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Prevalence of Metabolic X Syndrome in the Interior of Croatia: The Baranja Region

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A B S T R A C T

Metabolic syndrome (MS), a constellation of metabolic risk factors associated with development of cardiovascular diseases and type 2 diabetes, has emerged as a public health problem of enormous proportions in developed and developing countries. We have reported previously its prevalence in several isolated island populations in the Eastern Adriatic coast of Croatia. In spite of leading a relatively traditional life style pattern including the practice of a typical Mediterranean diet, the prevalence of MS in these populations is high and comparable to those in developed nations. However, data on prevalence of the syndrome in mainland Croatia is limited. We have, therefore, conducted a study in an outbred population comprising of Croats, Hungarians and Serbs from the Baranja region of mainland Croatia. Although this is an ethnically heterogenous population, the constituent groups exchange mates and therefore, are not reproductively isolated. The life style patterns are also similar. We observed similar prevalence of MS in these groups. We assessed MS following the definitions prescribed in the guidelines of the World Health Organization (WHO) and the National Cholesterol Education Program (NCEP). Overall prevalence is considerably high in this cosmopolitan group, by WHO criteria 26% in males and 38% in females, and by NCEP criteria 84% in males and 71% in females. It is likely that, in addition to genetic risk factors, a host of environmental factors that include dietary habit and relatively urban life style in a modernized society influence the levels of the constituent metabolic traits leading to increase prevalence of MS.

Key words: *metabolic syndrome, Croatia, body mass index, waist hip ratio, carbohydrate intolerance, dyslipidemia, cardiovascular disease*

Introduction

Metabolic syndrome (MS), variously defined as syndrome X plus, insulin resistance syndrome, plurimetabolic syndrome, has emerged as a major health problem in developed and developing countries[1,2]. The syndrome is a co-occurrence of impaired glucose tolerance, obesity, dyslipidemia, and high blood pressure. It is estimated that 40% of individuals in the age group of 60 years and above and 10% in the age group of 20–60 have MS[1,2]. Age adjusted prevalence of MS in an island population of the Eastern Adriatic coast of Croatia, a distinctly homogenous population living in relative isolation with a traditional living pattern in the island Hvar, is 26% (32% in males and 24% in females) with body mass index of $>30 kg/m^2$, and 42% (57% in males and 36% in females) with waist-hip ratio of >0.90 in men, >0.85 in women as the measures of obesity [3,4]. MS increases the risk for coronary heart disease, stroke, peripheral angiopathy and type 2 diabetes[4,5]. Traits involved in MS primarily consist of overweight and abdominal (intraperitoneal) apple shape obesity (high body mass index), insulin resistance or glucose intolerance, hypertriglyceridemia with low level of HDL and high level of LDL cholesterol, arterial hypertension, prothrombotic state with high serum fibrinogen level or high plasminogen activator inhibitor-1

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level, and pro-inflammatory state with the high serum level of C-reactive protein. About 12% of school student population fulfills at least three criteria for MS[6,7]. The aim of the study is to determine the prevalence and parameters of MS in the interior of Croatia: the Baranja region.

Investigations of metabolic traits in Croatia

In the investigation entitled »The first Croatian health project«, performed in the continental part of Croatia, Turek et al.[8] reported that the population of continental Croatia is predisposed to several metabolic disorders connected with metabolic syndrome. In a sample of 5,840 adults, they found 79% of men and 50% of women were obese or very obese. About 32% of men and 24% of women had arterial hypertension, 63% had elevated serum cholesterol, 38% presented raised triglycerides, while 20% showed elevated fibrinogen level. These results show that the population of continental Croatia has a significant risk for the majority of metabolic disorders connected with MS. This investigation did not include the inhabitants of the eastern continental Croatia – the Baranja region, and for this reason we conducted this research with the aim to assess the prevalence of metabolic disorders, which were evaluated in the rest of the continental Croatian populations as well as in isolated island populations[9].

The collaborators of the Institute for Anthropology in Zagreb recently investigated the prevalence of MS and its associated traits among the inhabitants of nine Adriatic islands (six on the island of Rab and two on the island of Vis). The collaborators of the School of Public Heath »Andrija Štampar« from Zagreb performed a similar investigation in the island of Mljet. The research was presented by Kolcic et al.[5]. This research particularly emphasized the likely impact of consanguinity on MS. This is the second study of prevalence of MS performed among the isolated populations on Adriatic islands. The first one was conducted during mid 1990s[3] (Rudan, 2005) among the inhabitants of five villages in the island of Hvar, published in more detail recently[4]. Kolcic et al.[5] found that MS was not connected with the estimation of heterozygosity. Such high occurrence of MS in one third of the inhabitants of these geographically isolated population groups with a traditional life style pattern points to the likely involvement of genetic factors.

