

WAIST CIRCUMFERENCE IS A BETTER PREDICTOR OF CARDIOVASCULAR RISK THAN BODY MASS INDEX IN PATIENTS WITH METABOLIC SYNDROME

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ABSTRACT. *Background and aim.* Waist circumference and body mass index represent diagnostic elements in different definitions of metabolic syndrome. The aim of this work was to establish which one of these parameters correlates better with cardiovascular risk in subjects with metabolic syndrome. *Material and method.* The study group was represented by 383 subjects with metabolic syndrome, 41% male, mean age \pm SD=54.2 \pm 13.6 years. The cardiovascular risk was estimated with the aid of SCORE charts for high risk populations. The threshold for statistical significance for p was 0.05. *Results.* Cardiovascular risk was higher in men than in women (4.9 \pm 4.4% vs. 3.7 \pm 3.5%, p=0.003) and increased extremely significant with age (p <0.001). There was a correlation between cardiovascular risk and body mass index ($r=0.57$). The correlation was stronger between cardiovascular risk and abdominal circumference, both in men ($r=0.66$) and in women ($r=0.69$). *Conclusion.* Abdominal circumference is a better predictor for cardiovascular events than body mass index in persons with metabolic syndrome.

Keywords: waist circumference, cardiovascular risk, body mass index, metabolic syndrome

INTRODUCTION

Metabolic syndrome (MS) gained its worldwide recognition as a clinical entity generating an important risk for cardiovascular diseases (CVD) and for type 2 diabetes mellitus (Hu G. et al., 2004; Kahn R. et al. 2005; Kuk J.L. et al., 2006; Wilson P.W. et al., 2005).

By providing a definition for metabolic syndrome in year 1998 (Alberti K.G. et al., 1998), World Health Organization did not suggest the existence of a new disease, but rather recognized the presence of a clustering of several risk factors (RF), that together predict better type 2 diabetes mellitus and CVD in comparison to each of them considered apart (Sundström J. et al., 2006).

The debate related to MS concerns mainly its pathogenesis, i.e. the background for this clustering of metabolic and clinic abnormalities: obesity or insulin resistance. The lack of consensus regarding the main element involved in the pathogenesis of MS is

proven by the different names given to this entity by different authors: plurimetabolic syndrome, X syndrome, deadly quartet, insulin resistance syndrome, dysmetabolic syndrome (Kaplan N.M., 1989). Furthermore, based on a numbers of clinical and biological parameters, the main scientific societies gave different definitions to MS (Alberti K.G. et al., 1998; NCEP 2002; Einhorn D. et al., 2003; Alberti K.G. et al., 2005). Among the parameters used to define MS one can find waist circumference (WC) (NCEP 2002; Alberti K.G. et al., 2005) or body mass index (BMI) (Alberti K.G. et al., 1998; Einhorn D. et al., 2003). In clinical practice, the definition of MS proposed by International Diabetes Federation (IDF) in year 2005 is used frequently (Alberti K.G. et al., 2005). According to this, increased WC represents the mandatory criterion for the definition of MS (Alberti K.G. et al., 2005).

The purpose of this paper was to establish which one of the 2 clinical parameters

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mentioned previously (WC or BMI) correlates better with the cardiovascular risk (CVR) in subjects with MS, risk estimated by the aid of commonly used charts.

MATERIALS AND METHODS

The study group was composed by 383 subjects with MS, without known CVD, recruited from the databases of 4 general physicians. From the whole group, 157 subjects (41%) were male and 226 (59%) female. The patients have been evaluated clinically and biologically regarding the following parameters: height, weight (using these 2 parameters BMI was calculated), WC, blood pressure, fasting blood glucose, total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides. In addition, the patient was labeled as smoker or non-smoker. The main characteristics of the study group are shown in table 1.

The criteria proposed by IDF in year 2005 were used to define MS (Alberti K.G. et al., 2005). According to IDF, a subject is labeled as having MS if the mandatory criterion is

present (WC \geq 94 cm in male and \geq 80 cm in female), together with at least 2 out of the following 4: serum triglycerides \geq 150 mg/dl or therapy for hypertriglyceridemia; HDL cholesterol $<$ 40 mg/dl in male and $<$ 50 mg/dl in female or therapy for this type of dyslipidemia; systolic blood pressure \geq 130 mmHg and/or diastolic blood pressure \geq 85 mmHg or antihypertensive therapy; fasting blood glucose \geq 100 mg/dl or previously diagnosed diabetes mellitus.

