Relationship between type D personality and metabolic syndrome in general population of the Kemerovo region (results of the ESSE-RF epidemiological study)

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Abstract

Objective. To study prevalence of type D personality and examine the relationship with metabolic syndrome (MS) in general population of the Kemerovo region. **Design and methods.** A randomized sample was selected from general population in Kemerovo region within the multicentre observational trial «Epidemiology of Cardiovascular Diseases in the Regions of Russian Federation — ESSE-RF», including 1 610 subjects (response was more than 80 %). The mean age was 45.8 ± 11.9 years, gender distribution was the following: women — 918 (57 %), men — 692 (43 %). They were divided into two groups: patients with type D personality (n = 231) and patients without type D (n = 1379). Psychological status was assessed by the questionnaire DS-14. MS was defined according to the recommendations of the experts of the Russian Scientific Society of Cardiology (2009). **Results.** MS was detected in 406 (25.2 %) patients. The presence of type D personality was associated with the more than twofold increase in the risk of MS and its components, such as obesity and hypertension. **Conclusions.** Predisposition to the MS may be one of the factors explaining the association between type D personality and poorer cardiovascular prognosis.

Key words: Type D personality, metabolic syndrome, cardiovascular diseases, ESSE-RF

Взаимосвязь типа личности Д и метаболического синдрома по данным исследования ЭССЕ-РФ в Кемеровской области

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Резюме

Целью исследования явилось изучение клинико-анамнестических показателей у лиц с наличием метаболического синдрома (МС) в зависимости от наличия у них типа личности Д. **Материалы и методы.** Исследование проведено в рамках многоцентрового эпидемиологического исследования «Эпидемиология сердечно-сосудистых заболеваний и их факторов риска в Российской Федерации» (ЭССЕ-РФ). Объем выборки — 1610 человек (мужчин и женщин в возрасте 25–64 лет). Тип личности Д оценивался с помощью опросника DS-14. Сформировано 2 группы больных: 1 группа — с наличием типа личности Д (n = 231), и 2 группа — без типа личности Д (n = 1379). МС определялся согласно Рекомендациям экспертов Всероссийского научного общества кардиологов (2009). **Результаты.** При обследовании неорганизованной популяции распространенность типа личности Д составила 14,3 %. Общее количество лиц с диагностированным МС составило 25,2 %. Наличие типа личности Д было ассоциировано с более чем двукратным возрастанием риска выявления МС (47 % случаев против 21 %), а также таких его компонентов, как ожирение и артериальная гипертензия. В наибольшей степени влияли на выявление типа личности Д, по данным логистической регрессии, наличие МС (отношение шансов (ОШ) 3,88; 95 % доверительный интервал (ДИ) 2,53–4,93; р = 0,002), индекс массы тела (ОШ 3,03; 95 % ДИ 1,35–5,78; р=0,003), наличие сахарного диабета (ОШ 2,75; 95 % ДИ 1,07–6,04; р = 0,004), наличие ожирения (ОШ 2,33; 95 % ДИ 0,80–5,34; р = 0,012), показатель окружности талии (ОШ 2,13; 95 % ДИ 0,75–6,02; р = 0,044), уровень глюкозы (ОШ 2,13; 95 % ДИ 0,77–5,12; р = 0,011). **Заключение.** Предрасположенность к наличию МС может быть одним из факторов неблагоприятного влияния типа личности Д на прогноз при заболеваниях сердечно-сосудистой системы.

Ключевые слова: тип личности Д, метаболический синдром, сердечно-сосудистые заболевания, исследование ЭССЕ-РФ

Introduction

One of the risk factors of cardiovascular diseases is psychological stress [1] including distressor reactions, such as depression and anxiety [2, 3]. No wonder, researchers are strongly interested in personal peculiarities of patients that favour manifestation of psychological distress. A special D ("distressor") type of personality has been defined. Persons with such personality type are characterized by a tendency to experience negative emotions and to inhibit their expression in social interactions [1, 4]. Type D undoubtedly has unfavourable impact on the quality of life with a broad range of associated diseases [5, 6]. However, controversial results have been received while studying impact of this personality type on the prognosis of cardiovascular diseases [7, 8]. In addition, the mechanisms of possible unfavourable effect of type D personality on the state of patients with cardiological diseases remain unclear. According to one of the hypothesis, these may be pathophysiological reactions (increased stress reactivity, sympathetic activation, endothelial dysfunction, inflammatory responses, etc.) [9, 10]. However, the components of such responses in persons with type D of personality are not always evident, in particular, as related to raised stress reactivity [11] or increased level of subclinical inflammation markers [12]. Another potential mechanism includes behavioral factors which favour implementing impact of other cardiovascular risk factors (lack of physical activity, smoking, obesity) [13] and cause low compliance with medical recommendations in general [14]. Based on a number of studies, the tendency to psychological distress may be accompanied with the development of metabolic syndrome (MS) in these subjects [15, 16]. This syndrome is characterized by the combination of increased body weight, arterial hypertension and metabolic disorders (dyslipidemia, hyperglycemia), its presence contributes to the development and progression of atherosclerosis, which is associated with unfavourable prognosis [17, 18]. It remains unclear, whether there is any relation between type D personality and availability of MS: references contain controversial information regarding this issue [19], however, no studies have been performed in the Russian Federation in this respect. Therefore, this issue was the objective of our study that aimed at the assessment of clinical and anamnestic indicators in patients with MS, depending on type D personality.

