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PREVALENCE OF METABOLIC SYNDROME AMONG HOSPITALISED MYOCARDIAL INFARCTION PATIENTS: A CROSS-SECTIONAL STUDY FROM CENTRAL INDIA

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Abstract

Background: Metabolic Syndrome (MetS) is a cluster of cardiovascular risk factors including central obesity, hypertension, dyslipidemia, and insulin resistance. It is strongly associated with increased risk and poorer outcomes in Myocardial Infarction (MI).

Objective: To determine the prevalence of Metabolic Syndrome among patients admitted with Myocardial Infarction at a tertiary care hospital in Central India and to evaluate its association with MI severity and outcomes.

Methods: A hospital-based, cross-sectional observational study was conducted over 18 months in the Department of Medicine at Amaltas Institute of Medical Sciences, Dewas. Seventy-five adult MI patients were enrolled using non-probability convenience sampling. Data on demographics, clinical history, anthropometry, blood pressure, fasting glucose, and lipid profile were collected. The diagnosis of MetS was based on standard criteria. Associations between MetS and MI severity, cardiac biomarkers, and clinical outcomes were analysed.

Results: Metabolic Syndrome was present in 36% (27/75) of MI patients. Participants with MetS had significantly higher rates of severe MI (55.6% vs 31.3%; p=0.039) and adverse outcomes, including mortality (14.8% vs 0%; p=0.006) and severe morbidity (44.4% vs 10.4%; p=0.001). They also showed significantly elevated cardiac enzymes, including troponin (p=0.003), CK-MB (p<0.0001), and LDH (p=0.008).

Conclusion: Metabolic Syndrome is common among MI patients and is associated with increased severity, higher cardiac enzyme levels, and worse clinical outcomes. Early identification and management of MetS components in MI patients may improve prognosis and reduce cardiovascular risk.

Keywords: Metabolic Syndrome, Myocardial Infarction, Central Obesity, Cardiovascular Risk, Cardiac Biomarkers, India, Cross-Sectional Study, Morbidity, Mortality.

Introduction

Metabolic Syndrome (MetS) is a collection of inter-connected metabolic risk factors that contribute to an increased risk of cardiovascular diseases, i.e., myocardial infarction and type 2 diabetes mellitus[1,2]. The development of the concept of Metabolic Syndrome has spanned decades. In the modern era, various organizations, i.e., National Cholesterol Education Program's Adult Treatment Panel III (ATP III), International Diabetes Federation (IDF), and World Health Organization (WHO), have developed diagnostic criteria of Metabolic Syndrome. These are based on a common reservoir of central obesity, dyslipidemia with increased triglycerides and reduced HDL cholesterol, hypertension, and increased levels of fasting blood glucose.[1,2]

The prevalence of Metabolic Syndrome has become a major worldwide concern, mainly due to its association with increased morbidity and mortality related to cardiovascular diseases[3,4]. Myocardial Infarction (MI), commonly known as a heart attack, is a severe cardiovascular condition characterized by the sudden interruption of blood flow to a segment of cardiac muscle with resulting ischemia and eventual necrosis of myocardial tissue[5,6]. Myocardial Infarction on clinical presentation is characterized by a wide range of symptoms, with the most common being chest pain or discomfort[5,6]. Myocardial Infarction is a multifactorial condition, with several well-established traditional risk factors contributing to its development. These include[5–7]:

- Hypertension:
- Smoking:
- Diabetes:
- Dyslipidemia:
- Obesity:

In addition to these traditional risk factors, emerging risk factors have been identified, further elucidating the complex etiology of MI[5–7]:

- Inflammation:
- Hypercoagulability:
- Metabolic Syndrome:

The components of Metabolic Syndrome—central adiposity, insulin resistance, increased blood pressure, and dyslipidemia—cooperate synergistically to enhance atherosclerosis, the shared basic pathophysiological mechanism for MI[8,9]. The interaction between the metabolic abnormalities not only accelerates the rate at which atherosclerotic plaque formation occurs but also amplifies the likelihood of the rupture of the plaque [10–12].

In spite of the strong evidence suggesting the involvement of Metabolic Syndrome in MI risk, literature still has some lacunae. For instance, the relative contribution of each of the components of Metabolic Syndrome to MI risk is not known, and the most suitable diagnostic criteria for Metabolic Syndrome recognition in various populations is debated[13,14]. The prevalence of Metabolic Syndrome in hospitalized Myocardial Infarction (MI) patients is a critical area of study, considering its wide-ranging implications on patient outcomes and health planning. It is crucial to study the prevalence of Metabolic Syndrome in this specific population for a variety of reasons.