Geomorphologic characteristics of the Baranja region

Baranja is an isolated geographic entity of the eastern Croatian plain. The Danube (Dunav) and the Drava rivers form boundaries towards Bačka and Slavonia, while state border with Hungary is drawn through a lowland area without relief or hydrographic barriers. This area is a part of a broader, historical District of Baranja. The oldest settlements are mentioned already in the 12th century (Branjin Vrh); the others were founded during the 13th and 14th centuries. The partition of the District of Baranja was enacted by the Treaty of Trianon in 1920. Baranja is divided into two parts: the Croatian part encompasses 1,147 square kilometers and the Hungarian one 4,541 square kilometers [10].

Natural and geographic features

Baranja (Fig 1) is mostly flatland area with very young relief. In the content and structure prevail Holocene and Pleistocene sediments (loess and loess-like sediments, sand, etc.). The following morphological entities are prominent: younger alluvial plains, older Holocene terraces of the Drava river, younger and older Würm terraces of the Drava, younger Würm terrace of the Danube, loess plains and Bansko Brdo. Very humid alluvial plains (particularly in the Kopačev Rit area) encompass 63 percent of the Baranja territory. The drainable areas (river terraces and loess plains) are most favorable for settling and agriculture (humus – fertile black soil, and brown soil). The most important waterway is the Danube, navigable the whole year. Baranja has a moderate continental climate. With the average annual precipitation rate (642 mm), it belongs to the driest parts of Croatia. The average annual temperature is 10.7°C. The commonest is the northwest wind[10].

Inhabitants

The oldest traces of human presence date from the Neolithic period. The Hungarians arrived at the end of the 9th century and mostly assimilated the already settled Slavs. Serbs came to Baranja during the Ottoman period (1526–1687). When the Turks had retreated after liberation, the deserted Baranja was settled by Croats (Šokci) from the surroundings of Srebrenica in Bosnia (1689–1713), and during the Crnojevici migration (Čarnojevići) a lot of Serbs came along. From 1720 onwards

Fig 1. Croatia: Baranja region.

immigrated the Germans, mostly from Austria, the Rhine basin and Bavaria. According to the historical data, Baranja had 6,900 inhabitants in 1720. Since then, except in the period of the First World War and from 1948 to 1953, when (due to war tribulations and emigration of the Germans) the population declined in number, it has been constantly growing. Today Baranja has a complex national structure. The Germans had abandoned Baranja at the end of the Second World War II, and it was from 1945 to 1948 colonized by Croats and Serbs from the regions of Hrvatsko Zagorje, Međimurje, Banija and Dalmatia [10]. Along with all the above mentioned nationalities, a large Romany community also lives in Baranja. We can say with good reason that the present population of Baranja has become heterogeneous during the several past centuries. Nowadays Baranja has one city (Beli Manastir) and eight civil districts (Bilje, Čeminac, Darda, Draž, Jagodnjak, Kneževi Vinogradi, Petlovac and Popovac). According to the census of the year 2001, Baranja has 42,633 inhabitants. From the statistics is obvious that up to the age of 19 years there are 6,868, and over 65 years 7,056 inhabitants[9].

Baranja is a suitable region in Croatia for analyzing the occurrence of MS and its components, due to its geographical configuration, historical migrations of population resulting in the current ethnic – national pattern, as well as because of roughly equal life and work conditions in this biotope, thus fulfilling the conditions for an anthropological-ecological natural experiment[11].

Sample and Methods

Baranja is divided into four regions: central, northern, southern-west and southern-east. This study deals with a representative sample consisting of 1.5% of the adult population from all regions: 414 people from all ethnic groups, including 287 women (63.3%) and 127 men (30.7%), aged 18 to 92 years. The sample is chosen at random from the regional general practice medical services. The research was performed by standardized questionnaire used at the Institute for Anthropological Research for almost three decades, consisting of data on the family structure, health condition and life habits. Then follow anthropometric procedures and the analysis of the body mass index estimation (height in cm and body mass in kg), abdomen-waist and hip circumferences, clinical examination and three measurements of blood pressure in mmHg with a mercury manometer, according to the principles of the International Biological Program[12]. Blood samples were taken from all examinees for analysis of serum concentrations of glucose, triglycerides, cholesterol and fibrinogen. The analysis was performed at the biochemistry lab of the Clinical Hospital in Osijek.

