# THE PREVALENCE OF METABOLIC SYNDROME IN CORONARY ARTERY DISEASE AND THE ASSOCIATION OF METABOLIC SYNDROME WITH SEVERITY OF CORONARY ARTERY DISEASE

JAMAL BASHEER MOHAMMAD, SIPAN SARBAST and MOUSA HAJI AHMED
College of Medicine, University of Duhok, Kurdistan Region-Iraq

**ABSTRACT**

**Introduction**

Metabolic syndrome (MetS) is the major and a common risk factor of many major diseases like Atherosclerotic cardiovascular disease (ASCVD), Cerebrovascular Accidents(CVA) and Diabetes Mellitus. This study was conducted to assess the association of metabolic syndrome with the Coronary Artery Disease and the severity of CAD evident angiographically. CAD are the leading causes of Death worldwide.

**Materials and Methods**

In our study 607 patients from both sex was included who presented to the cardiology department suffering from features of ischemic heart disease then underwent coronary angiography and have confirmed CAD with single or multi-vessels diseases, they were aged from 25 to 85 years.

Metabolic Syndrome was defined based on International Diabetes Federation (IDF) criteria(13) as follows: Central obesity (waist circumference: Male > 90 cm, female>80cm) plus any two: Raised triglycerides(>150mg/dl), reduced HDL cholesterol (<40mg/dl in men or <50mg/dl), ), raised blood pressure (systolic ≥ 130 mmHg or diastolic ≥ 85 mmHg or on treatment), or raised fasting plasma glucose (fasting plasma glucose ≥ 100 mg/dl or on treatment).

The results: Among the 607 participants in the study 334(55.02%) were males and 273(44.97%) were females, the mean age of the participant was 57yrs with no significant difference between those who have and haven`t metabolic syndrome. 371(61.1%) patients have metabolic syndrome; females were significantly affected with metabolic syndrome 224(60.4%) than males 147(39.6%) with P value <0.001. 224(82%) of participant females were fulfilling the criteria of metabolic syndrome which is very significantly higher than participant males 147 (44%).

Conclusion: There are high incidences of metabolic syndrome found in CAD, metabolic syndrome MetS is more common in females and its associated with severe CAD. Preventive measures should be applied at the level of the community for better life styles especially for women.

## INTRODUCTION

**M**etabolic syndrome (MetS) is the major and a common risk factor of many major diseases, which featured by the occurrence of central obesity, elevated blood pressure, Low levels of High Density Lipoproteins (HDL), Hypertriglyceridemia and hyperglycemia in peoples, making them at great risk for developing Atherosclerotic cardiovascular disease(ASCVD), Cerebrovascular Accidents(CVA) and diabetes Mellitus(1).).The presence of 3 or more of these criteria concomitantly increases the risk of developing ASCVD by 2-folds and risk of Type 2- Diabetes Mellitus (DM; is a metabolic disorder which is characterized by Hyperglycemia due to absolute or relative deficiency of Insulin) by 5-folds (2). Middle East being among the most affected regions with metabolic syndrome (3). The disease was found to be more common in women, more prevalent in urban than rural area's due to changes in the nutritional habits, using more carbohydrates, fast foods and more sedentary life style(physical inactivity and lack of exercise) (4,5). several epidemiological researches and meta-analysis have found a strong relations between Metabolic Syndrome and increased risk of Coronary Artery Disease(CAD), CAD is a term given to heart problems caused by narrowed heart arteries, when arteries are narrowed, less blood and oxygen reaches the heart muscle this is also called Ischemic heart disease and coronary heart

jamal.mohammad@uod.ac

disease and are the leading cause of mortality and morbidity in the world (6,7). Currently Metabolic syndrome makes a huge burden on the health system but the effects considered becoming much higher in the future (8). Several studies has demonstrated that prevalence of Met S in patients with Coronary Artery Disease (CAD) is about 72.5%6 and Prevalence of CAD is about 91% in people having Met S and 62% in those without Met S.8(9). Striking differences in coronary artery stenosis were found in 46.5% of patients with Metabolic Syndrome and 26% of patients without metabolic syndrome (10). There are studies supporting the relation between abnormal markers of inflammation and resistance to insulin and ASCVD severity (11, 12).

This study was conducted to assess the association of metabolic syndrome with the Coronary Artery Disease and the severity of CAD evident angiographically.

