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PREVALENCE AND PREDICTORS OF METABOLIC SYNDROME IN PATIENTS WITH CORONARY ARTERY DISEASE

Asif Khan[1], Mohsin Saif[2], Syeda Nargis Fatima Naqvi[3], Mohd Abdul Samad[4], S. Zahed Rasheed[5], Mohammad Ishaq[6]

[1,5,6]Department of Cardiology, Karachi Institute of Heart Diseases, Karachi-Pakistan

[2]Department of Medicine Combined Military Hospital, Malir, Karachi-Pakistan

[3]Department of Physiology, Shaheed Mohtarma Benazir Bhutto Medical College, Karachi-Pakistan

[4]Research Associate, Shaheen Research Group Karachi-Pakistan
Address for Correspondence:

Asif Khan

Department of Cardiology, Institute of Heart Diseases, Karachi-Pakistan

Email: asifkhan_dr@yahoo.com

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Contribution

AK conceived, designed and wrote manuscript. MS SNFN, MAS and SZR did data collection. MI did review and final approval of manuscript. All authors contributed equally to submission of manuscript.

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ABSTRACT

Objective: To identify the prevalence and predictors of metabolic syndrome using NCEP ATP III guidelines in patients with CAD who underwent angiography at Karachi Institute of Heart Disease (KIHD).

Methodology: This cross-sectional study was conducted at the Department of Cardiology; Karachi Institute of Heart Disease from 1st March to 31st December 2016. Patients with confirmed diagnosis of CAD after satisfying the inclusion and exclusion criteria were recruited in this study through non-probability consecutive sampling technique. Data was collected on demographics (i.e. age, gender, and ethnicity) and co-morbidities (i.e. diabetes and hypertension). Metabolic syndrome in patients with CAD was assessed according to the 2011 NCEP ATP III guidelines. Moreover, severity of CAD in patients was also recorded as well as systolic and diastolic blood pressure and biochemical parameters. The data was analysed using SPSS version 21.

Results: Among 400 participants, majority (60%) of the participants with CAD were diagnosed with metabolic syndrome. Significantly greater proportion of females (51.2% vs. 21.9%; p = 0.001) were diagnosed with metabolic syndrome. The mean weight, height, BMI and waist circumference was significantly higher in CAD patients diagnosed with metabolic syndrome. Significant difference was not observed in severity of CAD between patients with and without metabolic syndrome.

Conclusion: The study highlighted a higher prevalence of metabolic syndrome evaluated using the 2011 NCEP ATP III guidelines among patients with CAD.

Key Words: Coronary artery disease, Diabetes mellitus, Insulin resistance, Metabolic syndrome, NCEP ATP III

INTRODUCTION

Coronary Artery Disease (CAD) has a worldwide prevalence and affecting people of different regions. Considering it affects people worldwide, the disease has an epidemic proportion.[1] Among South Asian population the burden of the disease continued to remain high, being attributed to the South Asian phenotype, having a higher waist circumference, increased insulin resistance and greater abdominal obesity.[1-2] South Asian population has a greater prevalence of new risk factors as compared to Caucasians which included i.e. the onset of disease at a relatively early age, involvement of two or more vessels and aggressive course.[3]

Metabolic syndrome (MS) as reported by the study is a conglomeration of hypertension, abdominal obesity, dyslipidemia, and glucose intolerance and has been reported as one of the most pre-dominant factors contributing to the CAD and type 2 diabetes mellitus (DM).[3-4] The principal component of MS is insulin resistance.[5] The other features of MS are atherogenicity dyslipidemia manifested as increased triglyceride, decreased HDL, hypertension and abdominal obesity with speculations being made that insulin resistance being the most significant risk factor for CAD among South Asians.[6] A number of epidemiological studies has been conducted to identify the stigma related to the prevalence of MS with global prevalence, variation in prevalence in different regions, and corresponding variations in terms of age, gender and ethnicity. The diverse results of the studies conducted suggested an important effect of genetic and environmental factors, thereby suggesting and reinforcing the need to undertake regional studies.[7,8] Different criteria have been used to identify MS with most commonly used are i.e. World Health Organization (WHO) Criteria, Adult Treatment Panel (ATP) III Criteria, American College of Endocrinology Criteria and International Diabetes Federation (IDF) Criteria.[9]

Considering a strong role of age and gender in the prevalence of MS among patients with CAD, along with geographical variations, it is critical to conduct regional studies to better identify the prevalence in the respective population. Moreover, it has also been reported that MS in patients with CAD have significantly high morbidity and mortality associated. Considering, there has been no recent study conducted to identify the prevalence of MS in CAD patients in Pakistan, there is an emerging need to identify the prevalence and predictors of MS in patients with CAD established by coronary angiography. Therefore, the study was conducted to identify the prevalence and predictors of Metabolic Syndrome (MS) using ATP III guidelines among patients with CAD.

