

# Coronary Artery Disease in Patients with Metabolic Syndrome

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**Abstract:** ***Background:** Metabolic syndrome (MS) has been reported to be associated with coronary artery disease (CAD). **Objective:** The purpose of this study was to evaluate the presence of CAD in patients with MS, and to compare each component of the syndrome in patients with and without CAD. **Methods:** 205 patients with MS who underwent elective coronary angiography were enrolled in the study. MS was defined according to National Cholesterol Education Program (NCEP)/Adult Treatment Panel III criteria. All patients were divided in two groups according to the presence of CAD. **Results:** The proportion of MS patients with CAD was significantly higher compared to those without CAD (72.68% vs. 27.32%,  $p<0.001$ ). Patients with CAD had higher levels of fasting blood glucose (78.50% vs. 46.40%,  $p<0.001$ ) and lower levels of HDL-cholesterol (74.03% vs. 25.97%,  $p<0.001$ ). There was no significant difference between the two groups regarding triglycerides levels (75.80% vs. 80.40%,  $p=0.493$ ). Patients with CAD were less likely to have a high waist circumference (67.10% vs. 84.00%,  $p=0.001$ ) and to be hypertensive (43.00% vs. 57.10%,  $p=0.049$ ). **Conclusion:** MS and especially hyperglycemia and low HDL-cholesterol are associated with CAD. High waist circumference and hypertension were more prevalent in patients without CAD. There was no significant difference regarding elevated triglycerides in patients with and without CAD.*

**Keywords:** Coronary Artery Disease, Metabolic Syndrome

## 1. Introduction

Coronary artery disease (CAD) represents a narrowing of coronary arteries, usually caused by atherosclerosis. It begins in the early youth [1]. Coronary artery disease is the most common cause of death in USA and Europe [2], [3]. While specific, mortality from ischemic heart disease in Albania is the highest in the Southeastern European region. Furthermore, Albania is the only country in the region that has experienced an increase in mortality from heart attack and cerebrovascular disease during the last two decades. The metabolic risk factors of ischemic heart disease in Albania are high systolic blood pressure, high total cholesterol, high body mass index, high fasting plasma glucose and low glomerular filtration rate [4].

Metabolic syndrome (MS) is a group of metabolic disorders such as glucose intolerance, obesity, hypertension, and dyslipidemia. The underlying disorder of this syndrome is insulin-resistance with the implication of exaggerated flux of fatty acids [5]. The metabolic risk factors influence atherosclerosis disease and are associated with a high risk for coronary artery disease. Patients with metabolic syndrome have a 30-40% probability of developing CAD within 20 years depending on the number of components participating in the syndrome [6]. The purpose of this study was to evaluate the presence of CAD in patients with MS, and the characteristics of each component of the syndrome in these patients with and without CAD.

## 2. Methods

### 2.1 Subjects

The study enrolled 205 patients with metabolic syndrome who underwent elective coronary angiography from November 2011 to February 2012 at "Mother Teresa" University Hospital Tirana, Albania. The metabolic syndrome patients fulfilled at least three of the following five criteria of this syndrome according to the National Cholesterol Education Program/Adult Treatment Panel III: 1- central obesity (WC>102 cm for males, >88 cm for females), 2- elevated BP (systolic BP $\geq$ 130 mmHg or diastolic BP $\geq$ 80 mmHg), 3- elevated TG ( $\geq$ 150 mg/dL), 4- reduced HDL-cholesterol (<40 mg/dL for males, <50 mg/dL for females), and 5- elevated FBG ( $\geq$ 110 mg/dL). A previous diagnosis of type 2 diabetes mellitus is considered to be evidence of an elevated FBG.

### 2.2 Biochemical assessment

Fasting plasma blood samples were taken prior to elective coronary angiography. Serum lipid profile and fasting plasma glucose were analyzed in the laboratory of the University Hospital Centre "Mother Teresa", Tirana, Albania.

### 2.3 Angiographic assessment

Coronary angiography was performed via the femoral artery. The angiographic characteristics of all coronary lesions were described in the respective formulary and interpreted by interventional cardiologists. CAD was defined as  $\geq$ 50%

luminal diameter stenosis of at least one major epicardial coronary artery.

The metabolic syndrome score was defined as the number of components present.

### 3. Statistical Analysis

- Data analysis was performed with SPSS statistical package, version 20 (Statistical Package for Social Sciences).
- Discrete data were presented in absolute value and percentage.
- Continuous data were presented as mean and standard deviation.
- Differences between groups, for discrete variables were performed using Chi-Square test.
- Differences between groups for continuous variables were performed using t test.
- A value of  $p \leq 0.05$  was considered as significant.

