Original Research

The Ability of Hypertensive Waist to Predict High Cardiovascular Risk in General Population

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Abstract: *Objective:* Previous studies have demonstrated that hypertensive waist (HTW) can be useful for the screening of metabolic syndrome (MetS) in general population. The objective of this study was to compare the ability of HTW and of MetS to predict moderate and high cardiovascular risk (CVR). *Patients and Method:* 1294 persons from the general population of Cluj County have been enrolled in the study. Blood samples in fasting state have been withdrawn for measuring of blood glucose, total and HDL-cholesterol and serum triglycerides. HTW was defined as concomitant presence of a systolic blood pressure of $\geq$ 130 mmHg and/or a diastolic blood pressure of $\geq$ 85 mmHg or personal history of hypertension plus an abdominal circumference of $\geq$ 80 cm in females and $\geq$ 94 cm in males. MetS was diagnosed based on International Diabetes Federation criteria. CVR was estimated with Framingham Risk Score. *Results:* The prevalence of HTW was 43.3%, and the prevalence of MetS was 45.7%. High CVR was prevalent in 32.4% of persons with MetS and in 36.1% of those with HTW. The sensitivity and specificity of HTW to predict moderate and high CVR were higher than for MetS (62.9% versus 52.3%, and 67.1% versus 61.4%). Aria under the receiver operating curve (aROC) was higher for the HTW than for MetS. *Conclusion:* The use of HTW is a valuable method to screen for moderate and high CVR in the general population.

Keywords: Metabolic syndrome; Cardiovascular risk; Waist circumference.

Introduction

Recent data published by International Diabetes Federation (IDF) reported a prevalence of the metabolic syndrome in the general population ranging from 16% to 37%, according to the set of criteria used to define metabolic syndrome and of the population in which such data has been obtained [1]. The metabolic syndrome is nowadays considered as one of the most important determinants of cardiovascular morbidity and mortality in developed and developing countries. A recent meta-analysis of large-scale epidemiological studies demonstrated that the presence of metabolic syndrome increases total mortality with 27-37% and cardiovascular disease (CVD) risk with 65-93% [2]. Due to high prevalence in the general population, extended and continuous screening for metabolic syndrome represents the best method to identify these high-risk individuals but this would imply that a large number of subjects should be screened. Therefore, we consider that a pre-screening test such as „hypertensive waist" is useful in this case [3]. Hypertensive waist is defined as the concomitant presence of high abdominal circumference and systemic hypertension and can be used as a first-step method to screen for metabolic syndrome based on two easy-to-measure parameters. In each individual with hypertensive waist, measurement of blood glucose, serum triglycerides and HDL-cholesterol should be performed to identify all diagnostic criteria of metabolic syndrome (Figure 1).
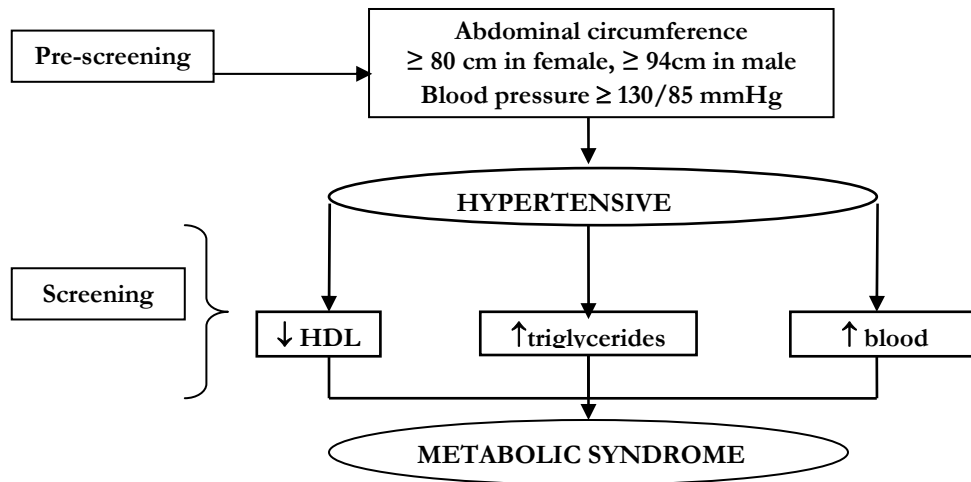
Figure 1. Stepwise screening for metabolic syndrome using hypertensive waist [3]

Previous studies have demonstrated that hypertensive waist is a frequent combination in persons with metabolic syndrome and can be useful for the screening of metabolic syndrome in general population, having a high specificity and sensitivity, and high positive and negative predictive [4]. The objective of this study is to compare the ability of hypertensive waist and of metabolic syndrome to predict moderate and high cardiovascular risk based on Framingham Risk Score.