METHODOLOGY

This cross sectional study was conducted at the Department of Cardiology, Karachi Institute of Heart Diseases (KIHD) from 1st March to 31st December, 2016. Patients with confirmed diagnosis of CAD were recruited in this study. Patients satisfying the following inclusion criteria were recruited; confirmed diagnosis for CAD, either gender (males or females), greater than 18 years, and willing to give informed consent and comply with the study procedures. Following patients were excluded i.e. (G0 = with no coronary vessel stenosed), valvular heart disease, congenital heart disease, and cardiomyopathy. Moreover, patients greater than 70 years, pregnant women and psychiatric illness not willing to abide by the study procedure were also excluded. In the current participants satisfying the inclusion and exclusion criteria were enrolled using non-probability consecutive sampling technique.

Coronary artery disease (CAD) diagnosis was based on history of angina/Myocardial infarction with previously documented disease, ECG following Minnesota codes 1-1, 4-1, 5-9, 5-2, or 9-2, history of PTCA (Percutaneous Transluminal Coronary Angioplasty) / CABG (Coronary Artery Bypass Graft) or angiographically documented disease and treadmill or stress echocardiogram study suggesting myocardial ischemia. Patients who did not fulfil any of the criteria had a stress test done in order to detect silent ischemia. Findings on angiogram were used to determine the severity of CAD.[2] Patients in four groups were classified as; G0 = none of the coronary vessels stenosed, G1 = stenosis of one vessel, G2 = two vessels with more than 50% stenosis and G3 = all three major vessels greater than 50% stenosed.

Metabolic syndrome in patients with CAD was assessed according to the 2011 ATP III guidelines having confirmed with presence of any three of the following; 1) Abdominal obesity as defined by Waist Circumference =94 cm for men and =80 cm in women, 2) TG = 150 mg/dl, 30 HDL-C = 40 mg/dl in men and = 50 mg/dl in women, 4) BP of >130/85 mm Hg, 5) FBS of = 110 mg/dl.

Data for all participants were recorded on a pre-designed proforma. The demographic data (i.e. age, gender, and ethnicity) of all participants were recorded. Moreover, systolic and diastolic blood pressures were also noted. Anthropometric measurements (i.e. Weight, height, Body Mass Index and waist as well as hip circumference) were also recorded. Serum glucose, total cholesterol, triglycerides, HDL-cholesterol and LDL-cholesterol were also determined.

The study was approved by the Ethical and Scientific review committee, Karachi Medical & Dental College. A written informed consent was obtained from all the study participants. Anonymity and confidentiality of study

participant's response and clinical data was maintained.

The data was analysed using statistical analysis software (SPSS version 21).Data transformation was performed and new variable were computed where desirable (i.e. age categories and BMI etc.). Descriptive statistics was performed and categorical variables (i.e. gender, marital status, ethnicity, severity of CAD and co-morbidities such as diabetes and hypertension) were presented as frequency/percentage. The quantitative variables (i.e. age, weight, height, BMI, waist circumference systolic BP and diastolic BP, fasting blood glucose, total cholesterol, HDL-cholesterol, LDL-cholesterol and triglyceridesetc.) were presented as mean ± SD.

The outcome variable presence of metabolic syndrome (Yes/No) were also presented as frequency/percentage. The frequency of patients' gender, ethnicity, severity of CAD and co-morbidities were compared in groups with and without MS using chi-square statistics. While the mean values of systolic and diastolic BP, FBS, total cholesterol, HDL-cholesterol, LDL-cholesterol and triglyceride in CAD patients with or without MS were compared by independent t test. For all analysis $p < 0.05$ was considered significant.

The predictors of metabolic syndrome in patients with CAD were identified using the binary logistic regression. The predictors of MS in CAD patients were presented with odds ratio and 95% confidence interval. $P < 0.05$ were considered significant.

RESULTS

The present study recruited 400 participants with age range 35 to 60 of either gender. The mean age in years was 54.25±5 years with majority lying in greater than 55 years category (46%). Majority, around 60.5% of the participants were males and around ninety percent were married. Moreover, majority 71.5% were Urdu speaking, followed by Sindhi(25.5%), Pakhtun (4.8%), Balochi (4.5%) and Punjabi (3.8%). Information about demographic characteristics is shown in table 1.