In order to calculate CVR we used the SCORE charts (Systematic Coronary Risk Evaluation) proposed by The European Society of Cardiology in year 2003 and confirmed in year 2007, that estimate the risk of fatal cardiovascular events over 10 years interval. Because Romania belongs to the countries having a high CVR, we used the charts imagined for this geographic region. The main parameters used to estimate CVR in the SCORE system are: age, gender, smoking status, systolic blood pressure and serum cholesterol level.

Main characteristics of the study group

| Parameter | | Value |
|----------------------------------|--------|------------------|
| Number* | | 383 |
| M/F* | | 157/226 |
| Age (years)** | | 54.2 \pm 13.6 |
| BMI (kg/m^2)** | | 31.3 \pm 5.3 |
| WC (cm)** | male | 107.7 \pm 10.4 |
| | female | 91 \pm 10.2 |
| Triglycerides (mg/dl)** | | 232.9 \pm 40.6 |
| Total cholesterol (mg/dl)** | | 224.4 \pm 31.8 |
| HDLc (mg/dl)** | male | 37.8 \pm 4.7 |
| | female | 44.3 \pm 5.7 |
| LDLc (mg/dl)** | | 136.2 \pm 27.8 |
| SBP (mmHg)** | | 141.4 \pm 17 |
| DBP (mmHg)** | | 88.7 \pm 11.5 |
| Fasting blood glucose (mg/dl)** | | 108.9 \pm 16.1 |
| Smokers* | male | 38 |
| | female | 42 |

Legend: M=male; F=female; BMI=body mass index; WC=waist circumference; HDLc=HDL cholesterol; LDLc=LDL cholesterol; SBP=systolic blood pressure; DBP=diastolic blood pressure; *=values expressed as number; **=values expressed as mean \pm standard deviation.

A risk for fatal cardiovascular events over 10 years interval $\geq 5\%$ is considered high (Fourth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice, 2007).

The database was worked in Microsoft Excel system. The statistical analysis was performed with the aid of GraphPad InStat 3.02:

- calculation of percentages for qualitative variables;
- calculation of mean value and standard deviation for quantitative variables;
- statistical comparison of means by the aid of the following methods:
 - unpaired t test (2 mean values);
 - ANOVA (several mean values);
 - linear (Pearson) correlation (r);
- linear regression.

The interpretation for the correlation coefficient (Pearson) was the following:

- $r > 0$ direct correlation
- $r < 0$ inverse correlation
- $r \leq 0.5$ weak correlation
- $r = 0.51-0.75$ medium correlation
- $r = 0.76-1$ strong correlation

The threshold for statistical significance for p was considered 0.05, corresponding to a statistical precision of 95%. The following cases could occur:

- $p > 0.05$ non significant differences NS
- $p < 0.05$ significant differences S
- $p < 0.01$ very significant differences VS
- $p < 0.001$ extremely significant differences ES

RESULTS AND DISCUSSIONS

The 10 year risk for fatal cardiovascular events, estimated by SCORE charts, was higher in men than in women ($4.9 \pm 4.4\%$ vs. $3.7 \pm 3.5\%$, $p = 0.003$) (figure 1).

The analysis performed on age groups showed an extremely significant increase ($p < 0.001$) of CVR with subject's age (figure 2). The risk was not significant before the age of

40 years. In age group 40-49 years, mean CVR was 1.7%, for subjects aged between 50 and 59 years the risk was 2.9%, the persons from the 7th decade of life had a CVR of 5.1%, and the highest values (9.2%) were met in persons aged ≥ 70 years.

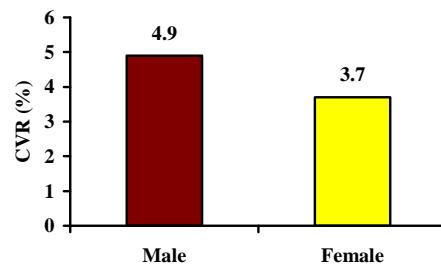
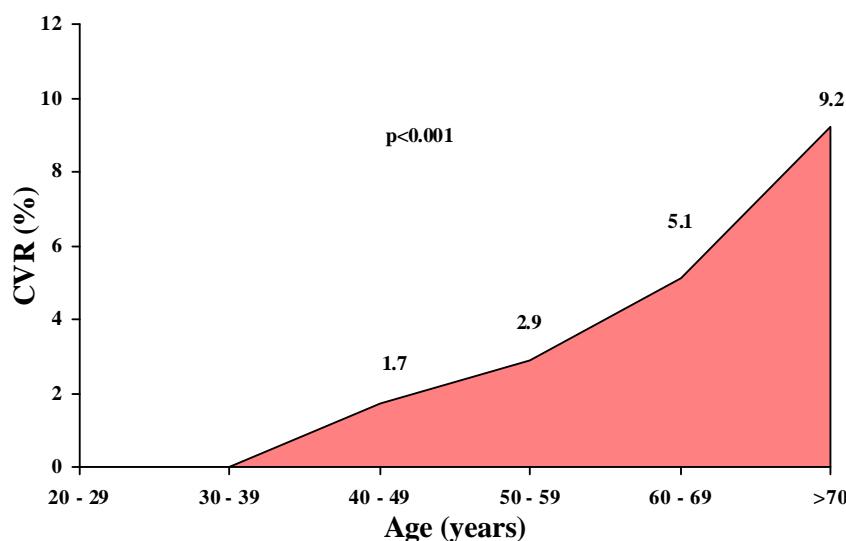


