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Original article ■

Evaluation of Anthropometric Indices for Metabolic Syndrome and their Association with Metabolic Risk Factors among Healthy Individuals in New Belgrade

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SUMMARY

People with metabolic syndrome (MetSy) are about twice as likely to develop cardiovascular disease and over four times as likely to develop type 2 diabetes compared to subjects without metabolic syndrome. Waist circumferences (WC) and body mass index (BMI) are useful screening tools for making the diagnosis. MetSy has increased the health risk in primary care. The aim of the study was to evaluate the anthropometric indices for MetSy and determine which of simple anthropometric measurements is most closely associated with metabolic risk factors.

The research included 264 individuals, of which 132 men with mean age (±SD) of 44.73 ±9.37 years and 132 women with mean age (±SD) of 46.67±8.44 years. Antropometric indicators were measured using standard protocols, without shoes and outerwear. BMI was calculated as weight/height^2(kg/m^2) ratio, as recommended by the World Health Organization (WHO). Blood pressure measurements were obtained with the subject in a seated position by using a standard mercury sphygmomanometer. Blood samples were obtained after a minimum of 12-h fast; the metabolic parameters (high-density lipoprotein-cholesterol, low-density lipoprotein-cholesterol, triglycerides, blood glucose) were analyzed by standard procedures. Analysis of the examinees' medical records was also performed. Metabolic syndrome was diagnosed using the International Diabetes Federation (IDF) criteria. The analysis of the research results were performed using the Statistical Package for Social Science version 10.0 (SPSS 10.0 for Windows).

The prevalence of the metabolic syndrome was 44.7% in men and 43.2% in women. Normal-weight subjects of both sexes were significantly younger and had significantly lower blood glucose, total cholesterol, LDL and triglycerides than overweight and obese subjects. Systolic and diastolic blood pressure values were significantly increased in parallel with increasing of BMI. For the whole sample, both anthropometric indices had significant associations with the other five components of MetSy.

Waist circumference is a simple measure of adiposity most strongly associated with metabolic abnormalities. The results obtained in this study indicate that WC is a good indicator of health risk in women but not in men. Measurement of WC by BMI categories may indicate a person with an increased risk of development of chronic diseases.

***Key words:* waist circumference, body mass index, metabolic syndrome, health risk appraisal**

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INTRODUCTION

The prevalence of metabolic syndrome (MetSy) has dramatically increased with the rapid development of economy and society. Changed lifestyle, dietary pattern and low regular physical activity have also shown to be the major risk factors for cardiovascular disease (CVD), diabetes, and other chronic diseases (1, 2). It has been estimated that 17-25% of the world population have MetSy, and the importance of the metabolic syndrome lies largely in the development of cardiovascular diseases and type 2 diabetes mellitus (3). Genetic factors, aging, hormonal factors and proinflammatory conditions may affect the occurrence of MetSy (4, 5).

In 1999, the WHO criteria for MetSy and BMI were considered to be among the optional criteria. As for the development of the MetSy definitions, waist circumference (WC) has been an optional component of MetSy, according to the Adult Treatment Panel III (ATPIII) Guideline (6). In the International Diabetes Federation (IDF) criteria (2005), central obesity is the major driver of MetSy developments (5, 6).

WC and BMI are useful screening tools for identifying obesity. Each index has different associations with obesity-related physiological and pathological processes (1, 3). Of many ways of measuring body fat and its distributions, anthropometric measurements still play an important role in clinical practice (7, 8).

BMI cut-off points may vary with age, gender, and menopausal status because of variation in body composition. While BMI is a convenient marker of the overall adiposity, it does not distinguish between fat and lean body mass, or between central adiposity, a better correlate of insulin resistance (IR) and peripheral adiposity. Compared to BMI, WC is a better measurement of abdominal fat accumulation. It is unclear if direct measures of adiposity add further information about the link between adiposity and MetSy components in lean populations beyond BMI and WC (9).

The aim of the study was to evaluate the anthropometric indices for metabolic syndrome (MetSy), to determine which of these adiposity measures are the best predictors of metabolic risk factors and assess whether the combination of BMI and WC is a better indicator of metabolic risk.

