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Original Research Article

A study on the occurrence of metabolic syndrome among young subjects presenting with acute myocardial infarction

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ABSTRACT

Background: Coronary artery disease (CAD) is a leading global cause of mortality, with rising prevalence in both urban and rural populations. Atherosclerosis drives coronary heart disease (CHD), and its increasing occurrence in younger individuals underscores the need for early risk factor detection. This study evaluates the prevalence of metabolic syndrome in Indian patients aged ≤45 years presenting with acute myocardial infarction (AMI). The objective was to study the occurrence of metabolic syndrome in subjects 45 years or less having acute myocardial infarction in Indian patients.
Methods: A cross-sectional study on 182 acute myocardial infarction patients ≤45 years excluded those with comorbidities. Statistical analysis assessed metabolic syndrome prevalence and component correlations, highlighting key risk factors contributing to young myocardial infarction in the Indian population.
Results: The study found a mean patient age of 35.55±6.25 years, with males comprising 71.97%. Metabolic syndrome prevalence was 54.39%, significantly associated with smoking and alcoholism. Abnormal waist circumference, fasting sugar, triglycerides, low high density lipoprotein (HDL), and elevated blood pressure were observed in 73.7%, 76%, 85%, 86%, and 45% of cases, respectively.
Conclusion: There is high prevalence of metabolic syndrome among young patients with acute myocardial infarction and there is need for early identification and management of risk factors for prevention of MI in young population.

Keywords: CAD, Metabolic syndrome, Young MI (≤45 years), HDL, Waist circumference, Fasting triglycerides

INTRODUCTION

Coronary artery disease (CAD) is a leading cause of death in both developed and developing countries, with a steadily increasing prevalence in urban and rural populations. The primary underlying mechanism is atherosclerosis, where chronic endothelial dysfunction and inflammation cause the formation of lipid- and smooth muscle-rich plaques in the coronary arteries. These plaques can rupture, leading to thrombosis, further narrowing, and even complete occlusion of the arteries, resulting in reduced oxygen supply to the heart muscle (myocardial hypoxia) and a spectrum of myocardial injury, from mild ischemia to myocardial infarction (MI).[1,2]

India, in particular, faces a disproportionately high burden of CAD. According to the World Health Organization, India accounts for one-fifth of all global deaths from cardiovascular diseases (CVDs), with a significant impact on the younger population. The Global Burden of Disease study reports an age-standardized CVD death rate of 272 per 100,000 in India, much higher than the global average of 235 per 100,000. Notably, CVDs tend to affect Indians about a decade earlier than Western populations, with rapid disease progression, early onset, and higher mortality rates. In 2016, CVDs accounted for 28% of all deaths and 14% of total disability-adjusted life years (DALYs) in India, reflecting a dramatic increase from 1990. Hospitalization rates for CAD complications are 2-4 times

higher among Indians compared to other ethnic groups, and 5-10 times higher in individuals younger than 45 years.[3]

Myocardial infarction occurs in two primary clinical forms: ST-segment elevation MI (STEMI) and non-ST-segment elevation MI (NSTEMI). STEMI is characterized by a distinct elevation in the ST segment on electrocardiography (ECG), while NSTEMI lacks this elevation but is associated with elevated cardiac biomarkers such as troponin. South Asian countries, including India, Pakistan, Sri Lanka, Bangladesh, and Nepal, report the highest prevalence of MI in people under 45 years of age. The Fourth Universal Definition of MI requires evidence of a rise and/or fall in cardiac troponin (cTn) above the 99th percentile, along with symptoms, ECG changes, imaging evidence, or identification of a coronary thrombus.[4]

A major risk factor for MI, especially in younger individuals, is metabolic syndrome (MS)—a cluster of interrelated conditions including central obesity, dyslipidemia, hypertension, and insulin resistance. The prevalence of MS is alarmingly high among young patients experiencing acute MI, highlighting a critical public health issue. The diagnostic criteria for MS have evolved: the World Health Organization's 1999 definition emphasized hyperglycemia and insulin resistance, while the National Cholesterol Education Program/Adult Treatment Panel III (NCEP/ATP III) in 2001 required three or more of the following—abdominal obesity, high triglycerides, low HDL cholesterol, elevated blood pressure, and high fasting glucose. The International Diabetes Federation (IDF) 2019 criteria now mandate central adiposity plus two or more additional risk factors.[5]

For young patients presenting with MI, it is crucial to assess for recent recreational drug use, family history of premature coronary heart disease, and other risk factors such as obesity, smoking, dyslipidemia, and diabetes. A detailed clinical examination should focus on hemodynamic stability and signs of sympathetic hyperactivity or drug misuse.