AIM:

To determine the prevalence of Metabolic Syndrome among patients admitted with Myocardial Infarction.

Material and Methods

Ø **Study Design:** This was a single centre, hospital-based cross-sectional observational study aimed at determining the prevalence of Metabolic Syndrome among patients admitted with Myocardial Infarction (MI).

Ø **Study Setting:** The study was conducted at the Department of Medicine, Amaltas Institute of Medical Sciences, Dewas.

Ø **Ethical Clearance:** Ethical clearance was granted by the Institute's Ethical Committee following a thorough review of the study protocol, data collection forms, and informed consent documents.
Ø **Study Duration:** 18 months:
Ø **Primary Outcome:** The prevalence of Metabolic Syndrome among patients admitted with Myocardial Infarction was the primary outcome, measured based on established diagnostic criteria, including central obesity, hypertension, dyslipidemia, and insulin resistance, at the time of admission.
Ø **Study Participants:** The participants for the present study included all adult patients admitted with a diagnosis of Myocardial Infarction. Eligible participants were required to meet specific inclusion criteria and provided informed consent to participate in the study.
Ø **Inclusion Criteria:**
1. Patients aged 18 years and above.
2. Patients diagnosed with acute Myocardial Infarction.
3. Patients willing to provide informed consent.

Ø **Exclusion Criteria:**
1. Patients with Rheumatic Heart Disease (RHD).
2. Patients with Congenital Heart Diseases.
3. Patients with Chronic kidney diseases.
4. Patients who declined to provide informed consent.

Ø **Sample Size:** The minimum required sample size for this cross-sectional study was calculated using the formula for estimating prevalence with a 95% confidence interval and assuming a 30% prevalence of Metabolic Syndrome in the target population. A total of 75 participants were enrolled.
Ø **Sampling Methodology:** Participants were recruited through non-probability convenience sampling based on their availability and willingness to participate during the study period.
Ø **Participant Recruitment:** All patients admitted with Myocardial Infarction were screened for eligibility based on the inclusion and exclusion criteria. Recruitment continued until the desired sample size was achieved.
Ø **Data Collection Procedure:**
a. Obtaining Informed Consent: Before any data collection, the Principal Investigator (PI) explained the study to the eligible participants in detail, including its purpose, procedures, potential risks, and benefits. Participants were given bilingual consent forms (in Hindi and English) to review, and they were encouraged to ask questions. Written informed consent was obtained only after participants fully understood the study and agreed to participate.
b. Recording Demographic Data: After obtaining consent, participants' demographic information (age, gender, and socio-economic status) was collected through direct interviews and recorded on the data collection form.
c. Collecting Medical History: Participants were interviewed about their medical history, including information on pre-existing conditions such as hypertension, diabetes, and previous cardiovascular events. Relevant lifestyle factors, such as smoking status and physical activity, were also recorded.
d. Waist Circumference: Standardized measuring tapes were used to measure the waist circumference at the midpoint between the lower rib and the iliac crest.
e. Body Mass Index (BMI): Height and weight were recorded using calibrated equipment, and BMI was calculated accordingly.
f. Measuring Blood Pressure: Blood pressure was measured using a standardized sphygmomanometer. Two measurements were taken after the participant had rested for 5 minutes, and the average value was recorded.
g. Collection of Laboratory Data: Participants were asked to undergo fasting blood tests. Fasting blood glucose and lipid profiles (including total cholesterol, triglycerides, HDL, and LDL levels) were collected from the hospital laboratory reports. The laboratory staff followed standard protocols for blood collection and analysis to ensure accurate and reliable results.

h. Assessment of Metabolic Syndrome Components: Based on the collected data (waist circumference, blood pressure, fasting blood glucose, and lipid profile), the presence of Metabolic Syndrome was assessed according to the diagnostic criteria.
i. Data Recording: All collected information (demographic, clinical, and laboratory data) was meticulously recorded on paper-based forms by Principal Investigator. Each form was reviewed for completeness and accuracy before being filed to prevent missing or erroneous data.