EXAMINEES AND METHODS

The study included 264 examinees (132 men, mean age 44.73±9.37 years and 132 women, mean age 44.73±9.37 years), who were on a regular systematic review in the Preventive center "Novi Beograd", in the period September-October, 2007. After the analysis of subjects'medical records, we excluded individuals with diabetes and CVD.

In the study groups, clinical examinations were performed including blood pressure measurement, as well as blood biochemistry, and evaluation of anthropometric parameters, nutritional status and metabolic risk factors.

Participants attended the survey site early in the morning (6:30-9:30 A.M.) after 12 hours fasting. Anthropometric measurements were performed with subjects in light clothing and barefooted, and under standard procedures (10).

Body weight was measured to the nearest 0.1 kg using a digital scale (SECAW, Columbia, USA), and height to the nearest centimetre using a wall stadiometer (SECAW, Hamburg, Germany). From these values, BMI was calculated as recommended by the World Health Organization (WHO) - weight in kilograms divided by the square of height in meter (10). According to the nutritional status, the subjects were divided into three groups: group 1 - normal-weight (BMI=18.5 to 24.99 kg/m^2), group 2 - overweight (BMI=25.00 to 29.99 kg/m^2); group 3 - obese (BMI≥30kg/m^2).

Waist circumference was measured with subject wearing light clothing (underwear) at a level midway between the lower rib margin and iliac crest to the nearest centimeter using a plastic, nonstretchable tailor's measuring tape. The measurements were recorded in centimeters.

Blood pressure was measured to the nearest 2 mmHg on the right arm with subjects seated, after at least 10 min of rest, using a standard mercury sphygmomanometer. The mean of the two readings was taken as each individual's blood pressure.

Evaluation of metabolic risk factors included the determination of blood glucose, total cholesterol, HDL-C, low density lipoprotein (LDL-C) and triglycerides. Two sets of fasting blood samples were collected from each subject in sodiumfluoride potassium oxalate tubes (for glucose) and lithium heparin vacuum tubes (for lipids). Blood glucose concentration was determined by the oxidation of glucose (glucose analyzer Beckman Coulter). Total cholesterol, HDL, LDL and triglycerides were determined by chromatography (accessories Boeringher Mannheim). Reference values for serum lipid profile and fasting glucose were determined on the basis of The International Diabetes Federation (IDF) diagnstic criteria for MetSy (4).

IDF diagnostic criteria for metabolic syndrome (5) are listed as following:

WC equal or greater than 80 cm in women or WC equal or greater than 94 cm in men plus 2 or more of the following:

- Low HDL cholesterol with values equaling or lower than 1.03 mmol/L for men and 1.29 mmol/L for women.
- Hypertriglyceridemia with values higher than 1.7 mmol/L or under treatment.
- Arterial hypertension with values equaling or higher than 130/85 mmHg, or under treatment;
- Fasting hyperglycemia with values equaling or higher than 5.6 mmol/L , or under treatment.

All data were expressed as mean value ± standard deviation (SD) unless other indicated. Descriptive analyses were performed for all variables, and analyses of variance were used to assess differences among groups for the continuous variables. Partial correlation coefficients were conducted to estimate the relationships between obesity indicators and metabolic risk factors. All statistical analyses were performed using the Statistical Package for Social Science version 10.0 (SPSS for Windows). All P values were based on two-sided tests with a significance level of 0.05.

RESULTS

Characteristics of subjects

Of 264 subjects, there were 132 men with mean age (±SD) 44.73±9.37 years and 132 women with mean age (±SD) 46.67±8.44 years. Characteristics of study subjects and the level of metabolic risk components are shown in Table 1.

Among the examinees, according to the criteria of IDF, MetSy was found in 44.7% of men and 43.2% of women. No statistically significant difference was found between the prevalence of MetSy in males and females (Table 2).

Among subjects with normal BMI, only 5 men had WC≥94cm, and 19 women had WC≥80cm (Table 3).

Normal-weight subjects of both sexes were significantly younger and had significantly lower blood glucose, total cholesterol, LDL and triglycerides than overweight and obese subjects. Systolic and diastolic blood pressure values were significantly increased in parallel with increasing BMI ($p<0.001$) (Table 4).

In addition to waist circumference ($p<0.001$), normal-weight men had significantly lower serum glucose level ($p<0.05$) and triglycerides compared to overweight and obese men, and higher HDL cholesterol compared to obese subjects (Table 5).