Despite the high prevalence of CAD and MS among young Indians, their impact on morbidity and mortality is not fully understood. The present study aims to determine the prevalence and profile of MS in young Indian patients (≤45 years) with acute MI, using 45 years as the age cutoff, consistent with most literature. Early identification and management of risk factors—especially in young individuals—are essential. Healthcare professionals should prioritize screening and targeted lifestyle interventions, such as smoking cessation, reduced alcohol intake, regular exercise, and healthy diets, to mitigate the risk of premature cardiovascular events.[6]

So, the objective of the study was to study the occurrence of metabolic syndrome in subjects 45 years or less having acute myocardial infarction in Indian patients.

METHODS

Study design

This cross-sectional analytical study was conducted to determine the prevalence of MS among patients aged 45 years or younger who presented with acute myocardial infarction (AMI). The research was carried out at K.P.S. Post Graduate Institute of Medicine and L.P.S. Institute of Cardiology, GSVM Medical College, Kanpur, India from February 2023 to July 2024. Both outpatients and inpatients were included, allowing for a comprehensive assessment of prevalence and correlations within this specific population at a single point in time.

Inclusion criteria

Patients of age ≤45 years, both sexes who had evidence of MI within 24 hours of presentation and those who provided informed consent were included.

Exclusion criteria

Patients of age >45 years, known thyroid illness, previous MI or significant comorbidities, life-threatening arrhythmias or shock (SBP <90 mmHg), known chronic kidney disease, stroke, sepsis, carcinoma, or autoimmune disease, and who declined consent were excluded.

Sampling method and sample size

A random sampling method was used to ensure representativeness. Eligible patients from both OPD and inpatient wards were assigned random numbers and selected until the required sample size was achieved. Recruitment occurred from February 2023 to July 2024.

Sample size calculation

Based on a 40% prevalence of MS among young MI patients in India (Uppalakal et al), with a 95% confidence interval and 5% margin of error, the calculated sample size was 164.[11] Accounting for a 10% non-response rate, the final sample size was set at approximately 182 patients.

Data collection methods

Patient interviews

Structured interviews collected demographic data (age, sex, weight, height, BMI, waist circumference) and medical history, including comorbidities such as diabetes, hypertension, thyroid disorders, and others.

Medical records

Past treatment details and relevant clinical history were extracted from records.

General examination

Blood pressure was measured in the left arm, supine, at heart level using a mercury sphygmomanometer.

Biochemical measurements

Blood samples were taken for cardiac troponin I, HDL cholesterol, fasting triglycerides, and fasting blood sugar. Troponin I was measured using a fourth-generation immunoassay (clinical cutoff: 0.1 ng/ml).

Electrocardiogram (ECG)

A standard 12-lead ECG identified ST-segment elevations (STEMI) or absence thereof (NSTEMI).

2D echocardiography

Regional wall motion abnormalities were assessed in the territories of the left circumflex, left anterior descending, and right coronary arteries.

Standardized protocols

All procedures followed standardized protocols to ensure consistency and reliability.

Pilot study

A pilot study involving 10 patients was conducted to test feasibility, validity, and reliability of the study design and data collection tools.

The pilot confirmed the practicality of procedures, effectiveness of data collection instruments, and appropriateness of the recruitment process. Minor adjustments were made to questionnaires and staff training based on pilot findings.

Validity and reliability

Internal validity

Maintained by strict inclusion/exclusion criteria and random sampling.

External validity

Enhanced by including both OPD and inpatient participants, making findings generalizable to similar settings.

Reliability

Standardized data collection and trained staff ensured consistency. Instruments were regularly calibrated, and pilot testing confirmed tool reliability.