## MATERIALS AND METHODS

In this study 607 patients from both gender were included who presented to the cardiac Center of Azadi General and Teaching Hospital suffering from features of ischemic heart disease then underwent Coronary angiography and have confirmed CAD with single or multi-vessels diseases, they were aged from 25 to 85 years.the study was conducted between $3^{rd}$ of December2019 to the $29^{th}$ of July 2021 After obtaining the consents all patient were interviewed with a detailed history including risk factors for CAD including age, sex, smoking, Hypertension, DM, family history for ASCVD, obesity and sedentary life styles. Patient with chronic kidney disease with serum creatinine >1.7 mg/dl and those taking corticosteroid for 3month or more were excluded from the study.

Patient demographic data were measured; height and Waist circumference (cm) was achieved by measuring midway between the lower limit of the rib cage and the iliac crest during normal inspiration. Blood pressure was measured in the sitting position in the right arm while patients were in physical rest for at least 5minutes using the mercury sphygmomanometer. 12hours (overnight) Fasting blood samples were taken for Fasting Serum Glucose, serum creatinine and lipid profile.

**Definitions**

Metabolic Syndrome was defined based on International Diabetes Federation (IDF) criteria(13) as follows: Central obesity (waist circumference: Male > 90 cm, female>80cm) plus any two: Raised triglycerides(>150mg/dl), reduced HDL cholesterol (<40mg/dl in men or <50mg/dl), ), raised blood pressure (systolic $\geq$ 130 mmHg or diastolic $\geq$ 85 mmHg or on treatment), or raised fasting plasma glucose (fasting plasma glucose $\geq$ 100 mg/dl or on treatment).

**Statistical methods**

The prevalence of metabolic syndrome and other abnormal conditions were determined in number and percentage. The age of patients was presented in mean and Sta. Deviation. The comparison of general characteristics between metabolic and non-metabolic patients was examined in an independent t-test or Pearson Chi-squared test. Angiography findings of coronary artery disease patients was compared between metabolic and non-metabolic patients using Pearson Chi-squared test. The comparison of number of components of metabolic syndrome in patients with different vessels was performed in Pearson Chi-squared test. The predictors of angiography findings were determined in univariate analysis. The significant level of difference was determined in a P-value of less than 0.050. The statistical analyses were performed by statistical package for social sciences version 25 (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp).

**The results:**

Among the 607 participants in the study 334(55.02%) were males and 273(44.97%) were females, the median age of the participant was 57yrs with no significant difference between those who have and haven`t metabolic syndrome. 371(61.1%) patients have metabolic syndrome, females were significantly affected with metabolic syndrome 224(60.4%) than males 147(39.6%) with P value <0.001. 224(82%) of participant females were fulfilling the criteria of metabolic syndrome which is very significantly higher than participant males 147 (44%). HDL levels were significantly lower in patient with metabolic syndrome (P value <0.001). serum triglyceride and waist circumference were significantly higher in patient with metabolic syndrome with P value <0.001 for both parameter, body mass index (BMI) was

significantly higher in the patient with metabolic syndrome with P value of <0.001, smoking was significantly less prevalent in patients with metabolic syndrome with P value <0.001.

incidence of Hypertension and DM are significantly higher in the metabolic syndrome group with P value <0.001 for both parameters, data shown in (table 1, 2) and (figure 1).