Ø **Statistical Analysis:** All statistical analysis for this study was undertaken using Stata software version 17.0. Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. The prevalence of Metabolic Syndrome and its components was calculated as proportions. Logistic regression analysis was performed to assess the association between Metabolic Syndrome and the severity of Myocardial Infarction, adjusting for potential confounders.
Ø **Funding:** There was no external funding for this study.
Ø **Conflict of Interest:** The Principal Investigator and research team declare no conflict of interest in the design, implementation, and interpretation of the findings of this study.

Results:
Baseline Characteristics of Participants (Table 1): Out of 75 patients admitted with Myocardial Infarction (MI), 27 (36%) had Metabolic Syndrome (MeTS), while 48 (64%) did not. The mean age of participants with MeTS was slightly higher (61.2 ± 4.9 years) compared to those without MeTS (58.6 ± 5.1 years), though the difference was not statistically significant ($p = 0.182$). Males constituted the majority in both groups, with 55.6% in the MeTS group and 62.5% in the non-MeTS group ($p = 0.142$). Body Mass Index (BMI) categories showed a significant association with MeTS status ($p = 0.029$). Notably, morbid obesity was more frequent in patients with MeTS (29.4%) compared to those without (6.25%). None of the MeTS patients had a normal BMI. Smoking (48.1% vs 52.1%), tobacco chewing (22.2% vs 37.5%), and alcohol consumption (77.8% vs 62.5%) were more common in the MeTS group, but these differences did not reach statistical significance ($p > 0.05$ for all).

Table 1: Baseline Characteristics of Participants

	No(n=48)		**Metabolic Syndrome (n=27)**		
	n	**%**	**n**	**%**	**P-value**
Age of participant (years)					
31-40	0	0	1	3.7	0.182
41-50	16	33.3	6	22.2	
51-60	15	31.3	9	33.3	
61-70	13	27.1	7	25.9	
71-80	4	8.33	4	14.8	
Mean SD	58.6	5.1	61.2	4.9	
Gender					
Female	18	37.5	12	44.4	0.142
Male	30	62.5	15	55.6	
BMI Category					
Normal	8	16.7	0	0.0	0.029
Overweight	18	37.5	12	44.4	
Obese	19	39.6	7	25.9	
Morbid Obesity	3	6.25	8	29.4	
Smoking	25	52.1	13	48.1	0.060

Tobacco Chewing	18	37.5	6	22.2	0.073
Alcohol	30	62.5	21	77.8	0.083

MI severity showed a significant association with the presence of MetS (p = 0.039). A greater proportion of patients with MeTS experienced severe MI (55.6%) compared to those without MeTS (31.3%). Mild MI was more common in patients without MetS (41.7%) than in those with MetS (14.8%). Regarding MI type, ST-elevation myocardial infarction (STEMI) was the most common presentation in both groups: 59.3% in MeTS and 70.8% in non-MeTS. Non-STEMI (NSTEMI), unstable angina, and other types did not show significant differences between groups (p = 0.532).

Table 2: Association of Severity and Type of Myocardial Infarction with MeTS

	No (n=48)		**Metabolic Syndrome (n=27)**		
	n	**%**	**n**	**%**	**P-value**
Severity of Myocardial Infarction					
Mild	20	41.7	4	14.8	0.039
Moderate	13	27.1	8	29.6	
Severe	15	31.3	15	55.56	
Type of Myocardial Infarction					
STEMI	34	70.8	16	59.3	0.532
NSTEMI	5	10.4	3	11.1	
Unstable Angina	5	10.4	5	18.5	
Other	4	8.33	3	11.1	

Table 3: Distribution of Participants based on Cardiac Markers

	No (n=48)		**Metabolic Syndrome (n=27)**		
	Mean	**±SD**	**Mean**	**±SD**	**P-value**
Creatine Kinase-MB (U/L)	29.8	9.01	46.7	10.4	< 0.0001
Troponin (ng/mL)	1.44	0.603	2.37	0.602	0.003
Lactate Dehydrogenase (U/L)	200	57.9	290	52.4	0.008
Cardiac Enzyme Composite Score	375	82.4	574	97.9	< 0.0001

Distribution of Cardiac Markers Among Participants (Table 3): Patients with Metabolic Syndrome had significantly higher levels of all measured cardiac biomarkers compared to those without MetS. The mean Creatine Kinase-MB (CK-MB) level was markedly elevated in the MetS group (46.7 ± 10.4 U/L) versus the non-MetS group (29.8 ± 9.01 U/L), with a highly significant difference ($p < 0.0001$).