Data collection procedure

Eligible patients were recruited from February 2023 to July 2024. After informed consent, demographic and clinical data were collected through interviews and records. Waist circumference was measured at the midpoint between the lowest rib and iliac crest. Biochemical tests and diagnostic procedures (ECG, 2D echo) were performed as per protocols.

Data were recorded in standardized forms and entered into an electronic database, with regular quality checks for accuracy.

Data analysis plan

Data were entered and coded in Microsoft Excel and analyzed using statistical package for the social sciences (SPSS) v20. Continuous variables were expressed as means±SD or median (IQR); categorical variables as percentages. Chi-square tests compared categorical data, one-way ANOVA compared continuous variables, and Pearson correlation assessed relationships. A p value <0.05 was considered statistically significant.

This summary covers all major aspects of your methodology in a concise and structured manner.

RESULTS

Figure 1 shows that among the 182 patients studied, the mean age was 35.55 years (SD 6.25), with ages ranging from 19 to 44 years. The largest proportion of cases (57%) were between 36 and 45 years old. Specifically, 9.34% were aged 25 or below, 13.18% were 26–30 years, 20.32% were 31–35 years, 28.02% were 36–40 years, and 29.12% were 41–45 years. The youngest participant was 19, and the oldest was 44.

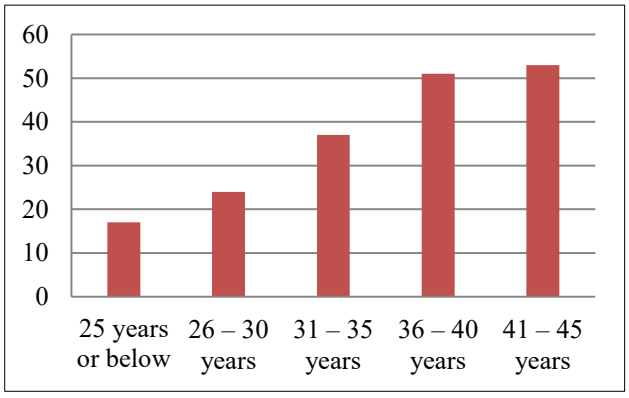

Figure 1: Age demographics.

Figure 2 illustrates the distribution of cases according to sex of the patient. It was observed that more than 70% of the cases in the study group were male while only 51 cases were female.

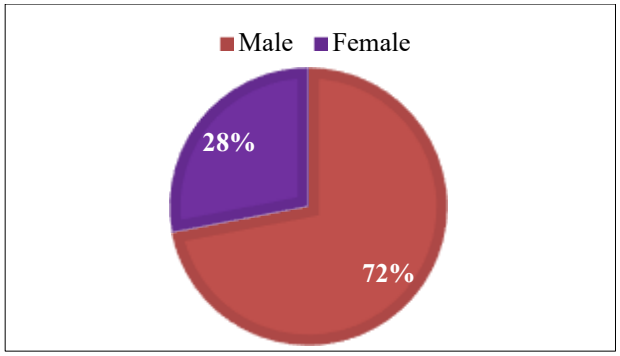

Figure 2: Distribution of gender.

Figure 3 shows that among study participants, 55.5% had increased abdominal girth, 59% had elevated fasting RBS, 58.2% had high triglycerides, 75% had low HDL, and 45% had raised blood pressure.

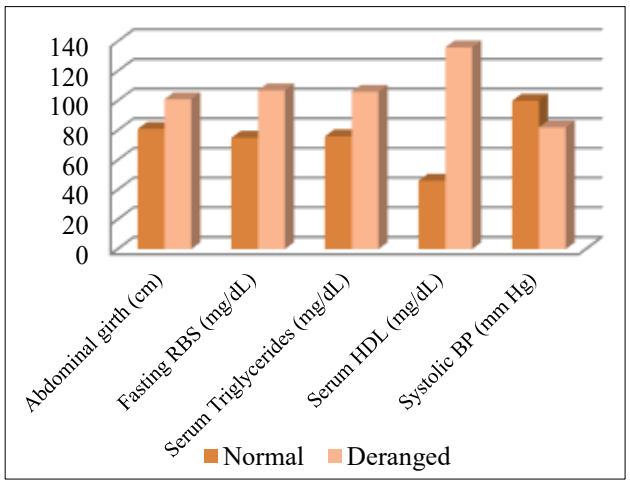

Figure 3: Distribution of participants with MS.