Definitions of metabolic syndrome

The WHO definition[13] requires that individuals with MS have hyperinsulinemia or fasting glucose level ≥6.1 mmol/L, and at least two of the following: 1) obesity : BMI >30 kg/m^2 or WHR (waist to hip ratio) >0.90 in men and >0.85 in women; 2) serum triglycerides level ≥1.69 mmol/L or HDL cholesterol <0.9 mmol/L in men and <0.85 mmol/L in women; 3) high blood pressure ≥140/90 mmHg.

The NCEP definition[14] does not explicitly include insulin resistance or glucose intolerance as required criteria, but rather defines MS as the co-occurrence of three or more of the following five criteria: 1) abdominal obesity – waist circumference >102 cm in men, >88 cm in women; 2) serum triglyceride level >1.69 mmol/L; 3) HDL cholesterol <1.04 mmol/L in men, <1.29 mmol/L in women; 4) high blood pressure ≥130/85 mmHg; 5) fasting plasma glucose ≥6.1 mmol/L.

We have followed the working definition proposed in ATP III, with the exception that we have used BMI (≥30 kg/m^2) and/or WHR (≥0.90m, ≥0.85 f) as predictors of obesity.

Biostatistical procedures

Clinical, physiological, anthropometric and biochemical state of the examinees was analyzed in order to assess MS prevalence in a representative sample. The data processing was done by the methods of non-parametric statistics of univariant variable analysis and by the frequency methods particular discreet values respectively, but also by multivariance methods of simultaneous analyses of the sample structure in the space of chosen variables [15]. Among non-parametric analyses the chi-square test was used, as well as procedures for the evaluation of continuous variables parameters: t-test and one-way and two-way variance analysis[16]. The data analysis deals with the investigation of the sample structure in the space of variables describing morphological, physiological and biochemical status, and with the investigation of the area structures of these variables. The role of gender, age and regional affiliation of each examinee were studied separately, and then also simultaneously, on the variables describing the examinees' status. Latent variable structure was investigated by the methods of factor analysis.

Statistical analysis

Descriptive statistics (e.g. mean and standard deviation) of anthropometric variables of the observed MS components (HEIGHT – body height; WAISTCF – waist circumference; HIPSCF – hips circumference; HIPSCF1 – hips circumference – the widest measure; BMI – body mass index; WHR – waist-hip ratio; SBP – systolic blood pressure; DBP – diastolic blood pressure; TG – triglycerides; FPG – fasting plasma glucose; FBG – fibrinogen; CHOL – cholesterol; HDL – high-density lipoprotein cholesterol, LDL – low-density lipoprotein cholesterol) and age for the total sample and for the samples of men and women was performed by the SPSS 15.0 program package. The main components analysis with varimax rotation produced four factors for both samples of men and women. The analysis was also done by using the SPSS 15.0 program package.

Results and Discussion

Results are presented in five tables. Table 1 presents descriptive statistics of the investigated parameters in both sexes of the representative sample from Baranja. The mean age was near the upper range for the chronological middle age and did not significantly differ between genders. Men had larger waist circumference and higher body mass than women. Women, however, had higher body mass index. WHR was higher in men, systolic pressure was higher than the upper normal limit in both sexes: 135 mmHg. The values of systolic and diastolic pressures did not differ regarding gender, as well as serum concentrations of glucose or fibrinogen. Triglycerides showed higher serum concentrations in men, and in women serum concentrations of the total cholesterol, HDL and LDL cholesterol were higher.

In Table 2 is presented the MS prevalence, including both criteria and according to age groups. In men, the highest frequency of MS according to WHO criteria was in the 40–49 yrs age group, and then in the group of 50–59 yrs, and in women in the age groups of 60 and over. Women had MS more often than men. According to the NCEP criteria, both in men and women the highest MS frequency was at the age of 50–79, and men had MS more often than women. In men, the NCEP criterion was present three times more often than the WHO criterion, in women it had almost double frequency.

