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# PREVALENCE OF METABOLIC SYNDROME COMPONENTS IN THE TYPE 2 DIABETIC POPULATION WHO PRESENTED CORONARY ARTERY DISEASE

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**Research Team on the Project: Coronary artery disease and type 2 diabetes*

A b s t r a c t: The scope of our study was to assess the prevalence of metabolic syndrome (MSy) and its components in the type 2 diabetic population with symptomatic coronary artery disease in a sample of the Macedonian population. 327 pts with type 2 diabetes and manifested coronary artery disease were randomly included in a survey. MSy was defined according ATP III criteria.

The data presented a prevalence of MSy in 86.2%, respectively. 98% of pts had at least one more MSy component than impaired glycaemia. Study groups with four and three MSy components were most frequent in the study population. The data presented gender differences in MSy prevalence: 93.4% in women vs. 82.8% in men (p 0.009), as women tend to have a much more increased waist, arterial hypertension and low HDL. The most prevalent metabolic syndrome component was arterial hypertension (78.3%). Low HDL was detected in 67.9%, hypertriglicerydaemia in 62.7%, and an increased waist in 49.8% of the study population.

**Key words:** metabolic syndrome, type 2 diabetes, coronary artery disease, prevalence.

## *Introduction*

Metabolic syndrome (MSy) is a cluster of risk factors that influence the development and risk stratification of diabetes and cardiovascular disease [1, 3]. Some published studies have addressed a prevalence of MSy in the general population, ranging from 20% to 30% [4]. There is a higher prevalence of MSy in special populations (established type 2 diabetes and coronary artery patients) [5, 7]. Different groups (ethnicity, gender, age, etc.) present variations in its prevalence [8].

The scope of our study was to assess the prevalence of metabolic syndrome and its components in the type 2 diabetic population with symptommatic coronary artery disease in a representative sample of the Macedonian population and estimate if there are gender and age differences.

## *Patients and methods*

Three hundred and twenty-seven (327) pts with type 2 diabetes (T2D) and manifested coronary artery disease (CAD) were randomly included in the survey. Type 2 diabetes was defined based on the criteria of the International Diabetes Federation. CAD in the evaluated population is defined as symptommatic CAD, angiographically confirmed. The study was conducted according to the Helsinki declaration on clinical studies.

Blood pressure was measured with a standard sphygmomanometer in a sitting position and presented as a mean value of two readings (in mmHg). Anthropometric measurements were made with the patient wearing lightweight clothing and no shoes. Weight was presented in kilograms (kg) and Body mass index (BMI) in $kg/m^2$. Waist and hip circumferences were measured by a plastic tape meter at the level of the umbilicus and of the major trohanter.

The following standard laboratory tests were performed in the evaluated patients: enzymatic methods for assessment of: total cholesterol, in the presence of cholesterol oxidizes; triglycerides, in the presence of glycerokinase, and HDL fraction with the direct method. The LDL fraction was evaluated with the Friedewald formula. Non-HDL cholesterol was the determinate as a value of total cholesterol minus HDL cholesterol. The values of fasting venous glucose concentration were evaluated by the enzymatic-photometric method, in the presence of glucoso-dehydrogenase. Interassay variability was up to 6%.

According to the National Cholesterol Education Programme: Adult Treatment Panel III criteria (ATP III), hypertriglyceridaemia was defined as the value of triglycerides >/= 1.7 mmol/L and low HDL as the value of < 1.03 mmol/L. Waist circumferences > 88 cm in women and > 102 cm in men were defined as abdominal obesity. Arterial hypertension was defined as a systolic

blood pressure >/= 130 mmHg, or/and diastolic pressure >/= 85 mmHg, or as antihypertensive drugs used. MSy was defined in a T2D pt when at least two criteria of the abnormalities mentioned above were presented [9].

An SPSS 10 packet was used for statistical analysis. Continuous variables were presented as mean values ± standard deviation. Dichotomous variables were presented as a percentage of the study population. Group differences in dichotomous variables were determined by the Chi-square test.

P value </= 0.05 was considered statistically significant.