Normal-weight women were significantly younger than obese and overweight ($p<0.001$). All valuable WC and laboratory parameters were significantly increased with increasing BMI. HDL cholesterol in normal weight women was significantly higher than in other subjects (Table 6).

Relationship between anthropometric indices and metabolic risk factors

Table 7 shows correlations between anthropometric indices and nonadipose components of MetSy for the whole sample, according to the criteria of IDF. For the whole sample, both anthropometric indices had significant associations with the five nonadipose components of MetSy.

In men, BMI was positively related to body mass, blood pressure, blood glucose and triglyceride levels, while negatively correlated with HDL cholesterol. WC values in men were significantly associated only with the values of body mass ($r=0.58$, $p<0.01$) and BMI ($r=0.78$, $p<0.01$) (Table 8).

In women, WC values show a significant correlation with all parameters and values of body weight, and BMI were significantly associated with all indicators, except triglycerides (Table 9).

Table 1. *Characteristics of subjects (Mean±SD)*

Variable	Male (n=132)	Female (n=132)
Age (years)	44.73±9.37	46.67±8.44
Waist circumference(cm)	101.43±12.38	84.07±14.30
Body mass index (kg/m^2)	27.79±3.63	24.60±4.45
Systolic blood pressure(mmHg)	131.25±15.79	122.16±15.25
Diastolic blood pressure(mmHg)	85.00±11.41	77.58±10.44
Blood glucosa(mmol/l)	5.64±1.36	5.37±0.65
Total cholesterol(mmol/l)	5.61±0.87	5.33±0.64
LDL cholesterol(mmol/l)	2.83±0.84	2.49±0.52
HDL cholesterol(mmol/l)	1.40±0.32	1.24±0.19
Triglycerides (mmol/L)	2.30±1.20	1.62±0.96

Table 2. *Number and percentage of subjects with abnormal value*

Variable	Male (n=132)	Female (n=132)	Statistical significance
BMI<25 kg/m^2	21 (15.9%)	74 (56.1%)	χ^2=83.89;p<0.001
BMI=25-29.9 kg/m^2	76 (57.6%)	40 (30.3%)	χ^2=19.85;p<0.001
BMI≥30 kg/m^2	35 (26.5%)	18 (13.6%)	χ^2=6.80; p=0.009
WC≥94 cm (m); 80 cm (f)	91 (68.9%)	74 (56.1%)	χ^2=4.65; p=0.031
SBP≥130 mmHg	73 (55.3%)	53 (40.2%)	χ^2=6.05; p=0.014
DBP≥85 mmHg	72 (54.5%)	41 (31.1%)	χ^2=14.87;p<0.001
Blood glucose≥5.6 mmol/L	43 (32.6%)	57 (43.2%)	ns
Total cholesterol≥5.2 mmol/L	67 (50.8%)	48 (36.4%)	χ^2=5.56 i p=0.018
LDL cholesterol≥2.6 mmol/L	62 (47.0%)	44 (33.3%)	χ^2=5.11 i p=0.024
HDL cholesterol<1.04 mmol/L (m); 1.29 (f)	6 (4.5%)	19 (14.4%)	χ^2=7.47 i p=0.006
Triglycerides≥1.7mmol/L	73 (55.3%)	41 (31.1%)	χ^2=15.81;p<0.001
METABOLIC SYNDROME	59 (44.7%)	57 (43.2%)	ns

Mantel-Haenszel chi square test (χ2 value) ns - no significant difference

Table 3. *Number and percentage of subjects with MetSy and abnormal value of WC according to BMI category*

Variable	Normal weight (n=21)	Overweight (n=76)	Obesity (n=35)	Statistical significance (Mantel-Haenszelχ^2 or Fisher's test)
WC≥94cm (m)	5 (23.8%)	52 (68.4%)	34 (97.1%)	A‡,B‡, C†
METABOLIC SYNDROME	1 (4.8%)	35 (46.1%)	23 (65.7%)	A†, B‡
	Normal weight (n=74)	**Overweight (n=40)**	**Obesity (n=18)**	
WC≥80cm (f)	19 (25.7%)	37 (92.5%)	18 (100.0%)	B‡
METABOLIC SYNDROME	15 (20.3%)	29 (72.5%)	13 (72.2%)	A‡, B‡