Tables 3 and 4 demonstrate the prevalence of MS in the four national groups of the population in Baranja, i.e. in Croats, Hungarians, Serbs and Romany. It is clearly evident that among them statistically significant differences do not exist, so that the population of Baranja can be considered as a homogenous group with respect to the prevalence of MS and its constitutive traits.

In Table 5 are presented the factor analysis results. In the case of men, the *first factor* that explains 23.7% of the total variance, is expressed by BMI, WHR and FPG (weight 0.754, 0.687 and 0.702) with a smaller contribution of TG (weight 0.410). The *second factor* explains 16.4% of the total variance and is saturated by SBP and DBP pressures (weight 0.854 and 0.858). The *third factor*, which explains 15.9% of the total variance, is cholesterol itself (weight 0.846) with the contribution of TG (weight 0.682) and of course HDL (weight 0.747). The *fourth factor*, explaining 11.4% of the total variance, presents FBP (weight 0.697), saturated with age and HDL.

Table 6 presents factor scores for women. It is pretty different from that in men. The *first factor* explains 27.4% of the total variance and presents SBP and DBP pressures (weight 0.836 and 0.883). The *second factor*, explaining 15.0% of the total variance, is saturated with FBG (weight 0.722) and age (weight 0.697), with relatively high impacts of WHR (weight 0.587) and FPG (weight 0.447). The *third factor* which explains 12.7% of the total variance, presents TG (weight 0.877), along

TABLE 1
DESCRIPTIVE STATISTICS OF THE EXAMINED TRAITS IN BARANJA REGION, AGE 18 TO 92 YEARS

Traits*	Male		Female	
	N	Mean±SD	N	Mean±SD
Age (years)	127	59.20±14.88	287	60.29±14.91
HEIGHT (cm)	127	171.99±7.81	287	158.92±7.91
WAISTCF (cm)	127	98.77±13.88	287	94.75±14.77
HIPSCF (cm)	127	104.92±10.49	287	108.73±12.57
HIPSCF1 (cm)	127	99.86±10.33	287	102.37±11.98
WEIGHT (kg)	127	82.19±16.40	287	73.17±13.94
BMI (kg/m^2)	127	27.74±4.95	287	29.09±5.49
WHR	127	0.989±0.09	287	0.929±0.12
SBP (mmHg)	127	135.62±19.94	287	135.93±22.02
DBP (mmHg)	127	81.84±10.00	287	82.95±11.25
TG (mmol/L)	127	2.49±1.70	286	2.26±1.31
FPG (mmol/L)	127	6.01±2.76	286	5.97±2.96
FBG (g/L)	125	3.68±1.02	279	4.04±0.99
CHOL (mmol/L)	127	5.37±1.20	286	5.72±1.13
HDL (mmol/L)	127	1.02±0.38	286	1.16±0.40
LDL (mmol/L)	127	3.24±0.85	286	3.60±0.88

Abbreviations for traits referred in Tables 1, 3, 4, 5 and 6:
HEIGHT – body height; WAISTCF – waist circumference; HIPSCF – hips circumference; HIPSCF1 – hips circumference – the widest measure; BMI – body mass index; WHR – waist-hip ratio; SBP – systolic blood pressure; DBP – diastolic blood pressure; TG – triglycerides; FPG – fasting plasma glucose; FBG – fibrinogen; CHOL – cholesterol; HDL – high-density lipoprotein cholesterol, LDL – low-density lipoprotein cholesterol

TABLE 2
PREVALENCE (%) of METABOLIC SYNDROME IN VARIOUS AGE GROUPS

Age (years)	Male			Female		
	N	WHO*	NCEP	N	WHO	NCEP
–29	6	0.0±0.0	16.7±16.7	6	33.3±21.1	0.0±0.0
30–39	6	0.0±0.0	83.3±16.7	15	26.7±11.8	40.0±13.1
40–49	21	38.1±10.9	81.0±8.8	52	23.1±5.9	51.9±7.0
50–59	31	35.5±8.7	87.1±6.1	62	35.5±6.1	56.5±6.3
60–69	22	22.7±9.1	90.9±6.3	59	49.2±6.6	83.1±4.9
70–79	36	22.2±7.0	88.9±5.3	65	44.6±6.2	93.8±3.0
80–	5	20.0±20.0	100.0±0.0	28	42.9±9.5	92.9±5.0
Total	127	26.0±3.9	84.3±3.2	287	38.3±2.9	71.1±2.7

*WHO definition of MS, NCEP definition of MS

which BMI and WHR also have a relatively high influence. The *fourth* factor, explaining 10.9% of the total variance, present CHOL and HDL (weight 0.851 and 0.837).