Design and methods

The analysis has been performed within the scope of a multi-center epidemiological study "Epidemiology of Cardiovascular Diseases and Risk Factors in the Russian Federation" (ESSE-RF) [20]. The subject of study was a randomized sample of male and female adult population aged 25–64 years in the highly urbanized territory of West Siberia. A cross-sectional epidemiological study was held during the period from March to October, 2013. In accordance with the study protocol, the population was formed in 3 stages that included consistent selection of municipal health care institutions, medical districts, and households. Finally, the sample comprised 1,610 subjects (males and females at the age of 25 to 64 years old), the response rate comprised 81.4%. All subjects of the study were surveyed according to the standard questionnaire that included 12 modules and contained information on the sex and age, educational status of the study participants. In addition, the questionnaire included anamnestic data of past chronic diseases and risk factors, as well as drug therapy. Blood pressure was measured and heart beat rate was calculated twice in all subjects in accordance with the standard procedure described in the Appendix to the study protocol; the average of the two measurements was included in the analysis.

The standard ESSE-RF study protocol was extended in order to define personality type that was held with the use of the DS-14 questionnaire [4] taken from the Russian version of the Manual of the European Society of Cardiology. 14 questions with 5 options of replies were proposed to patients (false; probably false; hard to say; probably true; perfectly true). Points were calculated according to two scales: NA (negative affectability) and SI (social inhibition). Type D was determined when 10 points and more on each scale were got, 2 groups of patients were formed: Group 1 included patients with type D personality (n = 231) and group 2 included patients without type D personality (n = 1379). The groups were matching by anamnestic, anthropometric and laboratory parameters, cardiovascular diseases and risk factors.

Table 1

GENERAL CHARACTERISTICS OF PATIENTS

Parameter	Group 1 Personality type "D" (n = 231)		Group 2 Personality type "not D" (n = 1379)		p
	MS (n = 109)	No MS (n = 121)	MS (n = 297)	No MS (n = 1082)	
BMI, Me (LQ; UQ), kg/m^2	58.6 (45.5; 62.2)	39.7 (31.2; 47.3)*	56.3 (44.2; 61.1)	42.6 (35.5; 49.1)*	0.112
Weight, Me (LQ; HQ), kg	61 (55.2) 48 (44.8)	55 (44.9)* 67 (55.1)	170 (57.2) 127 (42.8)	662 (61.2)* 420 (38.8)	0.082 0.075
WC, Me (LQ; HQ), cm	29.4 (26.9; 35.9)	28.8 (24.05; 32.0)*	29.4 (25.9; 33.9)	26.88 (21.05; 30.0)	0.051
HC, Me (LQ; HQ), cm	82 (72; 90)	79.5 (73.0; 89.0)	80 (72; 90)	79.5 (73.0; 89.0)	0.133
Height, Me (LQ; HQ), cm	97.5 (87.1; 110)	91.8 (80.2; 100)*	92.5 (84.1; 99.1)	90.3 (81.2; 98.2)*	0.002
Obesity, n (%)	106.5 (99; 119)	103.1 (91.1; 101)*	101.5 (96; 117)	100 (93.1; 111.3)*	0.017
Hypercholesterolemia, n (%)	169 (163; 178)	171 (165; 176)	170 (164; 176)	168 (162; 177)	0.154
Ожирение, n (%)	83 (77)	50 (42)*	216 (73)	400 (37)*	0.006
Гиперхолестеринемия, n (%)	58 (53.2)	60 (49.6)	161 (54.2)	519 (48.0)	0.081
Job / employment / disability					
Disability, all groups, n (%)	21 (19.4)	13 (11)*	35 (11.8)	107 (9.9)*	0.011
Disability CVD, n (%)	8 (7.3)	8 (6.6)	18 (5.9)	52 (4.8)	0.058
Working, n (%)	75 (68.4)	79 (66.5)	231 (78.4)	822 (76.5)	0.009
Never worked /a, n (%)	0	0	0	0	
Now is not working / unemployed, n (%)	10 (9.1)	10 (8.3)	20 (6.9)	68 (6.3)	0.049
Family status					
Single, n (%)	19 (18)	22 (17.8)	53 (17.8)	178 (16.5)	0.749
Married, n (%)	66 (60.6)	71 (59.2)	179 (60.3)	645 (59.7)	0.675
Education					
Elementary, n (%)	1 (1.09)	1 (0.58)	1 (0.38)	4 (0.46)	0.062
Upper secondary education, n (%)	17 (16)	19 (15.9)	42 (14.2)	152 (14.1)	0.046
Bachelor, n (%)	16 (14.7)	16 (13.4)	46 (15.7)	177 (16.4)	0.049
Magister, n (%)	43 (40.1)	51 (42.2)	43 (35.1)	389 (36.2)	0.041