Fig. 1 Cardiovascular risk according to gender

According to the SCORE charts, persons aged between 20 and 39 years had a neglecting risk. In age group 40-49 years, the majority of subjects with MS had a CVR between 1 and 1.9%, none of them having a high CVR ($\geq 5\%$). In age group 50-59 years, 31.2% of the subjects had high CVR. From the patients aged between 60 and 69 years, 48.6% had CVR $\geq 5\%$, the proportion increasing to 73.9% in subjects aged ≥ 70 years (table 2).

CVR increased significantly ($p < 0.001$) with BMI. CVR in persons with class I obesity (6.4%) was significantly ($p < 0.001$) higher as compared to those with class II (5.5%) and class III (4.5%) obesity, as well as compared to overweight subjects (3.4%). The correlation between BMI and CVR in subjects with MS is shown in figure 3. Between these 2 parameters a medium correlation was noted ($r = 0.57$).

The risk for fatal cardiovascular events during the next 10 years, estimated with the aid of SCORE 2007 charts, increased significantly ($p < 0.001$) with WC, in both genders. The correlation was stronger between CVR and WC, both in men ($r = 0.66$) and in women ($r = 0.69$), than between CVR and BMI ($r = 0.57$) (figures 4 and 5).

**Fig. 2** Cardiovascular risk on age groups**Table 2****SCORE risk according to age group**

| Age group (years) | Risk of fatal cardiovascular events in the next 10 years | | | | | | | | | | | | | |
|-------------------|----------------------------------------------------------|------|--------|------|--------|------|--------|------|--------|------|----------|------|------|------|
| | <1% | | 1-1.9% | | 2-2.9% | | 3-4.9% | | 5-9.9% | | 10-14.9% | | ≥15% | |
| | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| 20-29 | 21 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30-39 | 37 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40-49 | 10 | 12.7 | 35 | 44.3 | 21 | 26.6 | 13 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50-59 | 0 | 0 | 27 | 29 | 19 | 20.4 | 18 | 19.4 | 13 | 14 | 9 | 9.7 | 7 | 7.5 |
| 60-69 | 0 | 0 | 0 | 0 | 14 | 13.2 | 41 | 38.3 | 18 | 16.8 | 18 | 16.8 | 16 | 14.9 |
| ≥70 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 26.1 | 13 | 28.3 | 11 | 23.9 | 10 | 21.7 |

In most of the European countries, the main cause of death in middle aged persons or elderly is represented by CVD and, first of all, by coronary heart disease. CVD have a multifactorial etiology (Rigo F. et al., 2005). The evaluation of CVR in a given population is very important (Ridker P.M. et al., 2004). Till recently, the guidelines that evaluated CVR were focused on only one RF (blood pressure, lipids or diabetes mellitus). In order to elaborate a complex strategy for primary and secondary prevention, it is mandatory to take into account as many RF as possible (Wilson P.W. et al., 2006). Based on these assumptions, we used the SCORE charts (Fourth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical

Practice, 2007) to estimate CVR in persons with MS, without known CVD.

Because SCORE charts don't take into account the ponderal status of the subject, we analyzed the correlation between estimated CVR and BMI or WC, respectively. We noted a direct correlation between the SCORE risk and BMI ($r = 0.57$) and between SCORE risk and WC in men ($r = 0.62$) and women ($r = 0.64$). Because the correlation coefficient is closer to the threshold for strong correlations ($r = 0.75$) when comparing SCORE risk with WC, we can state that CVR correlates better with WC than with BMI. In fact, recent studies confirm the importance of abdominal disposition of adipose tissue for the pathogenesis of CVD. That's why European Society of Cardiology and European

Hypertension Association consider abdominal obesity instead of obesity as RF for CVD

(Study rationale and design of ADVANCE, 2001).