On the basis of the performed analyses, several, not necessarily dependent explicative, hypotheses can be drawn. They refer to the population structure, to the frequency of particular components and to the manner of estimating MS, as well as to deliberations on the impact of intrinsic and/or extrinsic factors in the occurrence of MS.

In this study we investigated the prevalence of MS among the so-called integrated population, i.e. a reproductively open population, in the north-eastern part of Croatia. This area of Croatia is geographically bounded on the north by the state border with Hungary, on the east with Serbia with the state border mostly passing through the Danube river, and on the south with the Drava river which separates Baranja from the rest of the continental Croatia. Although it is geographically a distinctly defined area, the population is heterogeneous and consists of Croats, Hungarians, Serbs and others (mostly

TABLE 3
DESCRIPTIVE STATISTICS OF THE EXAMINED TRAITS IN BARANJA REGION FOR MALES BY ETHNIC GROUPS

Traits*	Croatians (N=76)	Hungarians (N=17)	Serbs (N=28)	Romany (N=6)
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Age (years)	58.5±14.8	59.2±12.4	63.1±15.4	50.0±17.7
HEIGHT (cm)	171.6±7.2	173.5±8.4	171.1±9.1	175.8±7.0
WAISTCF (cm)	97.6±12.8	100.3±13.4	101.8±16.9	94.8±13.5
HIPSCF (cm)	103.5±9.7	107.6±10.0	107.3±12.8	104.5±8.4
HIPSCF1 (cm)	97.9±9.3	103.4±8.6	102.8±12.9	101.0±10.4
WEIGHT (kg)	81.3±14.9	83.7±16.5	83.1±19.9	84.8±20.2
BMI (kg/m^2)	27.5±4.3	27.8±5.2	28.3±6.0	27.7±7.9
WHR	1.0±0.1	1.0±0.1	1.0±0.1	0.9±0.1
SBP (mmHg)	133.7±18.1	137.9±19.5	140.0±25.2	133.3±17.2
DBP (mmHg)	82.4±9.6	82.4±9.7	80.2±11.2	80.8±11.1
TG (mmol/L)	2.6±1.6	2.5±1.7	2.3±1.9	2.3±1.7
FPG (mmol/L)	5.9±2.4	6.2±4.3	6.1±2.6	6.4±2.2
FBG (g/L)	3.8±1.1	3.4±0.8	3.8±0.9	3.1±1.0
CHOL (mmol/L)	5.4±1.1	5.5±1.7	5.4±1.2	4.7±1.2
HDL (mmol/L)	1.0±0.4	1.0±0.4	1.1±0.4	1.0±0.4
LDL (mmol/L)	3.2±0.8	3.4±1.1	3.4±0.7	2.8±1.1

HEIGHT – body height; WAISTCF – waist circumference; HIPSCF – hips circumference; HIPSCF1 – hips circumference – the widest measure; BMI – body mass index; WHR – waist-hip ratio; SBP – systolic blood pressure; DBP – diastolic blood pressure; TG – triglycerides; FPG – fasting plasma glucose; FBG – fibrinogen; CHOL – cholesterol; HDL – high-density lipoprotein cholesterol, LDL – low-density lipoprotein cholesterol