Note: MS — metabolic syndrome; BMI — body mass index; WC — waist circumference; HC — hip circumference; CVD — cardiovascular disease; Me (LQ; UQ) — Median (lower quartile; upper quartile); * — statistically significant differences (p < 0.05) between the groups with and without MS.

The MS was determined in accordance with the guidelines of experts of the Russian Society of Cardiology (2009) when the combination of abdominal obesity (waist circumference (WC) of over 80 cm in females and over 94 cm in males, which is the main parameter) and any two of the following criteria: arterial hypertension (blood pressure ≥ 130/85 mmHg); elevated level of triglycerides (TG) (≥ 1.7 mmol/l); reduced level of high density lipoproteins (HDL) (<1 mmol/l in males, <1.2 mmol/l in females), elevated content of low density lipoproteins (LDL) (> 3.0 mmol/l), carbohydrate metabolism disorder: hyperglycemia in fasting condition (plasma glucose in fasting condition ≥ 6.1 mmol/l); glucose tolerance disorder (plasma glucose in 2 hours after glucose load within ≥ 7.8 and ≤ 11.1 mmol/l). Laboratory study methods included determination of the level of glucose in blood as well as the lipid spectrum: total cholesterol, HDL, LDL, TG.

Data in the form of qualitative and quantitative indicators (398 indicators) obtained after examination of 1,610 subjects were registered in the history case and were entered in a computer database. A standard statistical software package SPSS 22 was used for statistical processing. Shapiro-Wilk criterion was applied to assess the distribution type. In case of non-normal distribution, the data are presented as median and quartiles (Me [LQ; UQ]). Mann-Whitney criterion was used to compare two independent groups. For the analysis of cross tables, Pearson statistics (χ^2), significance level (p), and phi ration (φ), which is the indicator of relation strength, were assessed.

Relation between the MS and its components with the probability of type D personality was assessed with logistic regression of non-linear model with indication of odd ratio (OR). Confidence intervals (CI) provided in the course of work were built for the confidence probability p = 95%. The following variables were included only of their contribution significance was at the level of $\alpha \leq 0.1$. The level of internal correlation was assessed for each parameter, then several regression models were formed with consideration of revealed correlations. The achieved significance level (p) was calculated in all statistical analysis procedures; the critical significance level in this study was assumed to be equal to 0.05.

Results

The total number of subjects with diagnosed MS achieved 25.2%. Analysis of cross tables demonstrated that MS was diagnosed in persons with type D personality (47 vs 21% in persons with and without type D personality, respectively; df = 3, χ^2 = 42, p = 0.0001, φ = 0.146). Most of subjects with MS were in age groups of 46–55 (31%) and 56–64 (63%) years old, while 59% of patients without MS were 25–35 and 36–45 years old (df = 3, χ^2 = 23, p = 0.0001, φ = 0.136). The proportion of males with diagnosed MS was 1.3-times higher than that of females (df = 3, χ^2 = 35, p = 0.0001, φ = 0.126). Therefore, there were no significant differences in age (p = 0.112) and sex (p=0.075) distribution in groups with and without type D personality (Table 1).

High WC and hip circumference were found in persons with type D personality (p = 0.002 and p = 0.017, respectively). Their highest values were noted in subgroups with MS (p < 0.001).