## *Results*

The study population was aged 60.3 ± 8.3 years, mean diabetes duration 8.6 ± 6.2 years, and the basic characteristics are presented in Table 1. Males were dominant over women in the study group: 221 men (67.6%) vs. 106 women (32.6%)

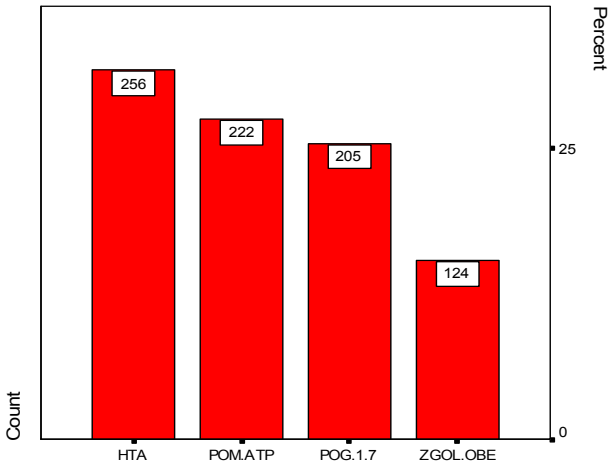
Table 1 – Tabela 1

*Continuous variables in estimated population*
*Континуирани варијабли во испитуваната популација*

| Variables | Mean values | Std. Deviation |
|---|---|---|
| Systolic pressure. (mmHg) | 143,9 | 19,5 |
| Diastolic pressure | 86,0 | 9,2 |
| Weight (kg) | 82,5 | 12,4 |
| Height (cm) | 169,3 | 7,4 |
| Waist | 96,9 | 8,0 |
| Hip | 53,0 | 6,7 |
| BMI (kg/m2) | 28,7 | 4,0 |
| Glycaemia (mmol/L) | 8,5 | 2,4 |
| Cholesterol | 5,4 | 1,4 |
| HDL | 1,0 | 0,4 |
| Non HDL | 4,3 | 1,4 |
| LDL | 3,3 | 0,9 |
| Triglycerides | 2,0 | 1,0 |
| HbA1C (%) | 7,2 | 1,3 |

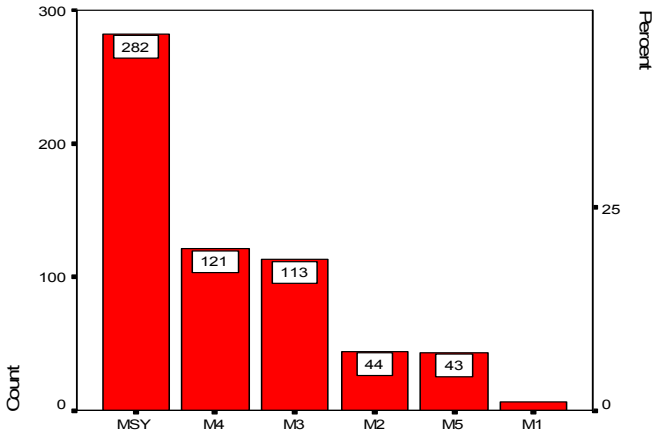
The most prevalent metabolic syndrome component was arterial hypertension (78.3%, 256 pts). Low HDL was detected in 67.9% (222) and hypertriglicerydaemia in 62.7% (205). Increased waist was found in 49.8%, or 124 pts. (Fig. 1)

Overall, the prevalence of MSy was 86.2%. Study groups with four and three MSy components were more frequent in the study population (37% and 34.6%) than those with 5 MSy components (13.1%) and two components (13.5%). (Figure 2)




Legend: HTA – arterial hypertension, POM.ATP – low HDL,
POG.1.7 – hypertiglyceridaemia, ZGOL.OBE – increased waist

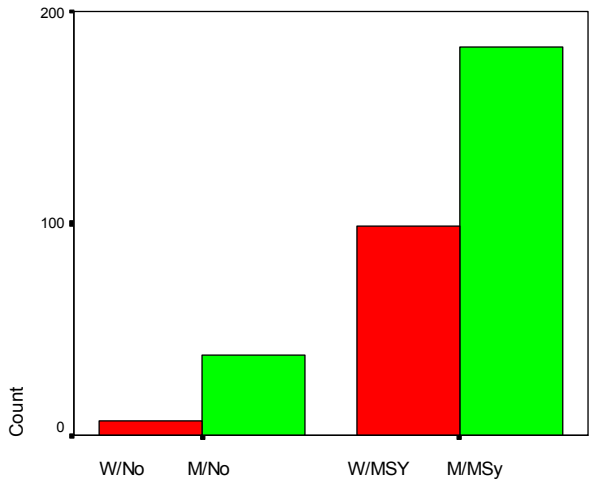
*Figure 1 – Prevalence of metabolic syndrome components*
*Slika 1 ‡ Преваленца на компонентите на метаболниот синдром*




Legend: M4 – groups with 4 metabolic abnormalities, M3 – with 3, M2 – with 2,
M5 – with 5 and M1 – with 1 metabolic abnormality

*Figure 2 – Distribution of study groups with different MSy abnormalities*
*Slika 2 ‡ Распределба на студиските групи со различни метаболни нарушувања*

The data presented gender differences in MSy prevalence: 93.4% in women vs. 82.8% in men. (p 0.009) (Fig. 3). Women tend to have a much more increased waist (p 0.0001), arterial hypertension (p 0.01) and low HDL (p 0.04) than men. No significance was found between MSy prevalence in the study group >/= 60 years (85.6%) than in the one aged < 60 years (86.9%). Neither difference was found when pts were stratified in groups with >/= 70 years vs. < 70 years old.