**Table (1):** Prevalence of metabolic syndrome in coronary artery disease patients
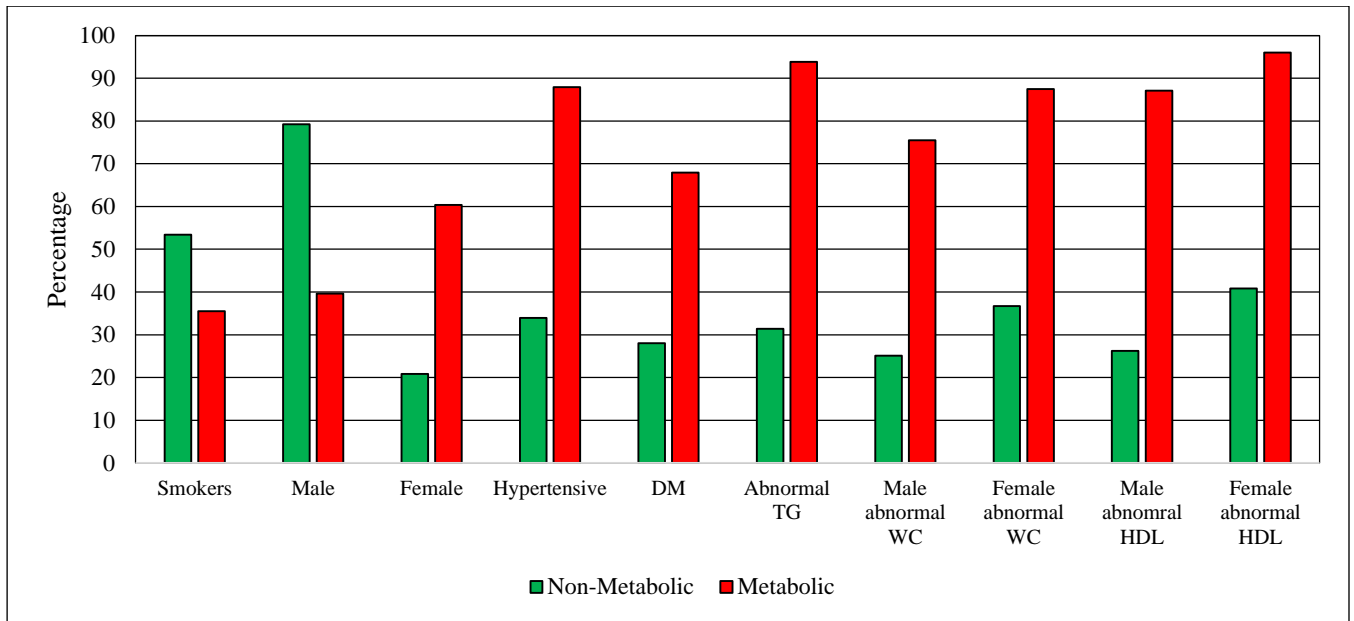
| Metabolic syndrome | CAD (n=607) | |
|---|---|---|
| | Frequency | Percent |
| No metabolic syndrome | 236 | 38.9 |
| Metabolic Syndrome | 371 | 61.1 |
| **CAD: Coronary artery disease** | | |

**Table (2):** Baseline characteristics of metabolic and non-metabolic patients

| Patients' characteristics (n=607) | Study Groups | | P-Value |
|---|---|---|---|
| | Non-metabolic(236) | Metabolic Syndrome (371) | |
| **Age** | 57.45 (11.13 | 57.91 (9.10 | 0.585[a] |
| Gender | | | <0.001[b] |
| Male | 187 (79.2) | 147 (39.6) | |
| Female | 49 (20.8) | 224 (60.4) | |
| **HDL** | | | |
| **Male** | 138 (73.8) | 19 (12.9) | |
| Normal | 49 (26.2) | 128 (87.1) | <0.001[b] |
| Abnormal | | | |
| **Female** | 29 (59.2) | 9 (4.0) | |
| Normal | 20 (40.8) | 215 (96.0) | <0.001[b] |
| Abnormal | | | |
| **Total** | 167 (70.8) | 28 (7.5) | |
| Normal | 69 (29.2) | 343 (92.5) | <0.001[b] |
| Abnormal | | | |
| **TG** | | | <0.001[b] |
| Normal | 162 (68.6) | 23 (6.2) | |
| Abnormal | 74 (31.4) | 348 (93.8) | |
| **WC** | | | |
| **Male** | 140 (74.9) | 36 (24.5) | |
| Normal | 47 (25.1) | 111 (75.5) | <0.001[b] |
| Abnormal | | | |
| **Female** | | | |
| Normal | 31 (63.3) | 28 (12.5) | <0.001[b] |
| Abnormal | 18 (36.7) | 196 (87.5) | |
| **Total** | | | |
| Normal | 171 (72.5) | 64 (17.3) | <0.001[b] |
| Abnormal | 65 (27.5) | 307 (82.7) | |
| **BMI** | | | <0.001[b] |
| Underweight | 0 (0.0) | 1 (0.3) | |
| Normal weight | 42 (17.8) | 49 (13.2) | |
| Overweight | 133 (56.4) | 114 (30.7) | |
| Obese | 61 (25.8) | 207 (55.8) | |
| **Smoking** | | | <0.001[b] |
| Yes | 124 (53.4) | 131 (35.5) | |
| No | 108 (46.6) | 238 (64.5) | |
| **Hypertension** | | | <0.001[b] |
| Abnormal | 80 (33.9) | 326 (87.9) | |
| Normal | 156 (66.1) | 45 (12.1) | |
| **Diabetes mellitus** | | | <0.001[b] |
| Yes | 66 (28.0) | 252 (67.9) | |
| No | 170 (72.0) | 119 (32.1) | |
| [a] An independent t-test and [b] Pearson Chi-squared test were performed for statistical analyses. | | | |

**Fig. (1):** Prevalence of metabolic syndrome in patients with abnormal parameters

Regarding the angiographic findings, those with metabolic syndrome have statistically significant more severe CAD. However, although patients with metabolic syndrome have more 2,3, &4 diseased vessels, the statistical significance was not different (Table 3 and figure 2).

