fourth result stay in line with our expectations. According to various studies, treatment with ACEI may be linked to arterial compliance improvement independently of changes in blood pressure [42, 43]. There is also a large body of evidence that the use of diuretics and ACEI in hypertensive patients may improve left ventricular hypertrophy [44]. That is the reason why ACEI and diuretics are recommended [19] to treat high blood pressure in patients with target organ damage.

The analysis of data that were collected from the study population revealed positive linear relationship between pulse wave velocity and age. This finding is consistent with the results of other studies which show significant increase in pulse wave velocity with individuals' age and blood pressure [2, 45, 46].

This study has limitations associated with its:

(1) Single-center design (obtained results cannot be easily generalized to the population of patients with arterial hypertension).

(2) Cross-sectional design (the study cannot provide information about causality).

(3) Self-report design (there are many potential sources of bias in this type of study, e.g., social desirability bias).

Because of the small sample size we were not able to perform methodologically correct subgroup analysis according to patients' age, sex and treatment scheme.

All outcomes of this study should be treated as preliminary. We believe that further research in this field is necessary to confirm results that were described above. In our opinion, additional studies on the associations between the level of sense of coherence and the presence of hypertensive target organ damage should consider longitudinal data and should be performed in populations large enough to stratify patients by age, sex and treatment scheme.

Conclusions

1. Patients with higher levels of comprehensibility and sense of coherence (measured using the SOC-29 questionnaire) had more advanced hypertensive vascular damage than other subjects with hypertension.
2. There were no differences in the level of sense of coherence (and all of its components) between individuals with and without hypertensive left ventricular hypertrophy.
3. We hypothesize that in the case of hypertensive patients strong sense of coherence may promote vascular stiffness.

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