Legend: W – women, M – men, No – groups without metabolic syndrome, Msy – groups with metabolic syndrome

*Figure 3 – Gender differences in metabolic syndrome prevalence*
*Slika 3 ‡ Полови разлики во преваленцата на метаболниот синдром*

## *Discussion*

Our data presents a high prevalence of MSy components among the T2D population with manifested CAD.

The prevalence of arterial hypertension was 78.3% of pts (Table 2). Arterial hypertension is twice as frequent in diabetics as in non-diabetics [10]. The prevalence of hypertension in the diabetic population rises with obesity, nephropathy and ageing [11].

Evident lipid disturbances in diabetics are hypertriglyceridaemia and low HDL-cholesterolaemia. This impairment has also been presented in the prediabetic phase and conditions of impaired fasting glycaemia. Plasma levels of triglycerides and cholesterol are correlated with the presence and progression of T2D, and HDL is associated inversely with T2D [12]. 327 pts in all were

estimated for metabolic syndrome components: hypertriglyceridaemia and low HDL. Hypertriglyceridaemia was present in 62.7% and low HDL in 67.9%. Our results are consistent with other studies referring to the more frequent prevalence of these disturbances in T2D than in the general population [13].

Obesity is one of the main reasons for insulin resistance in T2D. Abdominal obesity is related closely to the other metabolic disturbances in T2D pts. [14]. An increased waist as a determinant of obesity, according to ATP III criteria, was determined in 37.9%. Increased waist is less prevalent than in the American and Western European populations [15]. Central and Eastern European countries are expected to refer a positive trend in abdominal obesity, due to the westernisation of life.

There is a worldwide trend of MSy increasing in parallel not only with "epidemic" obesity but with population ageing as well. Our study population tends to be older (mean age of 60 years). But no significance was found between MSy prevalence, when the group was stratified for age >/= 60 years or less.

Most studies have presented a higher prevalence of MSy in men [4, 5]. Conflicting results on gender differences are provided by our data. However, women were only one third of the study population, and they customarily have a much more increased waist, arterial hypertension and low HDL cholesterolaemia than men.

Studies in a population-based cohort with T2D have presented a high prevalence of MSy, estimating this by ATP III, in a range of 70–80% [5–7, 16]. These studies were conducted on Italian, Australian and American citizens, predominantly whites. Over 85% of our study population presented MSy. A higher prevalence of MSy in the type 2 diabetic population may be explained by a higher cardiovascular risk, under treated risk factors, and presented coronary artery disease.

The study group with one MSy abnormality consisted of 6 pts (almost 2% of the study population). 98% of pts had at least one more MSy component than impaired glycaemia. Therefore in these pts cardiovascular risk goes beyond glycaemic control and these subjects would benefit from multifactorial risk reduction [17].

## *Conclusions*

Our data presented a high prevalence (86.2%) of metabolic syndrome in the type 2 diabetic population who manifested coronary artery disease. Almost all the patients (98%) had at least one more MSy component than impaired glycaemia. The most prevalent metabolic syndrome components were arterial

hypertension, low HDL and hypertriglicerydaemia. These epidemiological findings do have clinical implications in the light of a multidisciplinary and polypharmacy approach to this population.

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## REFERENCES

1. Saely CH., Aczel S., Marte T., Langer P., Hoefle G., Drexel H. *et al.* (2005): The metabolic syndrome, Insulin Resistance, and Cardiovascular Risk in Diabetic and Nondiabetic Patients. *J Clin Endocrinol & Metab;* 3: 23–38.

2. Bonora E., Targher G., Formentini G., Calcaterra F., Lombardi S., Marini F. *et al.* (2004): The Metabolis Syndrome is an independent predictor of cardiovascular disease in Type 2 diabeteic subjects. Prospective data from the Verona Diabetes Complications Study. *Diab Med;* 21(1): 52–8.