TABLE 4
DESCRIPTIVE STATISTICS OF THE EXAMINED TRAITS IN BARANJA REGION FOR FEMALES BY ETHNIC GROUPS

Traits*	Croatians (N=161)	Hungarians (N=35)	Serbs (N=75)	Romany (N=16)
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Age (years)	57.9±15.2	62.3±14.8	63.4±13.7	65.3±14.2
HEIGHT (cm)	158.9±7.7	161.4±8.8	158.3±7.7	156.5±8.6
WAISTCF (cm)	95.2±15.3	94.0±15.0	93.7±14.1	96.4±13.2
HIPSCF (cm)	109.9±12.7	106.6±13.7	107.1±11.9	109.5±11.8
HIPSCF1 (cm)	102.4±11.5	103.4±14.2	102.2±12.3	100.7±11.0
WEIGHT (kg)	74.7±14.8	70.8±12.9	71.4±11.9	71.3±14.9
BMI (kg/m^2)	29.7±5.8	27.2±4.6	28.5±4.7	30.0±6.1
WHR	0.9±0.1	0.9±0.1	0.9±0.1	1.0±0.1
SBP (mmHg)	134.4±21.5	140.9±24.4	135.4±22.4	142.5±18.3
DBP (mmHg)	83.2±11.4	82.4±10.2	81.8±11.4	86.6±11.4
TG (mmol/L)	2.3±1.5	2.0±1.0	2.3±1.0	2.4±1.3
FPG (mmol/L)	6.1±3.3	5.9±2.7	6.0±2.6	5.1±1.0
FBG (g/L)	4.0±1.0	4.0±0.9	4.1±1.0	4.4±1.0
CHOL (mmol/L)	5.7±1.2	5.6±1.2	5.8±1.0	5.7±1.2
HDL (mmol/L)	1.1±0.4	1.2±0.4	1.2±0.4	1.1±0.4
LDL (mmol/L)	3.6±0.9	3.7±1.0	3.6±0.8	3.7±0.9

Note: factor loadings < 0.25 in absolute value omitted.
HEIGHT – body height; WAISTCF – waist circumference; HIPSCF – hips circumference; HIPSCF1 – hips circumference – the widest measure; BMI – body mass index; WHR – waist-hip ratio; SBP – systolic blood pressure; DBP – diastolic blood pressure; TG – triglycerides; FPG – fasting plasma glucose; FBG – fibrinogen; CHOL – cholesterol; HDL – high-density lipoprotein cholesterol, LDL – low-density lipoprotein cholesterol

TABLE 5
LOADING EIGENVALUES, PERCENT OF VARIANCE, COMMUNALITY AND ROTATED COMPONENT MATRIX OF FOUR METABOLIC SYNDROME FACTORS IN MALES

Variables *	Factor 1	Factor 2	Factor 3	Factor 4	Communality
Age (years)	0.288	0.263	–0.447	0.639	0.760
BMI (kg/m^2)	0.754				0.644
WHR	0.687	0.360			0.614
SBP (mmHg)		0.854			0.771
DBP (mmHg)		0.858			0.795
TG (mmol/L)	0.410		0.682		0.676
FPG (mmol/L)	0.702				0.568
FBG (g/L)				0.697	0.494
CHOL (mmol/L)			0.846		0.794
HDL (mmol/L)			0.474	0.618	0.621
Eigenvalue	2.370	1.635	1.589	1.143	
Percent of Variance	23.703	16.350	15.886	11.432	
Cumulative Percent	23.703	40.053	55.939	67.372	

HEIGHT – body height; WAISTCF – waist circumference; HIPSCF – hips circumference; HIPSCF1 – hips circumference – the widest measure; BMI – body mass index; WHR – waist-hip ratio; SBP – systolic blood pressure; DBP – diastolic blood pressure; TG – triglycerides; FPG – fasting plasma glucose; FBG – fibrinogen; CHOL – cholesterol; HDL – high-density lipoprotein cholesterol, LDL – low-density lipoprotein cholesterol

TABLE 6
LOADING EIGENVALUES, PERCENT OF VARIANCE, COMMUNALITY AND ROTATED COMPONENT MATRIX OF FOUR METABOLIC SYNDROME FACTORS IN FEMALES

Variables *	Factor 1	Factor 2	Factor 3	Factor 4	Communality
Age (years)	0.331	0.697			0.626
BMI (kg/m^2)	0.361		0.490		0.420
WHR		0.587	0.521		0.628
SBP (mmHg)	0.836				0.769
DBP (mmHg)	0.883				0.791
TG (mmol/L)			0.877		0.796
FPG (mmol/L)		0.447	0.325		0.380
FBG (g/L)		0.722			0.582
CHOL (mmol/L)			0.322	0.851	0.839
HDL (mmol/L)				0.837	0.762
Eigenvalue	2.737	1.496	1.268	1.093	
Percent of Variance	27.370	14.957	12.681	10.927	
Cumulative Percent	27.370	42.328	55.009	65.936	

Note: factor loadings < 0.25 in absolute value omitted.
HEIGHT – body height; WAISTCF – waist circumference; HIPSCF – hips circumference; HIPSCF1 – hips circumference – the widest measure; BMI – body mass index; WHR – waist-hip ratio; SBP – systolic blood pressure; DBP – diastolic blood pressure; TG – triglycerides; FPG – fasting plasma glucose; FBG – fibrinogen; CHOL – cholesterol; HDL – high-density lipoprotein cholesterol, LDL – low-density lipoprotein cholesterol