### 4. Results

205 patients with MS were enrolled in total in the study. 131 were males (63.90%) and 74 were females (36.10%). The mean age of patients was  $59.99 \pm 8.98$  years, with a statistically significant difference ( $p < 0.001$ ) between patients with and without CAD. There were 149 patients (72.68%) in total with CAD, out of which 107 (71.80%) were males; thus CAD was significantly more common in men than in women ( $P < 0.001$ ). (Table 1) There was no significant statistically difference between the two groups regarding living area, religion and education.

**Table 1:** Demographic characteristics of the study population

	with CAD (%)	without CAD (%)	Total (%)	p value
All MS Patients	149 (72.68)	56 (27.32)	205 (100%)	<0.001
Age <40 years old	18 (12.10)	11 (19.60)	29 (14.20)	0.009
40-50 years old	53 (35.60)	24 (42.90)	77 (37.60)	
51-60 years old	53 (35.60)	16 (28.60)	69 (33.70)	
61-70 years old	25 (16.80)	5 (8.90)	30 (14.60)	
Gender				<0.001
Male	107 (71.80)	24 (42.90)	130 (63.90)	

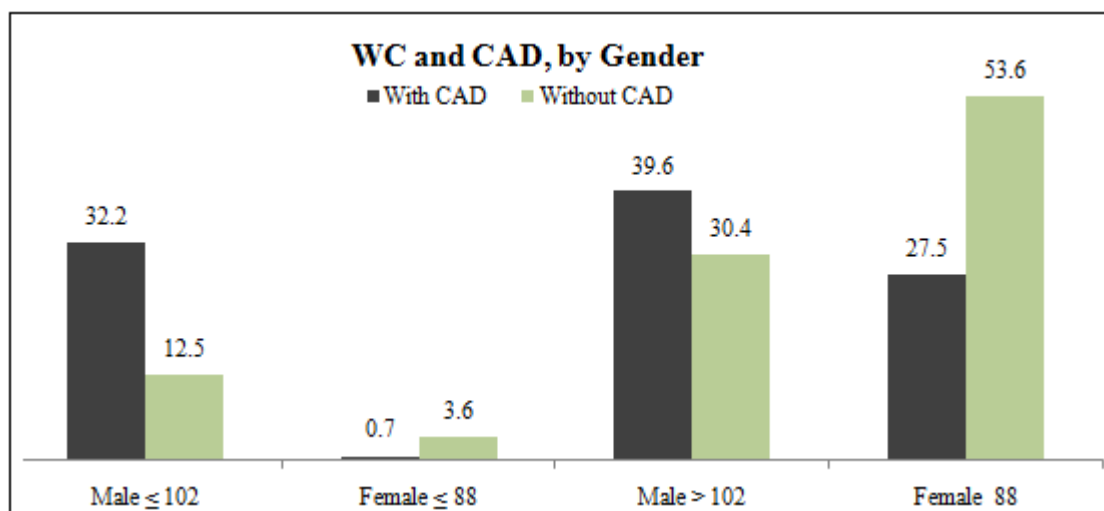
	Female	42 (28.20)	32 (57.10)	74 (36.10)	
Living area					0.611
Urban	112 (75.20)	44 (78.60)	156 (76.10)		
Rural	37 (24.80)	12 (21.40)	49 (23.90)		
Religion					0.333
Muslim	125 (83.90)	42 (75.00)	167 (81.50)		
Christian	24 (16.10)	14 (25.00)	38 (18.50)		
Education					0.795
Elementary	73 (49.00)	25 (44.60)	98 (47.80)		
High school	64 (43.00)	27 (48.20)	91 (44.40)		
University	12 (8.10)	4 (4.10)	16 (7.80)		

The most frequent metabolic component in MS patients with CAD was reduced HDL-cholesterol (74.03% vs. 25.97%,  $p < 0.001$ ), and elevated fasting blood glucose (78.50% vs. 46.40%,  $p < 0.001$ ). There was no statistically significant difference between MS patients with or without CAD regarding elevated triglycerides levels (75.80% vs. 80.40%,  $p = 0.493$ ). Increased waist circumference was more prevalent in patients without CAD (84.00% vs. 67.10%,  $p = 0.001$ ), but 62.5% of these patients were smokers. Although blood pressure was significantly more elevated in MS patients without CAD (57.10% vs. 43.00%,  $p = 0.049$ ), 85% of the patients with CAD had a history of hypertension. (Table 2)

**Table 2:** Frequency of each metabolic component in patients with and without CAD

Metabolic components	With CAD (%)	Without CAD (%)	Total (%)	P value
Low HDL-cholesterol	134 (74.03)	47 (25.97)	181 (88.29)	<0.001
Elevated FBG	117 (78.50)	26 (46.40)	143 (69.80)	<0.001
Elevated TG	113 (75.80)	45 (80.40)	158 (77.10)	0.493
Elevated BP	64 (43.00)	32 (57.10)	96 (46.80)	0.049
Increased WC	100 (67.10)	47 (84.00)	147 (71.70)	0.001

Figure 1 presents the relation between WC and CAD, according to gender. Males with decreased WC (26.80%) and females with increased WC (34.60%) had more CAD than males with increased WC (37.10%) and females with decreased WC (1.50%).