Differences in body weight index (BWI) varied significantly: 29.4 (26.9, 35.9) vs 26.88 (21.05, 30.0) kg/m² in persons with and without MS, respectively (p < 0.001). However, it would be less relevant when comparing groups by type D personality (p = 0.051). Prevalence of obesity among people with type D personality (47.6%) was higher than among people without it (37.9%, p = 0.006). In obese people, MS was also diagnosed twice more often (df = 3, χ^2 = 28, p = 0.0001, φ = 0.148).

Differences in social and economic parameters were also found. Thus, all-disease-related disability was more prevalent in subjects with type D personality (19.9%, p = 0.01). It was higher in MS subgroups as well, compared to groups without diagnosed MS (df = 2, χ^2 = 23, p = 0.001, φ = 0.122).

The number of employed people was lower among persons with type D personality than among persons without it (p = 0.009). 40% of people with type D personality had higher education, which was significantly higher than among persons without type D personality (36.2%, p = 0.041). No differences were found in MS subgroups regarding these parameters.

No significant differences were revealed with regard to nutrition habits (Table 2). However, general trends included rare consumption of

Table 2

АНАЛИЗ ПИЩЕВЫХ ПРИВЫЧЕК В ГРУППАХ

Parameter	Group 1 Personality type "D" (n = 231)		Group 2 Personality type "not D" (n = 1379)		p
	MS (n = 109)	No MS (n = 121)	MS (n = 297)	No MS (n = 1082)	
Do you add salt to already food?					
No salt, n (%)	64 (58.8)	71 (58.9)	372 (56.8)	594 (54.9)	0.411
Yes, without trying, n (%)	6 (5.6)	4 (3.1)	14 (4.6)	44 (4.1)	0.071
What kind of fat is most often used for cooking at home?					
Vegetable oil, n (%)	100 (91.8)	107 (89.1)	279 (94.8)	908 (84.1)	0.556
Butter, n (%)	3 (2.7)	3 (2.4)	9 (3.1)	32 (2.9)	0.342
No fat, n (%)	1 (0.9)	2 (1.1)	4 (1.2)	18 (1.7)	0.131
The frequency of use of these products					
1. Meat — 150 g (beef, pork, lamb, etc.)					
Do not eat / rarely, n (%)	8 (6.9)	7 (6.5)	20 (6.7)	75 (6.9)	0.731
Daily / almost daily, n (%)	56 (51.9)	59 (49.3)	151 (50.9)	538 (49.7)	0.431
2. Fish and seafood — 200 g					
Do not eat / rarely, n (%)	7 (6.1)	7 (6.4)	18 (6.0)	75 (6.9)	0.754
Daily / almost daily, n (%)	14 (12.9)	16 (13.4)	38 (12.8)	135 (12.5)	0.466
3. Bird — 150 g (chicken, turkey, etc.)					
Do not eat / rarely, n (%)	2 (2.2)	6 (4.9)	9 (2.9)	42 (3.9)	0.143
Daily / almost daily, n (%)	3 (29.4)	33 (27.9)	84 (28.4)	292 (27.6)	0.350
4. Sausages, meat products (tongue, liver, heart, etc.)					
Do not eat / rarely, n (%)	23 (21.2)	28 (22.9)	58 (20.2)	247 (22.8)	0.441
Daily / almost daily, n (%)	31 (28.6)	33 (27.5)	85 (28.6)	298 (27.5)	0.240
5. Fresh vegetables and fruits (3 pieces)					
Do not eat / rarely, n (%)	2 (2.2)	5 (1.9)	7 (2.3)	18 (1.7)	0.311
Daily / almost daily, n (%)	73 (67)	81 (67.2)	196 (66)	735 (68)	0.746
6. Sweets and confectionery (sweets, jam, cookies, etc.)					
Do not eat / rarely, n (%)	18 (16.2)	18 (14.5)	48 (16.1)	146 (13.5)	0.452
Daily / almost daily, n (%)	59 (53.7)	67 (55.5)	157 (53.2)	591 (54.7)	0.643
7 Dairy products					
Do not eat / rarely, n (%)	10 (9.2)	11 (8.9)	25 (8.5)	91 (8.4)	0.635
Daily / almost daily, n (%)	67 (61.5)	73 (60.2)	182 (61.4)	658 (60.8)	0.221

Note: MS — metabolic syndrome.