**Table (3):** Angiography findings of coronary artery disease patients

| Patients' characteristics (n=607) | Study Groups | | P-Value |
|---|---|---|---|
| | Non-metabolic(236) | Metabolic Syndrome (371) | |
| **Angiography categories** | | | 0.029 |
| RCA | 26 (11.0) | 44 (11.9) | |
| LCX | 24 (10.2) | 25 (6.7) | |
| LAD | 59 (25.0) | 64 (17.3) | |
| Multi-vessel | 127 (53.8) | 238 (64.2) | |
| **No. of vessel** | | | 0.131 |
| 1 | 109 (46.2) | 137 (36.9) | |
| 2 | 68 (28.8) | 130 (35.0) | |
| 3 | 55 (23.3) | 94 (25.3) | |
| 4 | 4 (1.7) | 10 (2.7) | |
| Pearson Chi-squared test was performed for statistical analyses. | | | |
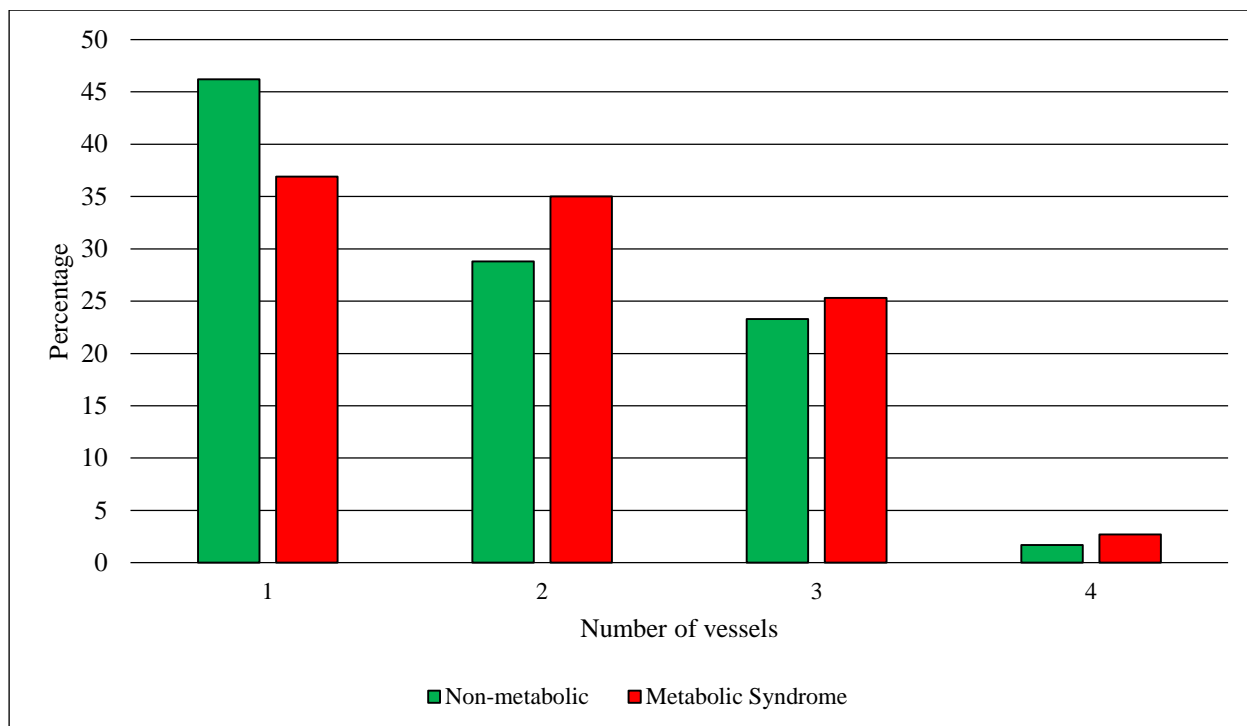
**Fig. (2):** Prevalence of metabolic syndrome in patients with different number of vessels in angiography findings
Severity of CAD according to the component of metabolic syndrome shows no significant differences in patient with non,1, 3 and 4 metabolic components but it was significant in those with 2 components (table 4).