A - optimal weight vs overweight; B - optimal weight vs obese; C - overweight vs obese; * - p<0.05; † - p<0.01; ‡ - p<0.001; ns - no significant difference

Table 4. *Average values of age, WC, BP, glycemia, cholesterol and triglycerides of the whole sample according to BMI category*

Variable	Normal weight (n=95)	Overweight (n=116)	Obesity (n=53)	ANOVA i Dunnet's test)
Ages (years)	42.96±8.68	47.09±8.75	47.57±8.85	A†, B†
Waist circumference (cm)	78.06±9.71	95.83±8.84	112.34±11.59	A‡, B‡, C‡
Systolic blood pressure (mmHg)	119.95±16.33	128.49±14.69	134.91±14.16	A‡, B‡, C*
Diastolic blood pressure (mmHg)	76.11±11.09	82.63±10.50	87.64±10.59	A‡, B‡, C*
Blood glucosa (mmol/l)	5.20±0.60	5.61±1.12	5.82±1.44	A†, B*
Total cholesterol (mmol/l)	5.11±0.71	5.65±0.75	5.73±0.71	A‡, B‡
LDL cholesterol (mmol/l)	2.40±0.69	2.82±0.75	2.78±0.57	A‡, B†
HDL cholesterol (mmol/l)	1.38±0.29	1.30±0.29	1.28±0.21	ns
Triglycerides (mmol/L)	1.52±1.12	2.16±1.05	2.31±1.12	A‡, B‡

A - optimal weight vs overweight; B - optimal weight vs obese; C - overweight vs obese; * - p<0.05; † - p<0.01; ‡ - p<0.001; ns - no significant difference

Table 5. *Average values of ages, WC, BP, glycemia, cholesterol and triglycerides of men according to BMI category*

Variable	Normal weight (n=21)	Overweight (n=76)	Obesity (n=35)	ANOVA i Dunnet's test)
Ages (years)	40.95±9.80	45.64±9.41	45.00±8.69	ns
Waist circumference (cm)	89.33±5.77	98.87±8.41	114.26±11.86	A‡, B‡, C‡
Sistolic blood pressure (mmHg)	127.86±23.00	130.33±13.74	135.29±14.40	ns
Diastolic blood pressure (mmHg)	82.14±13.47	84.67±10.56	87.43±11.72	ns
Blood glucosa (mmol/l)	5.14±0.38	5.64±1.32	5.94±1.71	A*, B*
Total cholesterol (mmol/l)	5.33±1.21	5.65±0.80	5.67±0.76	ns
LDL cholesterol (mmol/l)	2.74±1.12	2.90±0.85	2.75±0.58	ns
HDL cholesterol (mmol/l)	1.59±0.41	1.39±0.32	1.33±0.23	B*
Triglycerides (mmol/L)	1.65±0.81	2.38±1.20	2.50±1.30	A†, B*

A - optimal weight vs overweight; B - optimal weight vs obese; C - overweight vs obese; * - p<0.05; † - p<0.01; ‡ - p<0.001; ns - no significant difference

Table 6. *Average values of ages, WC, BP, glycemia, cholesterol and triglycerides of women according to BMI category*

Variable	BMI<25 kg/m^2(n=74)	BMI=25-29.9kg/m^2 (n=40)	BMI≥ 30kg/m^2(n=18)	ANOVA i Dunnet's test)
Ages (years)	43.53±8.32	49.85±6.62	52.56±6.96	A‡, B‡
Waist circumference (cm)	74.86±8.08	90.05±6.51	108.61±10.34	A‡, B‡, C‡
Systolic blood pressure (mmHg)	117.70±13.25	125.00±15.93	134.17±14.06	A*, B‡
Diastolic blood pressure (mmHg)	74.39±9.76	78.75±9.32	88.06±8.25	A*, B‡, C†
Blood glucosa (mmol/l)	5.22±0.65	5.56±0.58	5.60±0.68	A*, B*
Total cholesterol (mmol/l)	5.04±0.48	5.65±0.65	5.83±0.59	A‡, B‡
LDL cholesterol (mmol/l)	2.31±0.46	2.68±0.47	2.83±0.56	A‡, B†
HDL cholesterol (mmol/l)	1.31±0.21	1.13±0.12	1.18±0.10	A‡, B†
Triglycerides (mmol/L)	1.48±1.19	1.73±0.41	1.96±0.50	B*