Table 3

LABORATORY PARAMETERS

ParameterMe (LQ; UQ)	Group 1 Personality type "D" (n = 231)		Group 2 Personality type "not D" (n = 1379)		p
	MS (n = 109)	No MS (n = 121)	MS (n = 297)	No MS (n = 1082)	
Total cholesterol. mmol/L	5.5 (5.2; 6.0)	4.11 (4.05; 5.95)*	5.2 (4.2; 6.0)	4.91 (4.05; 6.05)	0.116
HDL cholesterol, mmol/L Male / Female	1.03 (0.68; 1.50) / 1.01 (0.77; 1.34)	1.12 (1.08; 1.52)* / 1.11 (1.01; 1.49)	1.03 (0.68; 1.50) / 1.01 (0.77; 1.1.34)	1.12 (1.08; 1.52)* / 1.11 (1.01; 1.49)	0.211
LDL cholesterol, mmol/L	2.9 (2.3; 3.9)	2.1 (1.98; 3.1)*	2.3 (2.1; 3.5)	2.4 (2.2; 3.1)	0.131
Triglycerides, mmol/L	2.4 (1.4; 2.8)	1.9 (1.5; 2.6)*	2.4 (1.4; 2.8)	1.9 (1.5; 2.6)*	0.141
Fasting plasma glucose, mmol/L	6.9 (6.1; 7.9)	5.5 (5.1; 6.4)*	7.3 (6.5; 8.1)	5.6 (5.3; 6.3)*	0.221
Creatinine, μmol/L	77 (64.5; 93.5)	75 (63; 91)	74 (63.5; 98.5)	76 (62.1; 90.5)	0.412
GFR MDRD, Me (LQ; UQ), ml/min/1,73 м²	89.4 (78.6; 101.3)	90.7 (81.9; 101.6)	88.9 (77.8; 1055.1)	91.5 (81.7; 1011.9)	0.190

Note: MS — metabolic syndrome; HDL cholesterol — high-density lipoprotein cholesterol; LDL cholesterol — low-density lipoprotein cholesterol; GFR — glomerular filtration rate; * — statistically significant differences (p < 0.05) between the groups with and without MS.

fish and seafood (only 13 % respondents used them more frequently than twice per week), low fruit and vegetable consumption (daily intake by not more than 67 % of respondents), but frequent consumption of sausage products (28 % respondents reported daily intake), sweets, and pastry (54 % respondents reported daily intake).

Significant differences in levels of LDLP, HDLP, TG, blood glucose level (p<0.001) were found in all cases, however, when separated by type D personality, no differences were shown (Table 3).

Smoking history duration (Table 4) was different: 12.3 (9.3, 15.6) years and 9.2 (6.2, 12.4) years in persons with and without type D personality, respectively (p = 0.009). 53 vs 46 % of subjects had a job with low physical activity among people with and without type D personality, respectively (p = 0.003). In addition, examined people with MS had lower physical activity as compared to the subgroup without MS (31 % vs 28 %) (df = 2, χ² =19, p = 0.004, φ = 0.112).

In persons with type D of personality (df = 5, χ² = 47, p = 0.001, φ = 0.132) and MS (df = 5, χ² = 75, p = 0.00001, φ = 0.198) arterial hypertension, diabetes mellitus (df = 4, χ² = 47, p = 0.0011, φ = 0.122) and MS were more prevalent (df = 4, χ² = 43, p = 0.00001, φ = 0.175). Inter-group differences were found when divided into degrees and stages of arterial hypertension. Past acute cerebrovascular accident or transient ischemic attack and asthma were more frequent in people with type D personality (p = 0.041 and p = 0.046, respectively) (Table 5). Regarding medication therapy, there were differences only considering glucose-lowering drugs: 6.06 % and 2.6 % in people with and without type D personality (p = 0.005). Subjects with MS took those drugs more often (df = 4, χ² = 37, p = 0.0021, φ = 0.142).

In logical regression analysis with stepped inclusion, 10 parameters (predictors) were shown to have significant contribution at the level of α ≤ 0.1 (Table 6): MS (OR 3.88; 95 % CI 2.53–4.93; p = 0.002), BMI (OR 3.03; 95 % CI 1.35–5.78;

