ANTHROPOMETRIC PARAMETERS – PREDICTIVE FACTORS FOR CARDIO-METABOLIC DISEASES

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ANTHROPOMETRIC PARAMETERS - PREDICTIVE FACTORS FOR CARDIO-METABOLIC DISEASES (Abstract): The aim of this study was to evaluate comparatively the predictive power of body mass index (BMI) and waist circumference (WC), two anthropometric parameters used in daily practice, for detecting cardio-metabolic diseases, in a rural community in north-east Romania. Material and methods: We evaluated 3248 persons, aged 19 or over, for whom we collected the following data: medical history, anthropometric parameters, blood pressure value and biochemical parameters. Results and conclusions: Both WC and BMI help correctly determine the presence of arterial hypertension, diabetes and dislipidemia. However, the cut-off value of each of these parameters differs for each pathology. The predictive value of WC for different cardio-metabolic diseases is maintained even at normal or borderline overweight values of BMI. Key words: WAIST CIRCUMFERENCE, BODY MASS INDEX, PREDICTIVE POWER, CARDIO-METABOLIC DISEASES.

The medical community admits as certain the epidemic progression of obesity and acknowledges the risks for morbidity, disability and mortality associated with excess weight \cite{1}. Energy imbalance causes various diseases, but those with cardio-metabolic echo warned international fora, causing mobilization of scientists to establish effective programs for prevention and treatment of these people. Data published in the literature have demonstrated the importance of location of excess fat at abdomen level \cite{2}, assessed by WC, even for people with BMI within normal limits (parameter recognized by the World Health Organization for diagnosis of obesity) \cite{3}. The purpose of this study was to assess comparatively the predictive power for cardio-metabolic diseases of the two anthropometric parameters used in daily practice, BMI and WC.

MATERIAL AND METHODS
We included 3248 persons in our study aged 19 or over, who lived in Deleni, Iaşi County, enrolled in the interval July 2007 – July 2008. We collected the following data for each subject: medical history, anthropometric parameters, blood pressure values and biochemical parameters – fasting glycæmia, total cholesterol, HDL cholesterol, triglycerides. Measuring weight and height
were performed under light clothing and fasting, using calibrated instruments, standardized and calibrated according to international standards. Determination of weight status was based on BMI (BMI = weight/height², kg/m²) and WC was measured midway, between the lower rib margin and the anterior superior iliac spine. Diagnosis of hypertension was set at values >140 mmHg systolic and/or >90 mmHg diastolic and/or antihypertensive treatment. Diabetes was present when fasting blood glucose ≥126 mg/dl and in those with known diagnosis. Diagnosis of dyslipidemia was based on the values of fasting lipid fractions: total cholesterol, HDL cholesterol and triglycerides, and/or specific previous treatment. Diagnostic limits for each were: total cholesterol >200 mg/dl, HDL cholesterol <50 mg/dl in women or <40 mg/dl in men, triglycerides >150mg/dl.

Statistical analysis of data was performed using Statistical Package for Social Sciences program (SPSS) version 16.0.

RESULTS

The study included 3248 people, of which 1341 men (41.28%) and 1907 women (58.71%), aged between 19 and 91 years, mean age 50.58 ± 18.26. We have conducted previous epidemiological studies in this population and the findings were published in literature: the prevalence of obesity (BMI ≥ 30 kg/m²) 17.5% (n=570) (4), hypertension 31.1% (n=1010) (5), diabetes 5.2% (n=169) (5), hypercholesterolemia 42% (n=1364) (5), decreased HDL cholesterol 13.6% (n=442) (0.3% in men, 13.3% in women) (5), hypertriglyceridaemia 19.6% (n=637) (5).

Based on these data, we compared the predictive power of the two anthropometric parameters (BMI and WC) for the development of one of the co morbidities listed. We used as statistical method the Receiver Operating Characteristic curve (ROC curve), which is formed by representing sensibility (Se - maximum value 1) and specificity (Sp - maximum value 1) for the entire range of variation in the predictor (WC or BMI in our case). We then analyzed, comparatively, the predictive power of WC and BMI for the development of hypertension, diabetes mellitus, hypercholesterolemia, low HDL cholesterol and hypertriglyceridaemia.

The data obtained have statistical significance; hence both WC and BMI help determine the correct presence of hypertension, diabetes and dyslipidemia. There were differences however in the limit value of each of the anthropometric parameters as predictors for each co morbidity. Thus, analyzing the ROC curves we saw the following optimal predictive values: for hypertension, cut-off values were: 25.5 kg/m² for BMI, 98 cm for WC (fig. 1); for diabetes, BMI = 27 kg/m², WC = 100 cm were cut-off values (fig. 2); for hypercholesterolemia, BMI = 25 kg/m², WC = 96 cm were cut-off values (fig. 3); for low HDL cholesterol, BMI = 26.9 kg/m², WC = 99 cm were cut-off values (fig. 4); for hypertriglyceridaemia, BMI = 26.2 kg/m², WC = 99 cm were cut-off values (fig. 5).