A - optimal weight vs overweight; B - optimal weight vs obese; C - overweight vs obese; * - p<0.05; † - p<0.01; ‡ - p<0.001; ns - no significant difference

Table 7. *Correlation coefficients between anthropometric indices and other components for MetSy*

Variable	Body height	Body mass	WC	BMI	SBP	DBP	Blood glucose	Total cholesterol	LDL-C	HDL-C	Triglycerides
Ages	-0.06	-0.03	0.17†	0.21†	0.13*	0.13*	0.25†	0.18†	0.19†	0.08	0.02
Body height		0.01	0.07	0.06	0.03	0.01	0.06	0.07	0.06	0.05	0.02
Body mass			0.78†	0.85†	0.36†	0.40†	0.24†	0.22†	0.16†	0.03	0.31†
WC				0.87†	0.32†	0.35†	0.22†	0.35†	0.30†	0.07	0.30†
BMI					0.35†	0.38†	0.28†	0.32†	0.22†	0.16†	0.28†
SBP						0.84†	0.14*	0.15*	0.16†	0.03	0.32†
DBP							0.14*	0.19†	0.20†	0.07	0.36†
Blood glucose								0.12	0.12	0.09	0.15*
Total cholesterol									0.81†	0.26†	0.25†
LDL-C										0.19†	0.26†
HDL-C											0.13*

* - p<0.05; † - p<0.01

Table 8. *Correlation coefficients between anthropometric indices and other components for MetSy-men*

Variable	Body height	Body mass	WC	BMI	SBP	DBP	Blood glucose	Total cholesterol	LDL-C	HDL-C	Triglycerides
Ages	-0.39†	-0.12	0.17	0.12	0.05	-0.01	0.29†	0.21*	0.22*	0.05	0.02
Body height		0.57†	-0.07	0.07	0.08	0.12	0.01	-0.24†	-0.30†	-0.08	0.05
Body mass			0.58†	0.83†	0.19*	0.23*	0.20*	-0.02	-0.15	-0.25†	0.24†
WC				0.78†	0.03	0.01	0.11	0.11	0.06	-0.17	0.13
BMI					0.19*	0.20*	0.26†	0.09	-0.01	-0.25†	0.26†
SBP						0.80†	0.08	0.04	0.05	-0.05	0.30†
DBP							0.07	0.10	0.08	-0.13	0.30†
Blood glucose								0.09	0.06	-0.06	0.09
Total cholesterol									0.85†	-0.26†	0.19*
LDL-C										-0.20*	0.13
Ages											-0.24†

* - p<0.05; † - p<0.01

Table 9. *Correlation coefficients between anthropometric indices and other components for MetSy-women*

Variable	Body height	Body mass	WC	BMI	SBP	DBP	Blood glucosa	Total cholesterol	LDL-C	HDL-C	Triglycerides
Ages	-0.06	0.27†	0.38†	0.42†	0.31†	0.41†	0.25†	0.20*	0.22*	-0.24†	0.09
Body height		-0.07	-0.11	-0.08	0.03	0.01	-0.15	-0.09	-0.08	0.10	-0.04
Body mass			0.76†	0.89†	0.31†	0.33†	0.25†	0.40†	0.33†	-0.32†	0.05
WC				0.91†	0.35†	0.41†	0.35†	0.54†	0.44†	-0.47†	0.21*
BMI					0.35†	0.39†	0.31†	0.49†	0.37†	-0.40†	0.13
SBP						0.84†	0.19*	0.19*	0.18	-0.23*	0.20*
DBP							0.21*	0.21*	0.22*	-0.27†	0.26†
Blood glucosa								0.12	0.19*	-0.37†	0.21*
Total cholesterol									0.71†	-0.48†	0.23*
LDL-C										-0.46†	0.35†
Ages											-0.21*

* - p<0.05; † - p<0.01

DISCUSSION

The prevalence of dyslipidemia, angina pectoris and myocardial infarction, as well as the lethal outcome, is higher in overweight patients (11). Not only BMI but also the distribution of body fat has a direct impact on the occurrence of metabolic disorders that lead to the metabolic syndrome (7, 8).