PHYSICAL ACTIVITY AND SMOKING STATUS IN STUDIED GROUPS

Parameter	Group 1 Personality type "D" (n = 231)		Group 2 Personality type "not D" (n = 1379)		p
	MS (n = 109)	No MS (n = 121)	MS (n = 297)	No MS (n = 1082)	
The level of physical activity during work					
Basically sitting, n (%)	59 (54.2)	64 (52.9)*	140 (47.2)	505 (46.7)	0.003
Basically walking, n (%)	31 (28.1)	37 (30.9)*	(28.1)	294 (27.2)	0.048
Lift and carry small gravity, n (%)	7 (6.2)	9 (7.5)	21 (7.1)	84 (7.8)	0.115
Heavy physical work, n (%)	6 (5.2)	8 (6.5)	16 (5.3)	71 (6.6)	0.112
Not working, n (%)	29 (26.4)	31 (25.8)	61 (20.4)	207 (19.1)	0.025
Difficult to answer, n (%)	2 (1.9)	2 (1.4)	7 (2.3)	19 (1.8)	0.311
Walking in free time, including walking to and from work,	42.0 (28.0; 92.0)	40.0 (27.0; 90.0)	60.0 (40.0; 120.0)	59.0 (41.0; 119.0)	0.034
Smoking					
Never smoked, n (%)	51 (47.2)	8 (46.7)	143 (48.2)	537 (49.6)	0.072
Smoked, but gave up, n (%)	22 (20.3)	26 (21.5)	56 (18.8)	210 (19.5)	0.131
Smokes, n (%)	36 (32.9)	39 (31.9)	91 (30.7)	333 (30.8)	0.056
Tobacco products daily, n (%)	6 (5.6)	7 (5.5)	20 (6.6)	70 (6.5)	0.076
Smoking experience, Me (LQ; UQ), yr	23.0 (10.5; 26.5)	23.9 (13.6; 29.7)	20.0 (10.4; 27.5)	20.9 (13.9; 29.7)	0.009
The average number of cigarettes / cigarettes a day, Me (LQ; UQ)	15.0 (10.0; 20.0)	15.2 (9.3; 17.5)	14.9 (10.7; 20.1)	14.8 (9.6; 18.0)	0.132

Note: MS — metabolic syndrome.

p = 0.003), diabetes mellitus (OR 2.75; 95 % CI 1.07–6.04; p = 0.004), obesity (OR 2.33; 95 % CI 0.80–5.34; p = 0.012), WC (OR 2.13; 95 % CI 0.75–6.02; p = 0.044), glucose level (OR 2.13; 95 % CI 0.77–5.12; p = 0.011). Paired correlation ratio was considered for the multi-factor analysis (Table 7). Based on several models, MS (OR of 2.24; p = 0.023), BWI (WC of 2.12; p = 0.011), and WC (OR of 1.38; p = 0.043) remained independent predictors of type D personality.

Discussion

In our study, MS was more often diagnosed in persons with type D personality than in subjects without it (46 % and 21 % of cases, respectively). Type D personality was associated with over double MS risk as well as its components, including obesity and arterial hypertension.

At present, the relation between type D personality and MS is not evident [19]. Three studies were held regarding this issue in various countries and in various cohorts of subjects. Thus, among outpatients in a lipid clinic in Greece, the frequency of type D personality was significantly higher in patients with MS than in the reference group (44 as compared to 15 %, respectively, p < 0.001). In the multiple logistic regression analysis, type D personality was associated

Table 5

CHARACTERISTICS OF GROUPS BY DISEASES AND MEDICATIONS

Category	Group 1 Personality type "D" (n = 231)		Group 2 Personality type "not D" (n = 1379)		p
	MS (n = 109)	No MS (n = 121)	MS (n = 297)	No MS (n = 1082)	
Morbidity					
Family history of premature CVD, n (%)	102 (94.3)	112 (93.0)	235 (79.3)	823 (76.1)	0.022
CHD, n (%)	17 (15.5)	17 (14.3)	31 (10.5)	101 (9.3)	0.043
Previous MI, n (%)	3 (2.6)	3 (2.1)	9 (2.9)	22 (2.0)	0.131
Previous Stroke/TIA, n (%)	6 (5.2)	6 (4.79)	10 (3.2)	30 (2.79)	0.041
HTN, n (%)	39 (35.9)	37 (30.2) *	89 (29.9)	294 (27.2)*	0.033
HTN grade 1, 2, n (%)	32 (29.3)	34 (28)	70 (23.6)	286 (26.4)*	0.039
HTN grade 3, n (%)	7 (6.4)	3 (2.5) *	19 (6.4)	12 (1.1)*	0.043
DM, n (%)	9 (8.6)	8 (6.9) *	14 (4.6) *	42 (3.9)	0.002
BA, n (%)	8 (6.9)	7 (5.9)	15 (4.9)	42 (3.9)	0.046
Medication					
Antihypertensive, n (%)	35 (32)	36 (29.6)	98 (33)	324 (30)	0.112
Hypoglycemic, n (%)	81 (4.1)	3 (2.6) *	13 (4.5)	37 (3.4) *	0.005
Antiplatelets, n (%)	9 (8.2)	9 (7.1)	24 (8.1)	75 (6.9)	0.131
Statins, n (%)	15 (13.8)	(11.1)	32 (10.8)	98 (9.1)	0.140

Note: MS — metabolic syndrome; CVD — cardiovascular diseases; CHD — coronary heart disease; MI — myocardial infarction; Stroke — acute ischemic stroke; TIA — transient ischemic attack; HTN — arterial hypertension; DM — diabetes mellitus; BA — bronchial asthma; * — statistically significant differences (p < 0.05) between the groups with and without MS.