There was highly significant difference in the severity of CAD between patients with diabetes mellitus and those without diabetes mellitus (more patients have 2,3 and 4 vessels disease) as shown in (able 6).

**Table (4):** Severity of coronary artery disease according to components of metabolic syndrome

| Metabolic Components | No. of vessel | | | | P-value |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | |
| **Metabolic Components** | 18 (7.3) | 21 (10.6) | 12 (8.1) | 2 (14.3) | |
| 0 | 31 (12.6) | 23 (11.6) | 22 (14.8) | 2 (14.3) | 0.548 |
| 1 | 60 (24.4) | 24 (12.1) | 21 (14.1) | 0 (0.0) | 0.620 |
| 2 | 73 (29.7) | 46 (23.2) | 39 (26.2) | 2 (14.3) | 0.010 |
| 3 | 64 (26.0) | 84 (42.4) | 55 (36.9) | 8 (57.1) | 0.244 |
| 4 | | | | | 0.945 |

Pearson chi-squared test was performed for statistical analyses.
The first row was considered the reference in calculating the P-values.

**Table (5):** Univariate analysis of variance of angiography results

| Predictors | Dependent Variable: Angiography categories | | Dependent variable: Number of vessels | |
|---|---|---|---|---|
| | **F Score** | **P** | **F Score** | **P** |
| Smoker | 0.023 | 0.881 | 0.023 | 0.881 |
| Gender | 7.660 | 0.006 | 6.906 | 0.009 |
| DM | 9.293 | 0.002 | 5.317 | 0.021 |
| Metabolic Syndrome | 1.611 | 0.205 | 4.680 | 0.031 |
| Age | 1.529 | 0.015 | 2.114 | 0.000 |

Univariate analysis was performed for statistical analyses.

**Table (6):** Angiography findings between diabetic and nondiabetic patients

| Angiography findings | DM | | P-Value (two-sided) |
|---|---|---|---|
| | **Yes** | **No** | |

| Angiography categories | 35 (11.0) | 35 (12.1) | <0.0001 |
|---|---|---|---|
| RCA | 17 (5.3) | 32 (11.1) | |
| LCX | 51 (16.0) | 72 (24.9) | |
| LAD | 215 (67.6) | 150 (51.9) | |
| Multi-vessel | | | |
| | | | |
| **Number of vessel** | 106 (33.3) | 140 (48.4) | 0.002 |
| 1 | 115 (36.2) | 83 (28.7) | |
| 2 | 89 (28.0) | 60 (20.8) | |
| 3 | 8 (2.5) | 6 (2.1) | |
| 4 | | | |

Pearson Chi-squared test was performed for statistical analyses.

## DISCUSSION

Coronary Artery Diseases (CAD) are leading cause of mortality in world (14). Many studies have shown that CAD is more common in metabolic syndrome (15). In this study we found the prevalence of metabolic syndrome among patient with CAD disease to be 61.1%, the results we nearly similar to study conducted in Egypt where they found the prevalence of MetS in CAD around 66.3%(16). Reza Miri and friends from Iran found the prevalence MetS in patients presenting with CAD to be 47% (17). Many studies have shown that MetS is an independent risk factor for CAD and diabetes, but there is debates about the role of MetS in cardiovascular risk among diabetic patients (18, 19). 3 Yoon et al. found no association between MetS and CAD in diabetic subjects (20). We found that metabolic syndrome is associated with severe CAD, Severe CAD was significantly present in higher number of patients having Met S compared to those not having Met S (66% vs. 46%, p=0.005) (21). Similar relation has been found by other studies. Kip et al showed significant prevalence of severe CAD in patients with Met S (47% as compared to 25% in patients without Met S). Yavuz et al, found significantly larger number of patients with MetS having severe CAD compared to patients without Met S (91% vs. 62%).

In this study we found that MetS is significantly more common among female than males affected with CAD this probably because females have more social barriers to work and to do exercises outside homes. Noha Hassanin et al found Young women with ACS reporteda higher incidences of metabolic syndrome than young men (83.78 vs. 58.82%) (P = 0.007) (16), some other Studies have showed decreased survival in women with MetS compared with women without MetS (22). In this study we found that smoking is significantly less common among MetS group because female was the majority of the MetS. Group and smoking is a rare habit among women of our community.

Conclusion:

There are high incidences of metabolic syndrome found in CAD, metabolic syndrome MetS is more common in females and its associated with severe CAD. Preventive measures should be applied at the level of the community for better life styles especially for women.

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