**Figure 1:** Relation between WC and CAD by Gender

Among the coronary risk factors, diabetes mellitus and smoking are more prevalent in patients with CAD. There is no significant statistically difference between the two groups regarding dyslipidemia, hypertension, and family history of CAD. (Table 3)

**Table 3:** Distribution of risk factors in MS patients with and without CAD

Risk Factors	with CAD (%)	without CAD (%)	Total (%)	p value
Hypertension	134 (89.90)	49 (87.50)	183 (89.30)	0.616
Diabetes Mellitus	75 (50.30)	13 (23.20)	88 (42.90)	<0.001
Smoking	70 (47.00)	15 (26.80)	85 (41.50)	0.009
Dyslipidemia	88 (59.10)	30 (53.60)	118 (57.60)	0.479
Family History of CAD	61 (40.90)	21 (37.50)	82 (40.00)	0.654

We did not find any relation between the metabolic syndrome score and the presence of CAD. (Table 4)

**Table 4:** Frequency of Metabolic risk score

Metabolic risk score	With CAD (%)	Without CAD (%)	Total (%)	p value
3/5	83 (55.70)	31 (55.40)	114 (55.60)	0.779
4/5	51 (34.20)	21 (37.50)	72 (35.10)	
5/5	15 (10.10)	4 (7.10)	19 (9.30)	

Table 5 presents a summary of some demographic, anthropometric and biochemical parameters (continuous variables) regarding the presence of CAD. Patients with CAD were older, had elevated fasting glucose, and low HDL-cholesterol statistically significant compared to those without CAD.

**Table 5:** Summary of some demographic, anthropometric and biochemical parameters

	With CAD	Without CAD	Total	p value
Age	61.21±8.75	56.73±8.88	59.99±9.98	0.001
FBG	131.39±45.44	106.02±31.61	124.46±43.54	<0.001
WC	103.00±11.23	105.77±10.99	103.76±11.21	0.115
Total Cholesterol	180.73±57.86	193.42±55.19	184.20±57.29	0.158
HDL-Cholesterol	34.76±6.70	37.85±7.72	35.60±7.11	0.005
LDL-Cholesterol	106.40±46.25	106.64±38.13	106.47±44.09	0.972
Triglycerides	214.60±120.92	213.97±107.4	214.43±117.13	0.972

## 5. Discussion

The purpose of our study was to evaluate the presence of CAD in patients with MS and to compare each component of the syndrome in these patients with and without CAD.

We use the ATP III definition criteria to diagnose metabolic syndrome [7]. Waist circumference is the first criteria in this definition that reflects abdominal obesity as the major contributor of the metabolic syndrome. In our study we found that waist circumference is decreased in patients with CAD. These patients were smokers in a greater percentage than the other group without CAD, and probably the reason of this finding is the effect of smoking on increasing whole body metabolism. In our knowledge there is no other study which has reached such a conclusion. There is a publication

showing that WC and waist-to-hip ratio is in normal range in patients with CAD, but not decreased [8].

Metabolic syndrome is known as insulin resistance syndrome [9]. Insulin resistance manifests as glucose intolerance, and when glucose intolerance leads to high glucose levels, this is a risk factor for CAD. The first prospective observation that found out the role of hyperglycemia in CAD was the Framingham Study which showed that the incidence of cardiovascular disease is two-to three folds higher in diabetic patients [10]. Fasting blood glucose in our study was higher in patients with CAD.

Dyslipidemia in serum lipid profiles presented as raised triglycerides and low HDL-cholesterol, raised total cholesterol and raised LDL-cholesterol. We found that the most frequent metabolic component present in our study was low HDL-cholesterol which is in concordance with other studies showing that reduced HDL is the most important lipid fraction affecting CAD [11]. Triglycerides, LDL cholesterol and total cholesterol had no statistically differences between patients with and without CAD. In other studies, elevated triglycerides correlate with CAD [12], [13].

As we have shown above, hyperglycemia and low HDL-cholesterol correlated with coronary artery disease, which has been noted as well in other studies [14]-[17]. Elevated blood pressure correlates with obesity and occurs in insulin-resistant patients. Hypertension is listed as a risk factor component of the metabolic syndrome, although probably less important than the others [18]. In our study hypertension was more prevalent in patients without coronary artery disease. The major number of patients with high blood pressure had a history of hypertension and was under treatment. In other studies high blood pressure has correlated with coronary artery disease [19]-[22].

## 6. Conclusion

In our study MS and especially hyperglycemia and low HDL-cholesterol were associated with CAD. High waist circumference and hypertension were more prevalent in patients without CAD. There was no significant difference regarding elevated triglycerides in patients with and without CAD.

## 7. Limitations

The number of patients was relatively small. The group without coronary artery disease is less healthy than the general population because they were hospitalized for a reason.

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