Table 6

ASSOCIATION BETWEEN THE METABOLIC SYNDROME AND ITS COMPONENTS WITH TYPE D PERSONALITY (LOGISTIC REGRESSION WITH PARTIAL CORRELATION)

Univariate analysis				
Step	Parameter	OR (95 % CI)	Partial correlation coefficient	p
1	Total cholesterol	1.22 (1.14–1.82)	0.018	0.044
2	Low-density lipoprotein cholesterol	1.42 (1.27–1.64)	0.051	0.031
3	Arterial hypertension	2.06 (0.83–3.49)	0.015	0.024
4	Triglycerides	2.09 (1.07–3.05)	0.065	0.042
5	Fasting plasma glucose	2.13 (0.77–5.12)	0.133	0.011
6	Waist circumference	2.13 (0.75–6.02)	0.155	0.044
7	Obesity	2.33 (0.80–5.34)	0.213	0.012
8	Diabetes mellitus	2.75 (1.07–6.04)	0.233	0.004
9	Body mass index	3.03 (1.35–5.78)	0.459	0.003
10	Metabolic syndrome	3.88 (2.53–4.93)	0.483	0.002

Note: R — odds ratio; 95% CI — 95% confidence interval.

Table 7

ASSOCIATION BETWEEN METABOLIC SYNDROME AND ITS COMPONENTS WITH TYPE D PERSONALITY (LOGISTIC REGRESSION WITH INTERNAL CORRELATION RATIO, SINGLE-FACTOR ANALYSIS)

Multivariate analysis		
Parameter	OR (95 % CI)	p
Model 1. Predictors of type D personality regardless of gender and age		
Waist circumference	1.14 (1.04–1.43)	0.041
Body mass index	1.28 (1.80–3.24)	0.023
Obesity	2.12 (0.75–6.02)	0.012
Arterial hypertension	3.21 (2.02–6.14)	0.011
Metabolic syndrome	3.53 (3.56–5.62)	0.002
Model 2. Predictors identify type D personality regardless of gender and age p < 0.001		
Obesity	1.24 (1.21–1.48)	0.049
Waist circumference	1.38 (1.24–1.49)	0.043
Body mass index	2.12 (0.55–4.22)	0.011
Metabolic syndrome	2.24 (2.02–4.18)	0.023

Note: OR — odds ratio; 95% CI — 95% confidence interval.

with MS independently of other clinical factors, symptoms of anxiety and depression (OR 3.47; 95 % CI 1.90 to 6.33) [16]. A population study in Holland also demonstrated that MS was more prevalent in subjects with type D personality than in persons without it (13 vs 6 %). Type D of personality was associated with a two-fold increase in the risk of MS (OR 2.2; 95 % CI 1.2 to 4.0; p = 0.011), irrespectively of other parameters [15]. On the other hand, when examining a cohort of employees of one of enterprises in cross-sectional (n = 458) and prospective (n = 268; 6.3 years of examination) analysis, no associations between type D personality and MS or its components were found [21].

It should be noted that the association between type D personality and MS was more profound among patients' cohorts and less evident in population studies (including ours). It was absent among practically healthy people, employees of industrial enterprises. In the latter one, the examined people were younger than in other studies; this could also affect the results as the frequency of MS increases with age [16]. Another reason of absence of relation between type D personality and MS in the cohort of employees of the industrial enterprise may be so called effect of a "healthy worker", i. e., the effect of professional selection in

the course of employment [22]. The influence of the geographic factor cannot be excluded either, for example, the results were different in studies of prognostic influence of type D personality in patients with coronary heart disease in Germany and Holland [7, 8]. There might be significant cultural and national peculiarities of nutrition, health-related factors, etc. Our study demonstrated association between type D personality and MS, which confirms the relevance of this problem in Russia.

