DOI: 10.7860/JCDR/2026/85817.23632

Original Article

Internal Medicine Section

Spectrum of Clinical Presentation, Risk Factors and Severity of Myocardial Infarction in Female Patients: A Hospital-based Cross-sectional Study

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ABSTRACT

Introduction: Myocardial Infarction (MI) in women is often underdiagnosed and undertreated owing to atypical presentations and distinct risk factor profiles. Evaluating the clinical spectrum, risk factors and angiographic severity of MI in female patients is crucial for improving diagnostic accuracy and optimising management.

Aim: To evaluate the clinical presentation, risk factors and severity of MI in female patients.

Materials and Methods: This was a cross-sectional observational study conducted in the Department of General Medicine at Goa Medical College and Hospital, Bambolim, Goa, India, over a period of 24 months January 2021 to December 2022 on 60 female patients with clinical features and Electrocardiogram (ECG) changes of Acute Myocardial Infarction (AMI), elevated cardiac enzymes (fulfilling definitive diagnostic criteria for AMI) and willing to give consent for coronary angiography were enrolled for the study. Data was collected on patient's demographics, clinical features, risk factors, laboratory parameters {Se.Trop I, lipid profile, Fasting Blood Sugar (FBS), Post Prandial Blood Sugar (PPBS), Glycated haemoglobin (HbA1c)}, electrocardiography, 2D Echocardiography, coronary angiography and analysed using Statistical Package for Social Sciences (SPSS) software. Descriptive statistics such as mean, standard deviation, frequencies and percentages were calculated for variables.

Results: Among the study group of 60, 27 patients (45%) in the age group of 51 to 60 years were the most commonly affected with a mean age of occurrence of MI being 63.72 years. Among the study participants, 44 patients (73.3%) had typical symptoms of AMI at the time of presentation to the hospital constituting the largest subgroup. A 36 patients (60%) had Hypertension, which was the most common risk factor followed by DM seen in 30 patients (50%) and Dyslipidaemia seen in 27 patients (45%). Among the patients, non ST Elevation Myocardial infarction (NSTEMI) and Anterior Wall MI (AWMI) were the most common ECG presentation with 16 (26.7%) patients in each group followed by anterolateral wall MI and Inferior wall MI (IWMI) with 12 (20%) patients in each group. Angiographic evaluation revealed that Single-Vessel Disease (SVD) was the most common finding, observed in 32 patients (53.3%).

Conclusion: The MI in women is characterised by a distinct clinical and angiographic profile, with a predominance of traditional cardiovascular risk factors and single-vessel coronary artery disease. These observations emphasises the need for heightened clinical vigilance and gender-sensitive diagnostic strategies, particularly in postmenopausal women with multiple risk factors. Regular and timely cardiovascular evaluation in this high-risk population may facilitate early detection of CAD and improve clinical outcomes.

Keywords: Acute myocardial infarction, Clinical presentation, Disease severity, Women

INTRODUCTION

The most common cause of mortality for women in India and around the world is Cardiovascular Disease (CVD) [1]. The perception of Coronary Heart Disease (CHD) as a disease mostly affecting males has changed throughout the century since Herrick first described the condition in 1912 [2]. Although cardiovascular mortality for women has dropped dramatically during the past 20 years due to advanced treatment methods, CHD in women is still understudied, underdiagnosed and undertreated [3,4].

Improvements in acute cardiac care have reduced overall mortality, but outcomes in women remain disproportionately worse in many settings [5]. Historically, cardiovascular research has predominantly focused on male populations, leading to gaps in understanding female-specific disease patterns. This has contributed to delays in diagnosis and poorer outcomes among women with MI [6].

Unlike the "classic" crushing chest pain described in men, women frequently present with atypical chest discomfort, epigastric pain, dyspnoea, fatigue nausea/vomiting and back or jaw pain. These atypical or subtle symptoms may lead to delayed hospital presentation, misdiagnosis at first contact and delay in reperfusion therapy [7]. Primary and secondary preventive strategies, along with advances in CVD management have been associated with improved survival among women [8]. Owing to the evolving research landscape and evidence generated from major randomised clinical trials, women now receive more evidence-based and effective cardiovascular care than in previous decades [9]. Recent research, inspired by two pivotal papers from the Institute of Medicine, highlights notable sex differences in the causes, clinical manifestations and outcomes of diseases. It emphasises that sex as a biological factor significantly affects health outcomes and should be incorporated into research design and analysis [10]. Although there has been progress, there are still gaps in women's health research and in applying these findings to clinical practice [11]. Historically, medical studies have paid little attention to women's health issues. Women's health encompasses two aspects: gender differences shaped by social, environmental and societal factors and sex differences rooted in biological factors. Despite a focus on sex-specific CVD research over the past

twenty years, which has enhanced understanding of sex-specific pathophysiology for CHD in women and provided valuable insights into a broader range of coronary atherosclerosis, female research subjects remain underrepresented in study planning, execution and analysis [12,13].