Similarly, mean Troponin levels were significantly higher in the MetS group (2.37 ± 0.602 ng/mL) compared to the non-MetS group (1.44 ± 0.603 ng/mL; p = 0.003). Lactate Dehydrogenase (LDH) levels also showed a significant difference, with higher values in the MetS group (290 ± 52.4 U/L) than in the non-MetS group (200 ± 57.9 U/L; p = 0.008). The composite cardiac enzyme score was substantially higher in patients with MetS (574 ± 97.9) compared to those without (375 ± 82.4), which was statistically significant ($p < 0.0001$).

Association of Clinical Outcomes with Metabolic Syndrome (Table 4): Metabolic Syndrome was significantly associated with poorer clinical outcomes. Mortality was observed only in the MetS group, with 4 deaths (14.81%), while no deaths occurred in the non-MetS group. This difference was statistically significant (p = 0.006). Severe morbidity was also more common among MetS patients, reported in 44.4% of cases compared to 10.4% in non-MetS patients (p = 0.001). These findings

indicate that the presence of Metabolic Syndrome in MI patients is linked with higher risk of death and serious complications during hospitalisation.

Table 4: Association of Clinical Outcome with MeTS among MI Patients

	No (n=48)		Metabolic Syndrome (n=27)		
	n	%	n	%	
Mortality					
No	48	100.0	23	85.19	0.006
Yes	0	0.0	4	14.81	
Severe Morbidity					
No	43	89.6	15	55.6	0.001
Yes	5	10.4	12	44.4	

Discussion:

In the present study, we found that 36% of patients presenting with acute myocardial infarction had metabolic syndrome. This means that more than one-third of AMI patients also have metabolic risk factors. Comparable prevalence was found by Varghese et al. (2023), who found metabolic syndrome in 37.08% of a series of 515 patients with acute coronary syndrome[15]. Radhakrishnan et al. (2023) found a slightly higher prevalence of 48.1% in 210 patients with AMI in a tertiary care center in Mumbai[16]. Likewise, Uppin et al. (2020) found an incidence of 48.7% in AMI patients in the ICCU[17]. Conversely, Pandey et al. (2009) found a lower prevalence of 26.19% in their series of 84 cases of AMI[18]. Additionally, Tran et al. (2024) found a much higher prevalence of 68.3% in their hospital-based series of AMI patients[19]. These differences may be due to differences in the study population, diagnostic criteria, sample size, and geographical location. Despite these differences, the consistent finding of metabolic syndrome in a high percentage of AMI patients highlights its clinical significance.

Olijhoek et al. (2004) studied patients with vascular disease and established that an increased number of metabolic syndrome components were independently associated with more vascular damage, thereby emphasizing the usefulness of metabolic syndrome as a disease burden predictive marker[20]. Zeller et al. (2005), in another study, reported that 46% of acute myocardial infarction (AMI) patients admitted to the hospital had metabolic syndrome[21].

Sarkar et al. (2016) found that metabolic syndrome was associated with much poorer biochemical markers in patients who had acute myocardial infarction (AMI), which included high triglycerides, raised fasting blood glucose, and raised waist circumference, along with low HDL-C[22]. Likewise, Islam et al. (2013) found high prevalence of metabolic syndrome among the population of AMI patients and noted high correlation with the complication of heart failure[23].

Collectively, these studies validate the present finding that a high percentage of AMI patients have metabolic syndrome. This highlights the importance of routine screening and early intervention to control metabolic risk factors among cardiac patients.

The present study found that mortality rates were significantly higher in patients diagnosed with metabolic syndrome. Conversely, no mortality was observed among the patients without metabolic syndrome, while 14.81% of the patients with metabolic syndrome died during their hospital stay ($p = 0.006$). In addition, the rate of severe morbidity was higher in the group with metabolic syndrome (44.4%) compared to those without this condition (10.4%), and this difference was statistically significant ($p = 0.001$). These findings suggest that metabolic syndrome is strongly associated with worse clinical outcomes in patients with myocardial infarction.