Table 1: Demographic Characteristics of the Study Participants (n=400)

Demographic Characteristics	n (%) / Mean ± SD
Age (years)	54.24 ± 5.0
Age Categories	
=50 years	99 (24.8)
51 - 55 years	117 (29.3)
> 55 years	184 (46)
Gender	
Male	242 (60.5)
Female	158 (39.5)
Marital Status	
Single	37 (9.3)
Married	363 (90.8)
Ethnicity	
Urdu speaking	286 (71.5)
Punjabi	15 (3.8)
Balochi	18 (4.5)
Pakhtun	19 (4.8)
Sindhi	62 (25.5)

The present study identified that the prevalence of MS diagnosis among participants with confirmed diagnosis of CAD was 60%. About 240 (60%) participants had metabolic syndrome, while remaining 160 (40%) did not had metabolic syndrome. Detail of comparison of anthropometric measurements and severity of coronary artery disease of the study participants with and without MS in patients with CAD is given in table 2. Significant difference was observed in mean weight (Kg), height (meters), BMI and waist circumference between patients with and without MS. The mean weight, height, BMI and waist circumference was significantly higher in CAD patients diagnosed with MS. Significant difference was not observed in severity of CAD between patients with and without MS.Comparison of systolic, diastolic blood pressure, co-morbidities and biochemical parameters of the study participants with and without MS in patients with CAD is shown table 3. Significant difference was observed in mean systolic, diastolic blood pressure, co-morbidities (hypertension and diabetes), and biochemical parameters (i.e. FBS, total cholesterol, HDL cholesterol, LDL cholesterol and Triglyceride) between patients with and without MS. The mean systolic and

diastolic BP was significantly higher among CAD patients with diagnosis of MS. Moreover, significantly greater proportion of patient were hypertensive and diabetic in the MS group compared to those not having MS. Finally, the mean FBS, total cholesterol, LDL cholesterol and Triglyceride was higher significantly in CAD patients diagnosed with MS, while the mean HDL Cholesterol was lower significantly among CAD patients diagnosed with MS

The binary logistic regression was performed with outcome variable of interest was MS.The variables (i.e. gender, weight, height, BMI, waist circumference, fasting blood sugar, systolic and diastolic BP, Total cholesterol, HDL, LDL and Triglyceride) which were significant on bivariate analysis were entered into the regression model. The binary logistic regression identified that gender, waist circumference, systolic BP, fasting blood sugar, HDL, LDL and triglyceride were significant predictors of MS in patients with CAD. The table 4 shows the similar information.

Table 2: Comparison of Anthropometric Measurements and Severity of CAD of the Study Participants (n=400)

Anthropometric Measurements	Metabolic Syndrome (n = 240)	No Metabolic Syndrome (n = 160)	P-value
Weight (kg)	67.68 ± 8.5	63.09 ± 8.3	0.001
Height (cm)	1.66 ± 0.05	1.63 ± 0.06	0.001
BMI (kg/m^2)	24.41 ± 2.7	23.73 ± 2.6	0.013
Waist Circumference (cm)	88.07 ± 5.3	85.37 ± 4.6	0.001
Severity of CAD			
One vessel stenosed	74 (30.8)	48 (30)	0.984
Two vessel stenosed with > 50% stenosis	76 (31.7)	51 (31.9)	
All 3 major vessels stenosed with > 50% stenosis	90 (37.5)	61 (38.1)	

Table 3: Comparison of Systolic and Diastolic BP, Co-morbidities and Biochemical Parameters of the Study Participants (n=400)

Variables	Metabolic Syndrome(n = 240)	No Metabolic Syndrome(n = 160)	P-value
Blood Pressure			
Systolic BP (mmHg)	133.04 ± 16.3	122.28 ± 15.3	0.001
Diastolic BP (mmHg)	81.96 ± 11.4	78.22 ± 10.5	0.001
Co-morbidities			
Hypertension			
Yes	134 (55.8)	37 (23.1)	0.001
No	106 (44.2)	123 (76.9)	
Diabetes			
Yes	143 (59.6)	30 (18.8)	0.001
No	97 (40.4)	130 (81.2)	
Biochemical Parameters			
Fasting Blood Sugar (mg/dl)	116.98 ± 26.4	94.24 ± 19.4	0.001
Total Cholesterol (mg/dl)	193.58 ± 34.9	179.90 ± 30.5	0.001
HDL Cholesterol (mg/dl)	38.60 ± 3.8	39.73 ± 3.5	0.003
LDL Cholesterol (mg/dl)	132.15 ± 29.1	118.35 ± 25.1	0.001
Triglyceride (mg/dl)	162.7 ± 35.9	147.31 ± 26.1	0.001

Table 4: Binary Logistic Regression Model for Predictors of Metabolic Syndrome among Patients with CAD (n=400)