Which factors allow implementing connection between type D personality and MS? In general, type D personality is known to be associated with less healthy lifestyle. However, specific studies provide various factors that correlate with type D personality. Thus, in a cohort of 187 healthy subjects, type D personality was associated with inadequate habits and significantly less healthy nutrition: higher consumption of fats and sugar and significantly lower consumption of fruit and vegetables. Regression analysis showed that these connections were partially mediated by habits. In general, results confirmed that type D personality may be the risk factor of unhealthy nutrition [23]. In a population study, subjects with type D personality showed lower physical activity (OR 1.5; CI 95 % 1.1 to 2.0; p = 0.02), their

nutrition was less various (OR of 0.50; CI 95 % 0.40 to 0.70; p < 0.0005), and they rarely limited consumption of fats (OR of 0.70; CI 95 % 0.50 to 0.90; p = 0.01) [15].

No differences in nutrition type was found in our study regarding type D personality, however, we confirmed lower physical activity in patients with type D personality. Similar data were demonstrated in patients with cardiovascular diseases [24 to 26]. Thus, in the test of 6-minute walk patients with type D personality after coronary artery bypass surgery walked shorter distance before (255 ± 91 vs 319 ± 106 m, p < 0.01) and after physical rehabilitation (361 ± 91 vs 411 ± 106 m, p < 0.05) compared to patients without type D personality [24]. Among 690 patients with ischemic heart disease that had acute coronary syndrome, type D personality was an independent predictor of lower physical ability (OR 1.77; CI 95 % 1.06 to 2.95; p = 0.03) and reduced motivation to routine physical activities (OR of 3.14; CI 95 % 1.73 to 5.73; p < 0.001) prior to the program of cardiological rehabilitation [25]. Low level of physical activity was found in 83.2 % patients with type D personality visiting of cardiological outpatient clinic, while among patients without type D personality it was detected only in 8.6 % of cases (p < 0.002). Based on the multifactor logistical regression analysis, type D personality had the highest independent effect on the risk of low level of physical activity (OR of 3.12; p = 0.004) [26]. I. e., low level of physical activity results from low motivation, and leads to the reduction in the functional state.

Association of type D personality with dyslipidemia was not found in our study, which corresponds with the data of other studies in patients with ischemic heart disease [27] and subjects without cardiovascular pathology [28].

The possible role of other manifestations of psychological distress, such as anxiety and depression, association between type D personality and MS was assessed in the work by D. Tziallas et.al. (2011) [16]. Indeed, according to the single variant analysis, all three parameters were associated with MS — type D personality (OR of 4.39; CI 95 % of 2.60 to 7.39; p < 0.001) and depression (OR of 2.87; CI 95 % of 1.68 to 4.91; p < 0.001) and anxiety levels (OR of 1.92; CI 95 % of 1.15 to 3.20; p = 0.01). However, in the

multivariant analysis, type D personality was the most significant predictor of MS irrespectively of depression or anxiety symptoms. In the systematic review of 18 studies for assessment of relation between such personal characteristics as hostility, anger, type A behavior, neuroticism, type D personality and MS, controversial data were received regarding association between high hostility, neuroticism, and type D personality with the incidence of MS. Nevertheless, the general trend in prospective studies was an association between more negative or hostile individual features with manifestations of MS [19].

People with MS and individual components of MS are characterized by specific feeding behavior, emotion-style food, insufficient sleep duration, sedentary lifestyle, as well as more pronounced alexithymia, lower level of subjective control, prevalence of ideas about the lack of control over the events of their lives, more frequent avoidance strategy in stressful situations. The study showed a significant role of internal aims in formation of attentive attitude to the nutrition regime as well as connection between the style of stress-coping behavior and characteristics of nutrition behavior and smoking [29]. We believe that most of personal characteristics described above perfectly fit the structure of type D personality and correspond with our results.

The association between type D personality and MS proved in this study may be one of the factors responsible for the unfavourable effect of such psychological type on the prognosis in patients with cardiovascular diseases. Correspondingly, for secondary prevention both correction of inadequate psychological stressor reactions [30] and mental corrective measures aimed at changing lifestyle and correction of personal aims and behavioral patterns that affect health [29], as well as additional search for MS manifestations and their control should be applied in persons with type D personality [31].

Conclusions
In a non-organized population, the prevalence of type D personality comprised 14.3 %. MS was found in 47 % people with type D personality and in 21 % people without type D personality. Type D personality was associated with over double MS risk as well as its components — obesity and arterial hypertension. Low physical activity was

also typical for persons with type D personality. At the same time, no association of type D personality with nutrition habits and the level of cholesterol and glucose was found. Predisposition to MS can be one of the factors of unfavourable prognostic effect of type D personality.

Conflict of interest
The authors declare no conflict of interest.

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