Material and Method

All employees of two companies in Cluj-Napoca and all persons ≥18 years of age from a rural area in Cluj County were invited to participate in the study. Individuals with diabetes were not included. A total of 2928 persons gave their informed consent and were included in the study from October 2002 to November 2003. Fasting blood samples were obtained for measurement of blood glucose, total and HDL-cholesterol and serum triglycerides. LDL-cholesterol was calculated using Friedewald equation. Hypertensive waist was defined as concomitant presence of a systolic blood pressure of ≥ 130 mmHg and/or a diastolic blood pressure of ≥ 85 mmHg or personal hystory of treated hypertension and the presence of an abdominal circumference of ≥ 80 cm in females and ≥ 94 cm in males. Metabolic syndrome was diagnosed based on International Diabetes Federation set of criteria. Based on preexisting published data in which the prevalence of hypertensive waist was around 30% in the Romanian population [5], we calculated that the sample should include 1294 subjects for a 95% confidence interval (95% CI) ± 5% around a prevalence of 30%. In this report, only data from subjects with a complete physical examination and biochemical profile has been included.

Cardiovascular risk was calculated with Framingham Risk Score, a score recommended for non-diabetic population [6, 7]. Risk stratification according to the risk score was: < 10% low risk, 10-20% moderate risk, ≥ 20% high risk.

Statistical analysis was performed using the software SPSS for Windows version 15.0. Distribution of variables was tested with Kolmogorov- Smirnov test. Statistical data is presented as mean ± standard deviation for normally-distributed variables, median (1st quartile; 3rd quartile) for variables with abnormal distribution and percentage for categorical variables. Student t-test was used to compare variables with normal distribution, and Mann-Whitney U test for variables with abnormal distribution. Chi-square test was used to compare frequencies. A two-tailed p value≤ 0.05 was considerred statistically significant. The ability of hypertensive waist and of metabolic syndrome to predict moderate and high cardiovascular risk were compared by receiver operating characteristics (ROC), and by specificity and sensitivity values.

Results

Current report evaluated 756 women and 538 men, with a mean age of 49.1 ± 16.0 years for whom complete clinical and biochemical data was available. The prevalence of hypertensive waist was 43.3%, and of metabolic syndrome 45.7%. Among individuals with hypertensive waist, 85% had metabolic syndrome (Table 1).

Table 1. Prevalence of hypertensive waist in persons with and without metabolic syndrome

Metabolic syndrome	Hypertensive waist		Total
	No- n (%)	Yes- n (%)	- n (%)
Yes	116 (15.8)	476 (85.0)	592 (45.7)
No	618 (84.2)	84 (15.0)	702 (54.3)

Characteristics of individuals with hypertensive waist, with or without metabolic syndrome are presented in Table 2. Individuals with hypertensive waist but without metabolic syndrome are more frequently males, have younger age, lower BMI, lower blood pressure values, lower values of lipids and blood glucose levels and have less frequently ischemic heart disease and a lower level of sedentary lifestyle.

Table 2. Characteristics of individuals with hypertensive waist, with or without metabolic syndrome

		Metabolic syndrome		p
		Yes	No	
Sex[§]	Female (%)	91.3	8.7	<0.001
	Male (%)	72.0	28.0	<0.001
Age (years)		58.2±12.3	54.7±13.6	0.009
Body weight (kg)		78.1±13.9	78.2±13.7	0.95
Abdominal circumference (cm)		97.9±10.3	96.7±8.7	0.34
BMI (kg/m²)		28.6±4.2	27.1±3.0	<0.001
SBP (mmHg)		151.3±20.5	138.9±13.9	<0.001
DBP (mmHg)		91.1±11.9	82.8±8.3	<0.001
Total cholesterol (mg/dl)		203.4±44.0	176.1±50.4	<0.001
HDL-cholesterol (mg/dl)*		47.2 (43.0 ; 47.2)	43.0 (43.0 ; 47.2)	<0.001
LDL-cholesterol (mg/dl)		124.3±39.0	114.7±41.0	0.04
Serum triglycerides (mg/dl)*		148 (104.0 ; 200.5)	103.5 (82.5 ; 127.5)	<0.001
Fasting blood glucose (mg/dl)*		106.0 (99.0 ;117.0)	96.0 (92.0 ; 99.0)	<0.001
Personal history of ischemic heart disease (%)[§]		32.8	11.9	<0.001
Low level of physical activity (%)[§]		63.4	52.4	0.01

Data are presented as mean ± standard deviation for normally-distributed variables;
*median (1st quartile;3rd quartile) for continuous variables with abnormal distribution;
[§] - % for categorical variables
BMI = body mass index;
SBP = systolic blood pressure;
DBP = diastolic blood pressure.