Variables	Beta	Sig	Exp (B)	95% CI for Exp B (Lower)	95% CI for ExpB (Upper)
Gender (Male)	-4.014	0.001	0.018	0.007	0.049
Weight (Kg)	-0.068	0.809	0.934	0.537	1.624
Height (meters)	-3.182	0.893	0.042	0.001	0.0001
BMI (Kg/m^2)	0.144	0.851	1.155	0.257	5.129
Waist circumference (cm)	-0.236	0.001	0.970	0.693	0.901
Systolic BP (mmHg)	-0.082	0.001	0.921	0.897	0.946
Diastolic BP (mmHg)	0.026	0.166	1.026	0.989	1.064
Fasting Blood Sugar (mg/dl)	-0.062	0.001	0.940	0.924	0.955
Total Cholesterol (mg/dl)	0.021	0.097	1.022	0.996	1.048
HDL(mg/dl)	0.137	0.013	1.146	1.029	1.277
LDL(mg/dl)	-0.034	0.022	0.967	0.939	0.995
Triglyceride (mg/dl)	-0.035	0.001	0.966	0.950	0.982
Constant	42.919	0.263	4.360E+18		

DISCUSSION

Metabolic syndrome patients along with CAD are accountable to increased morbidity as well as mortality. The present study highlighted that among four hundred participants, majority (60%) of the participants with CAD were diagnosed with metabolic syndrome. The mean weight, height, BMI, waist circumference, systolic BP and diastolic BP were significantly higher in CAD patients with diagnosis of MS against those not diagnosed with MS.

In contrast to present study conducted that reported the prevalence of metabolic syndrome as sixty percent among patients with CAD. Studies have documented variation in prevalence in different regions. The study conducted in United States has reported a prevalence of metabolic syndrome asslightly less than twenty five percent.10In a multicentre study, conducted in different countries of Europe among patients that are not diabetic using the ATP III criteria, MS prevalence was 25.9% in males and 23.4% in females.[11] The significant geographical variation from 11.8% to 24.5% in Mediterranean countries for the prevalence of MS has been reported.[12,13] A study by Santos, et al. conducted among Portuguese urban population reported the prevalence of 24%, having been diagnosed with MS using the ATP III criteria.[14] Similar results were reported showing that the prevalence of MS as slightly less than sixty percent in patients with CAD.[15]

The studies that identified prevalence of MS in Pakistan reported the prevalence of MS as 53% using the IDF criteria and a comparatively lower as 44% prevalence when the Asian criteria for NCEP was used for the diagnosis of MS.[16] Another study conducted in Pakistan reported the frequency of MS in Ischemic heart disease patients were significantly higher among females as (78.7%) compared to males (54.95%).[17]

A prospective population based study enrolling adults aged thirty five years or older residing in three districts of Iran reported that using the ATP III criteria among the 5398 subjects, the incidence of MS was 37.4%.[18] Another study that enrolled stable CAD patients from the outpatient cardiology departments of four hospitals reported the prevalence of MS as around 48% using the ATP III criteria.[19] A study from India conducted recently reported that MS was identified in around forty six percent of patients by ATP-III, 37.4% by IDF and around forty five percent by criteria of WHO.20 However, only around twenty eight percent were identified by all the three criteria.[20]

The present study also highlighted that female gender, waist circumference, systolic BP, fasting blood sugar, HDL, LDL and Triglyceride were significant predictors of MS in patients with CAD. The study reported that MS was diagnosed in around fifty six percent of patients having predominant features of MS as increased waist circumference (75%), raised fasting glucose (68.1%) and elevated blood pressure (56.5%).[21] A case-control study conducted in Congo among patients aged greater than or equal to twenty years admitted at the hospital, reported that the prevalence of CAD in patients with MS was 42.8% as compared to 17.2% in control population thereby, findings reinforces the hypothesis of significant association between MS and CAD.[22] The findings reinforces that MS was more common in women, obese individuals as per the BMI cut-off values, family history of diabetes, and dyslipidemia. The study highlighted presence of MS is a strong marker indicating the likelihood of CAD, while the strongest associations of CAD were found with obesity and microalbuinuria which seems more strongly significant than traditional risk factors like elevated LDL cholesterol, hypertension, and triglycerides.[8]

LIMITATIONS

The present study has certain limitations. This was a single centre study. Recruitment of participants from other sites would have improved the generalisation and external validity of the findings. Moreover, only ATP III criteria were used for the diagnosis of MS. The assessment using other criteria mentioned in literature i.e. World Health Organization Criteria, American College of Endocrinology Criteria and International Diabetes Federation Criteria would have improved the validity and have helped in comparison of diagnosis of MS by using different criteria.

CONCLUSION

The study highlighted a higher prevalence of metabolic syndrome using the ATP III guidelines among patients with CAD. Therefore, all patients with CAD should be evaluated for the presence of MS for management purposes to improve clinical outcomes. The epidemiological findings do have clinical implications in patients with confirmed CAD, metabolic syndrome prevalence is high as identified using the validated ATP III Criteria.

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