3. Kadota A., Hozawa A., Okamura T., Kadowak T., Nakmaura K., Murakami Y. *et al.* (2007): Relationship between metabolic risk factor clustering and cardiobascular mortality stratified by high blood glucose and obesity: NIPPON DATA90,1990–2000. *Diabetes Care;* 30(6): 1522–8.

4. Ford ES., Giles WH., Dietz WH. (2002): Prevalence of the Metabolic Syndrome among US Adults. *JAMA;* 287(3): 356–9.

5. Bruno G., Merletti F., Biggeri A., Bargero G., Ferrero S. et al. (2004): Metabolic Syndrome as a Predictor of All-Cause and Cardiovascular Mortality in Type 2 Diabetes (The Casale Monferrato Study). *Diabetes Care;* 27: 2689–94.

6. Alexander CM., Landsman PB., Teustsch SM., Haffner SM. (2005): NCEP-defined metabolic syndrome diabetes and the prevalence of coronary heart disease among NHANES III participans age 50 years and older. *Diabetes Care;* 52: 1210–4.

7. Meigs JB., Wilson PWF., Nathan DM., D'Agostino RB., Williams K., Haffner SM. (2003): Prevalence and characteristics of the metabolic syndrome in the San Antonio Heart and Framingham Offspring studies. *Diabetes;* 52: 2160–7.

8. Kolovou GD., Anagnostopoulou KK., Salpea KD., Mikhailidis DP. (2007): The prevalence of metabolic syndrome in various populations. *Am J Med Sci;* 333(6): 362–71.

9. Alberti G. (2007): The metabolic syndrome: setting the scene. *Diabetes Vascular Disease Research;* 4(2): 1–3.

10. Sowers KRM., Sowers Jr., Diabetes and Hypertension. In Weber MA. (2001): *Hypertension Medicine*. Humana Pres, New Jersey.

11. The National High Blood Pressure Education Working Group. (1994): National high blood pressure education program working group report on hypertension in diabetes. *Hypertension;* 23: 145–58.

12. Stamler J., Vaccaro O., Neaton J. et al. (1993): Diabetes, other risk factors, and 12-year cardiovascular mortality for men screened in the multiple risk factor intervention trial (MRFIT). *Diabetes Care;* 16: 434–4.

13. Ford ES., Giles WH., Dietz WH. (2002): Prevalence of the Metabolic Syndrome Among US Adults. *JAMA;* 287; 3: 356–9.

14. Grundu SM., Benjamin IJ., Burke GL. et al. (1999): Diabetes and Cardiovascular Disease: A statement for Healthcare Professionals from the AHA. *Circulation;* 100: 1134–46.

15. Klein S., Burke L., Bray G. (2004): Clinical Implications of Obesity With Specific Focus on Cardiovascular Disease. *Circulation;* 110: 2952-67.

16. Adams RJ., Appleton S., Wilson DH. (2005): Population comparison of two clinical approaches to the metabolic syndrome: implications of the new International Diabetes Federation Consensus definition. *Diabetes Care;* 28: 2777–9.

17. Gaede P., Vedel P., Larsen N., Jensen G., Parving HH., Pedersen O. (2003): Multifactorial Intervention and Cardiovascular Disease in Patients with Type 2 Diabetes. *N Engl J Med;* 348: 383–93.

Резиме

## ПРЕВАЛЕНЦА НА КОМПОНЕНТИТЕ НА МЕТАБОЛНИОТ СИНДРОМ ВО ПОПУЛАЦИЈА СО ТИП 2 ДИЈАБЕТ И КОРОНАРНА АРТЕРИСКА БОЛЕСТ

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**Istra`uva~ki tim na proektot „Koronarna arteriska bolest i tip 2 dijabet“*

Целта на студијата беше да се испита преваленцата на метаболниот синдром (МС) и неговите компоненти кај пациентите со тип 2 дијабет (Т2Д) и симптоматска коронарна артериска болест (КАБ) во репрезентативен примерок од македонската популација. Во студијата на попречна анализа беа рандомизирани 327 пациенти со Т2Д и КАБ. МС беше дефиниран со критериумите на АТП III панелот.

Резултатите покажуваат преваленца на МС од 86,2%. 98% од пациентите имаат најмалку една компонента повеќе од присутната хипергликемија. Студиските групи со четири и три компоненти на МС беа најчести во испитуваната популација. Најчеста превалентна компонента од МС беше артериската хипертензија (78,3%). Нискиот ХДЛ беше детектиран кај 67,9%, хипертриглицеридемијата кај 62,7% и зголемениот абдоминален обем во 49,8% од студиската популација.

**Клучни зборови**: метаболен синдром, тип 2 дијабет, коронарна артериска болест, преваленца.

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