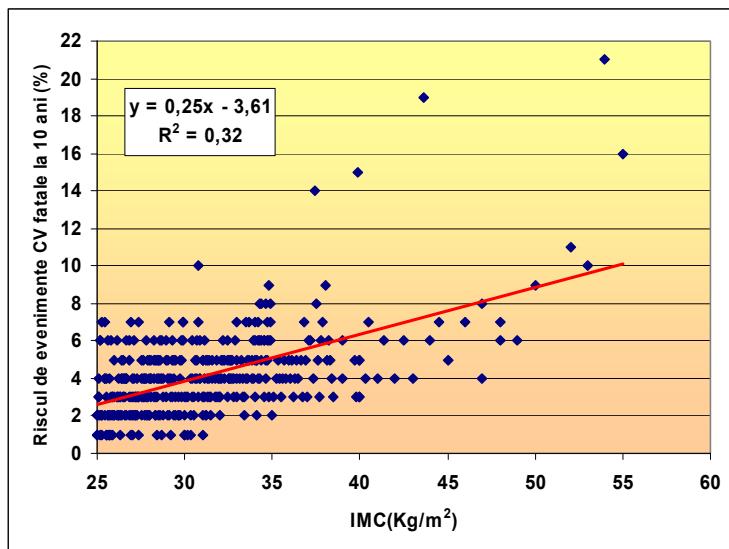


Fig. 3 Correlation between cardiovascular risk and body mass index

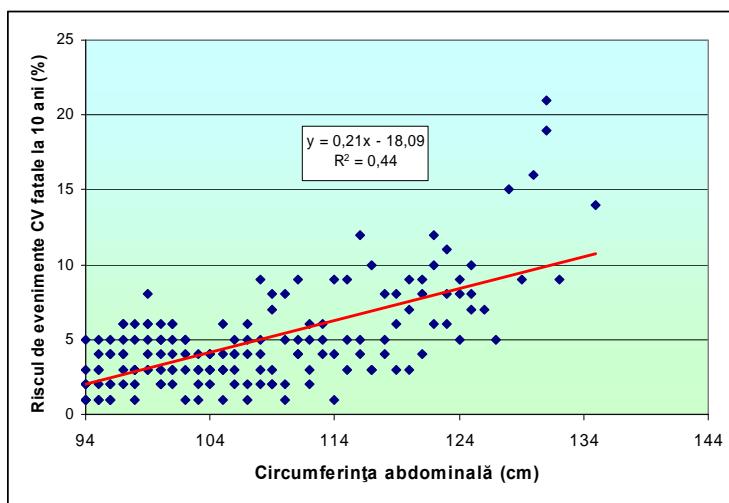


Fig. 4 Correlation between cardiovascular risk and waist circumference in men

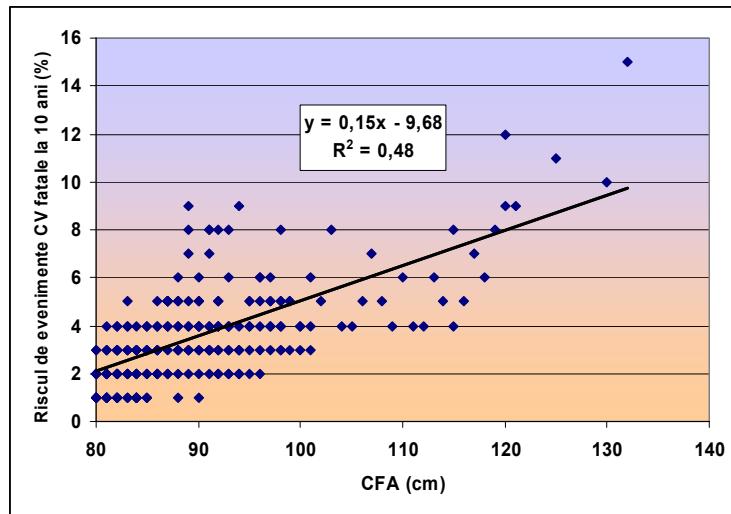


Fig. 5 Correlation between cardiovascular risk and waist circumference in women

CONCLUSIONS

Based on our analysis, one can state that WC is a better predictor for CVR than BMI, in subjects with MS. These data support the decision of IDF to consider WC as mandatory criterion for the definition of MS.

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