The prevalence of low, moderate and high cardiovascular risk in subjects with metabolic syndrome and with hypertensive waist is displayed in Figure 2.

The two receiver operating characteristics (ROC) curves for hypertensive waist and metabolic syndrome in subjects with high cardiovascular risk (≥ 20%) are super imposable (Figure 3), the two conditions having equal sensitivity and specificity values (table 3).

Hypertensive waist had a higher value in predicting moderate and high cardiovascular risk (≥ 10%) compared with the metabolic syndrome, with higher sensitivity and specificity values (62.9% versus 59.3% and 67.1% versus 61.4%) (Figure 4, Table 4).
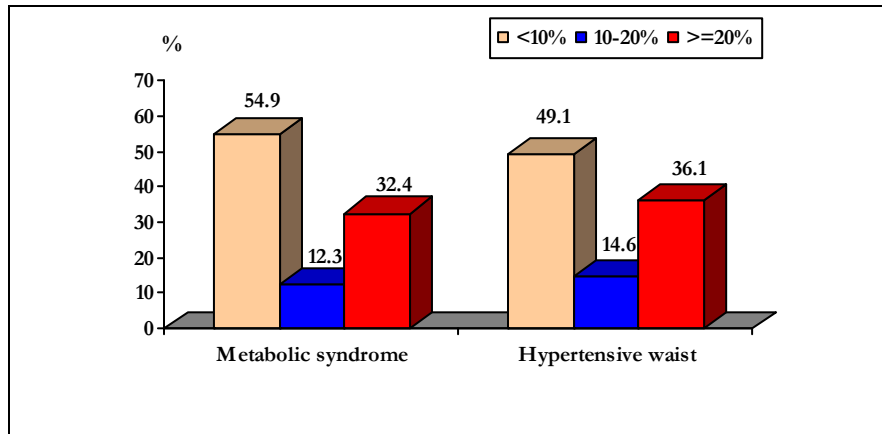
Figure 2. Prevalence of cardiovascular risk categories in subjects with metabolic syndrome and with hypertensive waist

Table 3. Sensitivity and specificity for hypertensive waist and metabolic syndrome in subjects with high cardiovascular risk ($\geq$ 20%)

	aROC (95%CI)	Sensitivity (%)	Specificity (%)
Hypertensive waist	0.68 (0.64-0.71)	71.8	63.5
Metabolic syndrome	0.66 (0.62-0.69)	71.4	60.3

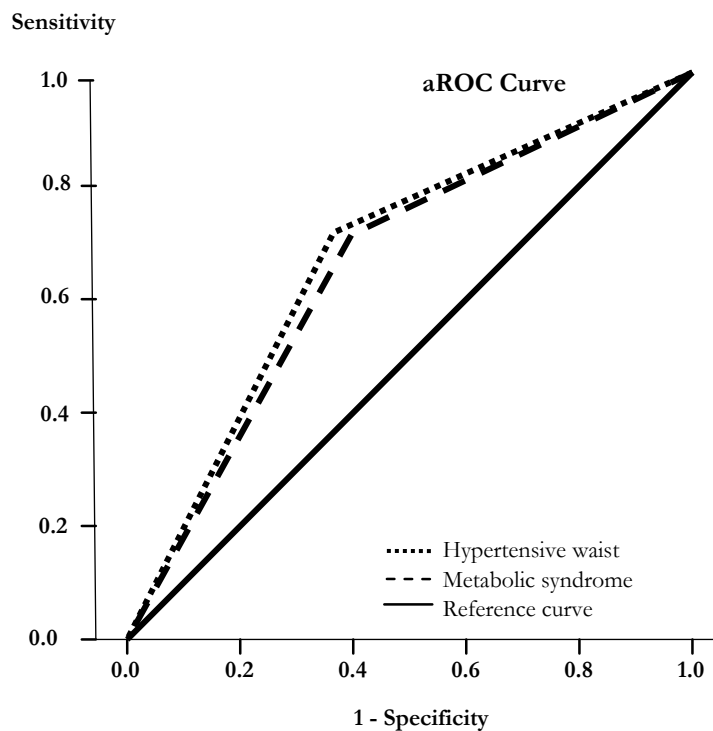aROC- area under the receiver operating curve

Figure 3. The ability of hypertensive waist and metabolic syndrome to predict high cardiovascular risk ($\geq$ 20%)