Figure 4 shows the distribution of cases according to prevalence of metabolic syndrome. It was observed that more than half of the cases (54.4%) in the study group had metabolic syndrome.

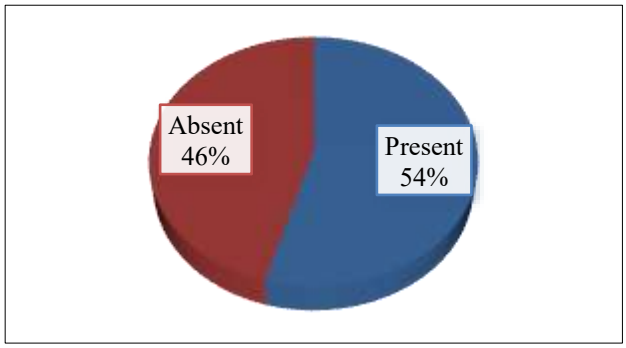

Figure 4: Distribution of cases according to prevalence of metabolic syndrome.

Figure 5 shows that among patients with metabolic syndrome, 73.7% had increased abdominal girth, 76% had elevated fasting RBS, 85% had high triglycerides, and 86% had low HDL. Blood pressure was raised in 52% with metabolic syndrome, while 64% without metabolic syndrome had normal blood pressure. All associations were significant.

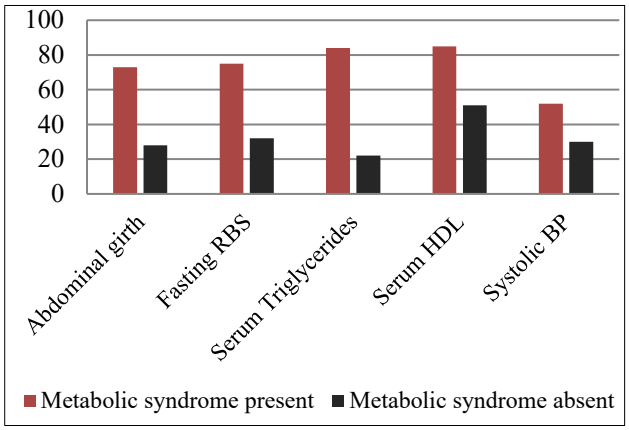

Figure 5: Presence and absence of MS.

Table 1 shows that the distribution of metabolic syndrome across age groups showed that 26% of cases aged 36–40 years and 21% aged 31–35 years had metabolic syndrome, with similar proportions in those without the syndrome. Overall, age was not significantly associated with the presence of metabolic syndrome in this study.

Table 1: Distribution of metabolic syndrome across age groups.

Age (years)	MS present (%)	MS absent (%)	P value
≥25	12 (12.12)	5 (6.02)	
26–30	11 (11.11)	13 (15.66)	
31–35	21 (21.21)	16 (19.27)	0.586
36–40	26 (26.26)	25 (30.12)	
41–45	29 (29.29)	24 (28.91)	

DISCUSSION

The present study highlights the high prevalence of MS among young patients (≤45 years) presenting with acute myocardial infarction (AMI). Our findings demonstrate that 54.39% of patients had MS, which is consistent with previous reports and emphasizes the rising burden of cardiometabolic risk factors in younger populations.

Demographic profile

The mean age of patients was 35.55±6.25 years, slightly younger than the cohorts studied by Wadhwa et al (39.2±4.2 years), Ramesh et al (42±2.91 years), and Zarich et al (41.3±4.6 years).[12-14] This indicates a trend of earlier onset of AMI in Indian patients, possibly due to lifestyle-related risk factors and genetic predisposition. Male predominance (71.97%) was noted, aligning with Ramesh et al (84.3% males) and Ranjith et al (87% males).[12,15] This

reflects the well-documented higher cardiovascular risk among men in younger age groups, though changing trends in female risk factors warrant further evaluation.