The study included 264 examinees (132 men, mean age 44.73±9.37 years and 132 women, mean age 44.73±9.37 years), who were on a regular systematic check-up with no history of diabetes or cardiovascular disease. Our participants performed an easy physical work and lead a sedentary lifestyle.

In our study, metabolic syndrome was diagnosed in 59 men (44.7%) and 57 females (43.2%). It has been estimated that 17-25% of the world population has MetSy, and in people with DM the reported prevalence rates range from 59% to 61% (3). The authors who have studied this problem found different data. Ardern et al. (8) showed that 17% of men and 13.2% of women in Canada have MetSy, while the prevalence of MetSy among U.S. adults was 24,0% in men and 23.4% in women (12). According to the literature, the MetSy frequency ranges from 9% to 32% depending on the ethnic background of the examined population and the definition of the metabolic syndrome, which is used for establishing the diagnosis (5, 8). As can be seen from the data, the frequency of MetSy depends on gender, ethnicity, and is directly related to age. In the western populations, the MetSy frequency is higher and more common in men, while the Chinese and Arabs MetSy is more common in women. The prevalence of MetSy in the European population by IDF classification was 35.9% in men and 34.1% in women (5).

Studies have shown that MetSy is related to obesity. However, some studies have shown that there is a subgroup of obese, which is metabolically normal (13). Our research showed that MetSy is reported in 65.7% of obese men and in 72.2% of obese women, while in the category of normal weight subjects the syndrome occurs in 4.8% of men and 20.3% women. According to the NHANES (1988-1994), in normal weight individuals MetSy was reported in 4.6% of men, in 22.4% in the overweight group, and in 59.6% in obese group; similar distribution was observed in women, and even then Insulin Resistance Atherosclerosis Study suggested that waist circumference was introduced as a measure of obesity to predict the incidence of MetSy (5). Recent studies have shown that only about 7% of normal weight males, 30% of overweight males and 65% of obese males had MetSy. Slightly more than 9% of normal weight females, 33% of overweight females, and 56% of obese females had MetSy (13).

In people who are normally-nourished and obese, the prevalence of metabolic syndrome increases with increasing of waist circumference. If BMI≥30 kg/m^2, it points to the existence of central obesity (8). The prevalence of abdominal obesity in our study was 68.9% in men and 56.1% in women. In the group of normal-weight men and women, the prevalence of abdominal obesity was 23.8% and 25.7%, respectively. In the overweight group, 68.4% of men and 92.7% of women had increased WC, while in the obese group abdominal obesity occurs in 97.1% of men and 100% of women. In a study conducted by Ardren et al. (8), 65% of obese men and 80% of women had values higher than the WC limit values; in the group of overweight people, 13% of men and 27% of women had high levels of WC. Janssen et al. (14) have obtained similar findings: increased levels of WC had in the normal-weight category 1.0% of men and 13.7% of women, in the overweight group 27.6% of men and 71.6% of women, while the prevalence of abdominal obesity in the obese group was 84.8% of men and 97.6% of women. These data confirm previous studies that show that there is abdominal obesity if BMI≥ 30kg/m^2, in the case of which WC does not have to be measured (8).

Studies have shown that there were differences in the prevalence of each of the individual risk factors by sex. Males had a higher prevalence of hypertriglyceridemia, hypertension, and hyperglycemia than females, but females had a higher prevalence of abdominal obesity and low HDL cholesterol than males (13). In the examined male elements, that are commonly associated with the development MetSy, were elevated serum triglycerides (55.3%) and the presence of hypertension and impaired glycemic control (32.6%), while the WC and low HDL cholesterol were less important. In groups of women the most common elements of the metabolic syndrome were waist circumferences (56.1%), impaired glycemic control (43.2%) and elevated serum triglycerides (31%).

Analysis of the data confirmed a significant positive correlation between BMI and other parameters, and values of body weight and waist circumference were significantly positively interdependent with all indicators, except for HDL cholesterol.

This indicates that both anthropometric factors correlated with risk factors for cardiovascular disease. In the examined men, BMI showed a significant correlation with all factors: BMI is significantly positively correlated with the values of body mass, WC, blood pressure, blood glucose and triglyceride levels, while negatively correlated with HDL cholesterol. In men, WC values are positively related only with the values of body weight and BMI. In the examined women, WC values show a significant correlation with all measured parameters, and values of body weight and BMI are not correlated only with triglycerides.