Odds ratio (OR) for high cardiovascular risk ($\geq$ 20%) is 4.42 (95%CI: 3.26 – 5.98) in the presence of hypertensive waist and 3.79 (95%CI: 2.80 – 5.12) in the presence of metabolic syndrome. The same results were obtained for moderate and high cardiovascular risk (OR: 3.44 [95%CI 2.71 – 4.37] versus OR: 2.31[95%CI:1.83 – 2.82]).
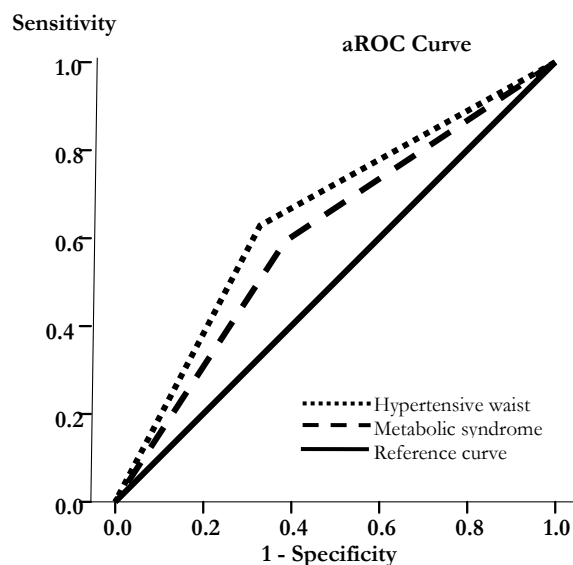
Figure 4. The ability of hypertensive waist and metabolic syndrome to predict moderate and high cardiovascular risk (≥ 10%)

Table 4. Sensitivity and specificity for hypertensive waist and metabolic syndrome in subjects with moderate and high cardiovascular risk (≥ 10%)

	aROC (95%CI)	Sensitivity (%)	Specificity (%)
Hypertensive waist	0.65 (0.62–0.68)	62.9	67.1
Metabolic syndrome	0.60 (0.57-0.64)	59.3	61.4

aROC- area under the receiver operating curve

Discussion

Metabolic syndrome is associated with an increased risk of type 2 diabetes and cardiovascular diseases [8, 9]. Although there is a debate surrounding the concept of metabolic syndrome [10, 11], it is recognized as a major and prevalent cardiovascular risk factor by bodies as the World Health Organization (WHO) [12], the National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) [7] and International Diabetes Federation (IDF) [13]. The IDF recommendations reflects the fact that obesity is a sine qua non component of the metabolic syndrome and together with insulin resistance might be one of the underlying causes of the metabolic syndrome [13]. It is established that waist circumference predicts increased risk of morbidity and mortality beyond that explained by BMI alone [14, 15]. Several organizations currently advocate for the measurement of waist circumference in clinical practice. However, a recent consensus from the ADA, the Obesity Society and the American Society for Nutrition questioned the clinical utility of waist circumference measurement [16]. The concept of hypertensive waist was proposed by us in 2004 [3] as a simple to use tool for the screening of the metabolic syndrome. When, in 2005, IDF established the new criteria for the diagnosis of the metabolic syndrome, hypertensive waist become even more appropriate for its specific purpose. The current study aimed to investigate whether hypertensive waist could be use to predict moderate and high cardiovascular risk based on Framingham Risk Score. The rationale was that the common cardiometabolic risk factors are not assessed in all the clinical settings in our country due to lack of personal and resources. In this case we often need to find a simple way to evaluate the cardiovascular risk of the patients in order to make the optimal clinical management decisions. The specificity and sensitivity of the hypertensive waist to predict moderate and high cardiovascular risk was even higher than those for the metabolic syndrome. Moreover, it is very simple to be applied and totally unexpensive, so it can be use to screen for the high cardiovascular risk individuals in all clinical settings.

Conclusions

Hypertensive waist has a higher predictive value for moderate and high cardiovascular risk in general population compared with that of the metabolic syndrome. The practical importance of this finding is that the association of two easy-to-measure parameters (systolic blood pressure $\geq$ 130 mmHg and/or diastolic blood pressure $\geq$ 85 mmHg or the presence of systemic hypertension plus an abdominal circumference $\geq$ 80 cm in female and $\geq$ 94 cm in male) can be used as an efficient screening method to identify individuals with moderate and high cardiovascular risk from the general population. Identification of the hypertensive waist will be followed by a detailed screening for all the others cardiovascular risk factors and of metabolic syndrome in order to properly manage the cardiometabolic risk

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