Comorbidities and addictions

In our study, diabetes (13.73%) and hypertension (15.38%) were less prevalent than reported by Ramesh et al (33.3% diabetes, 27.45% hypertension).[12] The lower rates may reflect either underdiagnosis or younger age distribution in our cohort. Notably, 70.88% of patients had no prior comorbidities, highlighting the need for screening asymptomatic young individuals.

Addictions were strongly associated with MS. Smoking (34.61%) and alcohol consumption (37.36%) were significantly more prevalent in MS patients (42% and 48.5%, respectively) compared to non-MS (25% and 24%). Similar associations have been reported by Jing Gao et al reinforcing the importance of addressing lifestyle risk factors in preventive cardiology.[16]

Metabolic syndrome components

The prevalence of deranged MS components was high: abdominal girth (56%), fasting blood sugar (59%), serum triglycerides (58%), low HDL (75%), and elevated blood pressure (45%). These proportions were comparable to Ramesh et al though Gao et al reported higher rates, particularly for hypertension and glucose abnormalities.[12,16] Compared to Zarich et al our cohort had higher fasting RBS (113.46 versus 104 mg/dl), but lower triglycerides (170.31 versus 216 mg/dl) and higher HDL (42.41 versus 36 mg/dl), suggesting regional and ethnic variations in risk factor patterns.[14]

ECG and echocardiographic findings

ST-segment elevation MI (STEMI) was the predominant presentation (75%), similar to Nguyen et al (70% STEMI, 30% NSTEMI).[13] Regional wall motion abnormality was observed in 81% of cases, reflecting the significant myocardial damage associated with STEMI in young patients.

Prevalence of metabolic syndrome

The prevalence of MS (54.39%) in our study corroborates findings from Gao et al (~50%), Ramesh et al (62%) and Ranjith et al (60%).[12,15,16] This consistency underscores that more than half of young AMI patients harbor MS, confirming it as a major contributor to premature CAD.

Associations with demographic and clinical factors

Although age and sex were not significantly associated with MS in our cohort, diabetes showed a significant correlation (p=0.019), in line with Gao et al who reported strong associations with both diabetes and hypertension.[16] Addictions such as smoking and alcoholism were also significantly linked with MS, strengthening the evidence from prior studies that lifestyle modification is critical in this population.

Sex differences in MS components

Females had significantly higher rates of deranged abdominal girth (82% versus 45%), whereas males showed markedly higher derangements in HDL (97% versus 17.6%) and blood pressure (49.6% versus 33.3%). These sex-specific differences mirror earlier observations, suggesting that risk factor profiles differ by gender and must be addressed accordingly.[12]

Association with MI type

Serum triglycerides were significantly associated with NSTEMI, whereas low HDL was more strongly associated with STEMI. This contrasts with previous studies, where no such distinct association was consistently observed.[12,16] These findings may indicate unique metabolic influences on MI subtypes in younger populations, warranting further research.

Overall implications

Our results, in agreement with earlier studies, emphasize that MS is highly prevalent among young AMI patients, with significant contributions from central obesity, dyslipidemia, hyperglycemia, and addictions. The findings underscore the need for early screening, targeted lifestyle interventions, and aggressive risk factor management to reduce the burden of premature CAD.

Limitations and future directions

This study has certain limitations. Being cross-sectional, it cannot establish causality between MS components and AMI. The sample size, though adequate, was limited to a single center, which may restrict generalizability. Some patients may have had undiagnosed comorbidities, particularly hypertension and diabetes, leading to underestimation. Future multicenter, longitudinal studies with larger sample sizes are required to validate these associations, explore genetic and ethnic variations, and assess the impact of early intervention in reducing premature cardiovascular events.

CONCLUSION

This study highlights a high prevalence (54.39%) of metabolic syndrome among young patients (≤45 years) with acute myocardial infarction. Metabolic syndrome was significantly associated with diabetes, smoking, and alcohol use. Individual components of MS especially abdominal girth, fasting blood sugar, triglycerides, and HDL were strongly linked to MS presence. Sex differences were notable in abdominal girth, HDL, and blood pressure abnormalities. The findings underscore the importance of early identification and management of metabolic

syndrome components to mitigate premature cardiovascular risk in young adults.

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