Romany). We did not find significant differences in MS prevalence either in men or in women. Thus the results should be accepted as the prevalence of MS and its components in genetically heterogeneous population, in contrast to the results of prevalence presented by Rudan[3], Deka et al.[4] and Kolcic et al[5], obtained from endogamous populations of the Adriatic islands that are roughly identical. Therefore, we conclude that the increased prevalence of MS and its components, i.e. their phenotype, along with intrinsic (genetic) factors, can also be conditioned by a series of exogenous factors (like nutritional habits, physical activity). We can presume that in the evaluation of phenotype expression of MS, various influences of both intrinsic and extrinsic factors can present with the same phenotype. Here the question arises which of these factors has a more prominent role in the prevalence of MS. It is known that the population of Baranja has clearly marked and different type of nutrition from the inhabitants of the Adriatic islands. It is primarily saturated by fats of animal origin and substantial quantities of animal proteins, in contrast to the so-called Mediterranean type nutrition, characteristic for the island inhabitants in the Adriatic. Thus we argue that the real evaluation of MS prevalence in a population should be based on the analyses of both intrinsic (genetic) and extrinsic (environmental) factors influencing the formation of the human morphological and biochemical phenotype. Here we again meet the eternal issue of evaluating eco-sensitivity of particular human phenotype segments (e.g. Hiernaux, 1963[11]). An attempt to obtain information on a common (genetic and/or environmental) factor determining the formation of their genotype through the analysis of the factorial structure of MS components is based on the hypotheses of Howells[17], Roberts and Coope[18], Jantz and Owsley[19] and Simic et al.[20]. Some logical groupings of MS components in accordance with individual extracted factors suggest the necessity of further research, primarily related to age and gender structure of a population, but also to interactive processes of intrinsic and/or extrinsic factors influencing the formation of phenotypes of particular MS components. The comparison of MS prevalence in reproductively more closed and more open populations is in our opinion a method of choice. Hiernaux's ideas[11], clearly expressed already in 1963, in the paper entitled »Heredity and environment: their influence on human morphology. A comparison of two independent lines of study« have, in our opinion, reached their full recognition.

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PREVALENCIJA METABOLIČKOG X SINDROMA U REGIJI BARANJE

SAŽETAK

Metabolički sindrom (MS) skup je metaboličkih čimbenika opasnosti koji su povezani s razvojem kardiovaskularnih bolesti i šećerne bolesti tipa 2. Velikog je i sve većeg javnozdravstvenog značaja u razvijenim zemljama i zemljama u razvoju. Ranije smo objavili prevalenciju tog sindroma u nekoliko izoliranih otočkih populacija Hrvatskog istočnog Jadrana. Prevalencija MS u tim populacijama je visoka, ako se podaci usporede s onima u razvijenim zemljama, unatoč tome što se na tim otocima provodi relativno tradicijski način življenja koji uključuje korištenje mediteranske prehrane, No međutim, podaci o učestalosti MS u kopnenom dijelu Hrvatske su oskudni. Stoga smo proveli istraživanje u populaciji koja obuhvaća Hrvate, Mađare i Srbe iz regije Baranje, koja se nalazi u kopnenom dijelu Hrvatske. Iako se radi o etnički heterogenoj populaciji, ona nije reprodukcijski izolirana, način života među tim skupinama je sličan, kao što smo ustanovili i sličnu učestalost MS. Dijagnozu MS postavili smo na osnovi kriterija koje je predložila Svjetska zdravstvena organizacija (SZO) i Nacionalni program kolesterolske poduke (NCEP). U toj analiziranoj kozmopolitskoj skupini, ustanovili smo visoku sveukupnu prevalenciju MS: prema kriterijima SZO prevalencija u muškaraca iznosi 26%, u žena 38%, dok prema kriterijima NCEP u muškaraca iznosi čak 84%, a u žena 71%. Čini se da pored genetskih čimbenika opasnosti, mnoštvo čimbenika okoline utječe na razinu sastavnih metaboličkih značajki koje vode ka porastu prevalencije MS, a što uključuje navike prehrane i relativno gradski način života u moderniziranom društvu.