In many studies, as in our study, it was shown that abdominal obesity in women is associated with metabolic syndrome and the presence of risk factors for cardiovascular disease, while the health risks associated with high WC are limited only to overweight men (15). However, studies have shown that both factors correlated with all 10 risk factors for cardiovascular disease in young adults of both sexes, and in the elderly these anthropometric factors are correlated with 8 of 10 risk factors (14). WC is increasingly being proposed as a better predictor of cardiovascular risk than BMI. However, few direct comparisons exist between BMI and WC as predictors of metabolic abnormalities in the elderly, and evidence tends to come from studies with a wide population range. In the third National Health and Nutrition Examination Study and in population studies from Canada, Hong Kong, and Japan, WC was more closely related to metabolic risk factors than was BMI (7).

The limitation of the study is the small sample size, so the results cannot be applied to the urban population in Serbia. Since the sample is small and we excluded examinees with diabetes and CVD, there is a possibility that among subjects not diagnosed with diabetes the frequency of MetSy and individual metabolic factors are higher than in similar studies. However, as in many studies, in our study the males had higher prevalence of hypertriglyceridemia, hypertension, and hyperglycemia than females, but females had higher prevalence of abdominal obesity and low HDL cholesterol compared to males. Therefore, the relationships between adiposity measures and MetSy in this report are the same as in many similar studies.

CONCLUSION

Results of our study indicate that MetSy is present in a high percentage in healthy individuals in Belgrade, which refers to both males and females. Determination of waist circumference is a quick and simple method for the assessment of central obesity. Anthropometric indices (BMI and WC) are useful screening tools for obesity, MetSy or its components, and CVD risk factors. The results obtained in this study indicate that WC is a good indicator of health risk in women but not in men. Measurement of WC by BMI categories may indicate a person with an increased risk of development of chronic diseases.

References

1. Lauenborg J, Mathiesen E, Hansen T, et al. The Prevalence of the Metabolic Syndrome in a Danish Population of Women with Previous Gestational Diabetes Mellitus Is Three-Fold Higher than in the General Population. J Clin Endocrinol Metab 2005;90(7):4004-10. http://dx.doi.org/10.1210/jc.2004-1713 PMid:15840755
2. Antić S, Lazarević G, Velojić M, Dimić D, Stefanović V. Exercise as a therapeutic option in cardiometabolic risk reduction. Med Pregl 2009; 62 Suppl3:59-65. PMid:19702118
3. Ogbera OA. Prevalence and gender distribution of the metabolic syndrome. Diabetologyand Metabolic Syndrome 2010;2:1. doi:10.1186/1758-5996-2-1. http://dx.doi.org/10.1186/1758-5996-2-1
4. Thiruvagounder M, Khan S, Sheriff DS. The prevalence of metabolic syndrome in a local population in India. Biochemia Medica 2010; 20(2):249-52.
5. Day C. Metabolic syndrome, or What you will: definitions and epidemiology. Diabetes and Vascular Disease Research 2007;4(1):32-8. http://dx.doi.org/10.3132/dvdr.2007.003 PMid:17469041
6. He YH, Chen YC, Jiang GX, et al. Evaluation of anthropometric indices for metabolic syndrome in Chinese adults aged 40 years and over. Eur J Nutr 2012; 51 (1):81-7. http://dx.doi.org/10.1007/s00394-011-0195-2 PMid:21479941
7. Wannamethee SG, Shaper AG, Morris R, Whincup P. Measures of adiposity in the identification of metabolic abnormalities in elderly men. Am J Clin Nutr 2005; 81 (6): 1313-21. PMid:15941881
8. Ardern CI,Katzmarzyk PT, Janssen I, Ross R. Discrimination of Health Risk by Combined Body Mass Index and Waist Circumference. Obes Res2003;11:135-42. http://dx.doi.org/10.1038/oby.2003.22 PMid:12529496
9. Ouyang F, Necheles J, Wang B. Association of surrogate and direct measures of adiposity with risk 1 of metabolic syndrome in ruralChinese women. Eur J Nutr 2009;48(6):323-32. http://dx.doi.org/10.1007/s00394-009-0016-z PMid:19337772
10. Lee DR, Neiman CD. Nutritional assessment, 4TH ED. Singapore: Mc-Graw-Hill Education, 2007.
11. Cvetković D, Ilić-Deljanin M, Nikolić M. Prevalence of metabolic syndrome in patients with arterial hypertension in relation to sex in the municipality of Niš. ACTA FAC MED NAISS 2006;23 (4):209-14.
12. Ford ES, Giles WH, Dietz WH. Prevalence of metabolic syndrome among U.S. adults: findings from the Third National Health and Nutrition Examination Survey. JAMA 2002; 287:356-9. http://dx.doi.org/10.1001/jama.287.3.356 PMid:11790215
13. Ervin RB. Prevalence of metabolic syndrome among adults 20 years of age and over, by sex, age, race and ethnicity, and body mass index: United States, 2003-2006. Natl Health Stat Report 2009;5(13):1-7.
14. Janssen I, Katzmarzyk P, Ross R. Body mass index, waist circumference and health risk. Arch Intern Med 2002;162:2074-79. http://dx.doi.org/10.1001/archinte.162.18.2074 PMid:12374515
15. Janssen J, Katzmarzyk TP, Ross R. Weist circumference and not body masa index explains obesity - related health risk. Am J ClinNutr 2004;79:379-84. PMid:14985210