![Fig. 1. ROC curve for the prediction of arterial hypertension](image-url)
DISCUSSION
In modern societies, energy imbalance manifests in various ways in every individual, causing frequent and important comorbidities, among which some life threatening diseases such as coronary or cerebrovascular disease, sleep apnea syndrome. The most evident rapidly modifiable parameter is weight status, often meaning the accumulation of excess fat which is dysfunctional. This leads to excess secretion of proinflammatory adipocytokines which are responsible for the increased cardio-metabolic risk of these people. In this context and in the light of the obesity epidemic, global interest in the medical world has turned to finding quick and cheap ways of early identification and assessment of individuals with cardio-metabolic risk. Our previous studies have shown not only a
high prevalence of overweight in this community in northeastern Romania (4), but also of comorbidities with cardio-metabolic risk (5, 6).

The current findings indicate that both WC and BMI, two commonly used anthropometric parameters in daily practice, both in primary care and specialty level, help determine the correct presence of hypertension, diabetes and dyslipidemia and, moreover, have the same predictive power for the conditions specified, in the rural population studied. The predictive value of WC for different cardio-metabolic diseases is maintained even at normal BMI, or borderline overweight values of BMI, which emphasizes the importance of location of excess fat.

The results are even more important as the literature increasingly mentions the need to assess both anthropometric parameters to fully characterize people from a cardio-metabolic perspective. Metabolic syndrome, a constellation which implies the presence of several metabolic disorders, has had WC value for a long time as mandatory criterion for diagnosis, reflecting the importance of evaluation of this parameter in practice. In the literature there are numerous published data on the importance of assessing WC. In this respect, a prospective study that analyzed the effects of change in WC on cardio-metabolic risk factors over a period of nine years was DESIR (Data from Epidemiological Study on the Insulin Resistance Syndrome) (7). The study enrolled over 3800 participants aged 30-64 years and showed that after adjustment for BMI, an increase of ≥ 7 cm of WC significantly increased the risk of co morbidities and metabolic syndrome (odds ratio 7.9 (95% CI: 4.4 to 13.9) in men and 4.7 (95% CI: 2.7 to 8) in women), while decreasing at least 3 cm of WC produced significant reduction in triglycerides, insulinemia, the prevalence of metabolic syndrome in both sexes and decreased blood pressure in women.

A recent analysis of the Dallas Heart Study (8) demonstrated that the number of cardio-metabolic risk factors increased with increasing WC, in both women and men, regardless of race. Risk factors quantified in this study were: triglycerides ≥ 150 mg/dl, HDL cholesterol < 40 mg/dl in men and < 50 mg/dl in women, insulin resistance defined as HOMA value ≥ 1.63, systolic blood pressure ≥ 130 mmHg, diastolic blood pressure ≥ 85 mmHg or antihypertensive treatment, C-reactive protein ≥ 3 mg/l.

National Health and Nutrition Examination Survey (NHANES III study), reference study regarding the health of the population, showed that the value of WC correlates better than BMI with four of the five examined risk factors: LDL cholesterol, HDL cholesterol, hypertension and hyperglycemia (9). Moreover, evidence from this study showed that WC is an independent risk factor for developing type 2 diabetes, being a stronger predictor than other cardio-metabolic risk factors (LDL cholesterol, HDL cholesterol or triglycerides) or than BMI, for the condition (10). Also, several recent studies have shown that visceral obesity and its metabolic complications are not only found in obese individuals, but contribute to increased cardio-vascular risk in normal-weight, apparently healthy people, as well (11, 12). On the other hand, it has been shown that there are obese individuals who are "metabolically healthy", with only a minimal amount of visceral fat (13).

All the evidence suggests that evaluation of visceral fat is a more relevant criterion than the total amount of fat for the assessment of cardio-vascular risk.

A special category is formed by people of normal weight but with phenotypical characteristics of obesity, called "metaboli-
cally obese normal weight". It has been hypothesized that these individuals would be characterized by hyperinsulinemia and/or insulin resistance, hypertriglyceridemia and hypertension associated with a BMI <25 kg/m². Compared with the control group, normal weight metabolically obese subjects have a low insulin sensibility, increased abdominal and visceral adiposity, an atherogenic lipid profile and increased blood pressure (14).

CONCLUSIONS
Our results showed that both WC and BMI had predictive power for the presence of diabetes mellitus, dyslipidemia or hypertension in people from this rural community located in north-eastern Romania. Practically there was no difference between the predictions of WC compared with BMI, both anthropometric indicators being equally valuable in the prediction of cardio-metabolic risk factors in the studied population. Therefore, routine measurement of WC, simple and easy to do, can be included in the algorithm for the initial assessment of each individual, in primary care, regardless of BMI.

REFERENCES