Similar results were also documented by Radhakrishnan et al. (2023), wherein patients with acute myocardial infarction (AMI) and metabolic syndrome exhibited significantly high case fatality rates ($p = 0.003$) and longer hospital stay durations[24]. Likewise, Uppin et al. (2020) had reported higher rates of complications and adverse recovery patterns in metabolic syndrome subjects, and hyperglycemia was found to be the strongest correlate of death[17]. Zeller et al. (2005) had reported that metabolic syndrome was associated with a higher rate of severe heart failure but did not appear as an independent predictor of death[25]. Likewise, Pandey et al. (2009) also reported a higher rate of in-hospital mortality in metabolic syndrome patients (5 out of 22) as compared to their counterparts without metabolic syndrome (3 out of 62). Complementing these findings, Islam et al. (2013) reported a higher rate of heart failure and reduced ejection fraction in metabolic syndrome patients, thus establishing yet another correlation with adverse outcomes[23]. Overall, these studies support the hypothesis that metabolic syndrome increases the risk of mortality and severe complications in patients with AMI substantially.

Severe myocardial infarction in the current study was prevalent in patients with metabolic syndrome. Out of the patients with syndrome, 55.56% were with severe infarction, while in the absence of the syndrome, it was 31.3%. Mild infarction was observed in just 14.8% of the metabolic syndrome group, while in the absence of the syndrome, it was 41.7%. The comparison of severity between the two groups was statistically significant ($p = 0.039$). The study indicates that metabolic syndrome may be responsible for greater cardiac damage in patients who present with myocardial infarction.
Similar findings were reported by Tran et al. (2024), who deduced that the Gensini scores were significantly higher in metabolic syndrome patients ($p = 0.002$), reflecting increased severity of coronary artery disease. The study noted high correlation of higher fasting glucose levels and waist circumference with rising severity. Nguyen et al. (2023) also documented that while metabolic syndrome did not enhance all-cause in-hospital mortality, it was associated with enhanced cardiovascular mortality, which reflected more severe cardiac events[26]. Islam et al. (2013) indicated that metabolic syndrome patients had decreased ejection fraction and were at increased risk for heart failure (46% vs. 20%), reflecting enhanced myocardial dysfunction[23]. Zeller et al. (2005) reported that metabolic syndrome was associated with increased frequency of severe heart failure (Killip class >II), thus further proving the association between metabolic abnormalities and severity of infarction[25]. Collectively, these studies support the current evidence that metabolic syndrome is associated with severe presentation of myocardial infarction.
In the current study, the cardiac biomarker levels were significantly elevated in patients with metabolic syndrome. The average CK-MB level recorded was 46.7 U/L in the metabolic syndrome group, as opposed to 29.8 U/L in the non-metabolic group ($p < 0.0001$). Troponin levels were also significantly elevated (2.37 ng/mL vs. 1.44 ng/mL, $p = 0.003$), as well as LDH levels (290 U/L vs. 200 U/L, $p = 0.008$). The composite cardiac enzyme score was significantly elevated in patients with metabolic syndrome (574 vs. 375, $p < 0.0001$). These results indicate a higher level of myocardial damage in patients with acute myocardial infarction with metabolic syndrome. Sarkar et al. (2016) also carried out similar studies, which showed much higher serum triacylglycerol, fasting blood glucose, and total cholesterol levels in acute myocardial infarction (AMI) patients who also had metabolic syndrome. They also showed lower HDL levels and increased blood pressure in this subgroup, which reflected more metabolic and cardiovascular stress. Islam et al. (2013) also showed that AMI patients with metabolic syndrome had much lower ejection fractions and a higher rate of heart failure, both of which reflect more myocardial damage[23]. Nguyen et al. (2023) also showed that patients with metabolic syndrome had higher cardiovascular mortality, though in-hospital mortality was equal, reflecting the presence of more cardiac damage[26]. These findings are in accordance with the results of the present study and reflect the role of metabolic syndrome in aggravating myocardial damage during infarct attacks.

Conclusion

This study found a high prevalence of Metabolic Syndrome among patients admitted with Myocardial Infarction. Patients with Metabolic Syndrome had significantly more severe myocardial infarction, elevated cardiac enzyme levels, and worse clinical outcomes, including higher rates of morbidity and mortality. These findings highlight the strong association between Metabolic Syndrome and adverse outcomes in MI patients. Early identification and management of Metabolic Syndrome components—especially obesity, dyslipidemia, hypertension, and insulin resistance—are essential to improve prognosis and reduce complications in this high-risk population. Routine screening for Metabolic Syndrome in MI patients should be integrated into hospital care protocols to guide targeted interventions.

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