EVALUACIJA ANTROPOMETRIJSKIH INDIKATORA METABOLIČKOG SINDROMA I NJIHOVA POVEZANOST SA METABOLIČKIM FAKTORIMA RIZIKA KOD ZDRAVIH OSOBA U NOVOM BEOGRADU

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Sažetak

Osobe sa metaboličkim sindromom (MetSy) imaju dva puta veće šanse da obole od kardiovaskularnih bolesti i preko četiri puta veće šanse da obole od dijabetesa tipa 2 u odnosu na osobe bez metaboličkog sindroma. Obim struka (OS) i indeks telesne mase (ITM) korisne su skrining metode za dijagnostikovanje MetSy i povećanog zdravstvenog rizika u primarnoj zdravstvenoj zaštiti.

Cilj studije bio je da se procene antropometrijski indeksi metaboličkog sindroma i da se utvrdi koja su od jednostavnih antropometrijskih merenja povezana sa metaboličkim faktorima rizika.

Istraživanje je obuhvatilo 264 pojedinaca, 132 muškarca prosečne starosti (±SD) od 44.73±9.37 godina i 132 žene prosečne starosti (±SD) od 46.67±8.44 godina. Antropometrijski indikatori su mereni korišćenjem standardnih protokola, bez obuće i odeće. ITM je izračunata kao TM/TV^2 (kg/m^2), po preporuci Svetske zdravstvene organizacije (SZO). Arterijski krvni pritisak je meren u sedećem položaju, sa standardnim živinim sfingomanometrom. Krv za biohemijsku analizu je uzimana nakon minimalno 12 časova gladovanja, metabolički parametari (lipoprotein visoke gustine-holesterol, LDL-holesterol, trigliceridi, glukoza u krvi) su analizirani standardnim procedurama. Takođe su analizirani i zdravstveni kartoni ispitanika. Metabolički sindrom je dijagnostikovan pomoću kriterijuma Međunarodne dijabetes federacije (IDF). Analize rezultata istraživanja vršene su uz pomoć statističkog paketa za socijalne nauke, verzija 10.0 (SPSS za Windows).

Prevalencija metaboličkog sindroma iznosi 44,7% kod muškaraca i 43,2% kod žena. Osobe oba pola optimalne telesne mase bile su znatno mlađe i imale znatno nižu glikemiju, ukupni holesterol, LDL-holesterol i trigliceride, nego predgojazne i gojazne osobe. Sistolni i dijastolni krvni pritisak se značajno povećava sa porastom ITM. Kod svih ispitivanih osoba oba antropometrijska indeksa su u korelaciji sa ostalih pet komponenti MetSy.

Obim struka je jednostavna mera za procenu abdominalne gojaznosti i u korelaciji sa metaboličkim poremećajima. Rezultati dobijeni u ovoj studiji pokazuju da je OS dobar pokazatelj zdravstvenog rizika kod žena, ali ne i kod muškaraca. Merenje OS po kategorijama ITM može da ukazuje na osobu sa povećanim rizikom za razvoj hroničnih bolesti.

Ključne reči: **obim struka, indeks telesne mase, metabolički sindrom, procena zdravstvenog rizika**