Considering the pathophysiological basis of AMI women are more likely to have microvascular dysfunction, plaque erosion rather than rupture and non obstructive coronary artery disease {Myocardial Infarction with Non Obstructive Coronary Arteries (MINOCA)}. These mechanisms may influence clinical severity, ECG changes, biomarker rise and complications. Other uncommon causes of AMI include coronary artery spasm and spontaneous coronary artery dissection [14].

Women paradoxically have less severe obstructive disease of their epicardial coronary arteries at elective angiography than males, while being older, having more risk factors and angina symptoms and as a result having more morbidity and death [15,16]. Numerous studies have demonstrated that women with Acute Coronary Syndromes (ACS) are less likely to receive timely reperfusion, cardiac catheterisation, or medicinal therapy that follow guidelines [17,18].

Most existing data on MI in women are derived from Western populations [19]. There is a paucity of prospective data from the Indian population that describes symptom patterns, risk factor clustering and severity at presentation [20]. Sociocultural factors, health-seeking behaviour and access to care may further influence outcomes in women in developing countries. Given the variability in symptoms, distinct risk factor profiles and potential differences in severity and outcomes, there is a need for systematic prospective evaluation of female patients presenting with MI. Therefore, the present cross-sectional study was undertaken to evaluate the spectrum of clinical presentation, associated risk factors and severity of MI among female patients presenting to a tertiary care centre. Understanding these patterns may help in improving early recognition, risk stratification and targeted management strategies for women with MI. The present study aimed to evaluate the clinical presentation, risk factors and severity of MI in female patients. The primary objectives included study of the clinical features and risk factors associated with AMI in female patients. The secondary objective as to assess the severity of AMI in females through coronary angiography.

MATERIALS AND METHODS

The present study was a cross-sectional observational study conducted in the Department of General Medicine at Goa Medical College, Bambolim, Goa, India, over a period of 24 months (January 2021-December 2022) after obtaining Institutional Ethical Committee clearance (IEC Approval No-IEC/GMC/Dec 2020-93),

Sample size calculation: The maximum sample size was 65 and it was calculated using below formula: [21]

$N=Z^2\times P\times(1-P)/d^2$ Z=standardised normal deviate (two tailed) for 95% i.e., 1.96

$=(1.96)^2\times(0.863)\times(0.137)/(0.086)^2$, P indicates proportion of patients presenting with typical clinical features of MI in study population, which in the cited study was 86.36% or 0.863 [19], Q(1-P)

=1-0.863=0.137

=0.4541/0.007 d= relative precision (10%)

=64.87~ 65.

Informed written consent was taken from the patients satisfying inclusion criteria.

Inclusion criteria: Female patients with clinical features and ECG changes of AMI, elevated cardiac enzymes (fulfilling definitive diagnostic criteria for AMI as per ESC/ACC/AHA/WHF task force for universal definition of AMI 2018) [22] and willing to give consent for CAG were included in the study.

Exclusion criteria: Female patients with symptoms of AMI but without ECG changes or elevated cardiac enzymes and those not willing for CAG were excluded from the study (8 patients).

Study Procedure

Data was collected prospectively on patient's demographics, clinical features, risk factors during hospitalisation. History suggestive of myocardial ischaemia such angina, chest, upper extremity, jaw or epigastric discomfort during exertion or at rest, or an ischaemic equivalent such as dyspnoea or fatigue was elicited. Chest, arm, or jaw pain that feels dull, heavy, tight, or crushing is typical of MI symptom. Atypical symptoms often involve epigastric or back pain or a burning, stabbing sensation similar to indigestion [23]. History of risk factors such as Diabetes Mellitus (DM), hypertension, dyslipidaemia, family history, alcohol intake, smoking noted.

All patients underwent ECG and 2D echocardiography at the time of admission and findings were documented. Patients were classified into various STEMIs based on the regional wall involvement and NSTEMI [24]. Left Ventricular Ejection Fraction (LVEF) was calculated as per modified Simpson criteria [25].

Electrocardiographic manifestations suggestive of acute myocardial ischaemia (in the absence of left ventricular hypertrophy and bundle branch block).

ST-elevation: New ST-elevation at the J-point in two contiguous leads with the cut-point: ≥1 mm in all leads other than leads V2-V3 where the following cut-off points apply: ≥2 mm in men ≥40 years; ≥2.5 mm in men <40 years or ≥1.5mm in women regardless of age.

ST-depression and T wave changes: New horizontal or downsloping ST-depression ≥0.5 mm in 2 contiguous leads and/or T inversion >1 mm in two contiguous leads with prominent R wave or R/S ratio >1 [22].

The 2D Echocardiographic findings suggestive of AMI and its complications include wall motion abnormalities localised to the territory of the occluded coronary vessel such as

- absence or reduction of systolic thickening
- decreased motion: hypokinetic, akinetic, dyskinetic and aneurysmal [26]

The Heart Failure was categorised as per The American College of Cardiology

- Heart Failure with preserved Ejection Fraction (HFpEF): LVEF ≥50%
- Heart Failure with reduced Ejection Fraction (HFrEF): LVEF ≤40%
- Heart Failure with mildly reduced Ejection Fraction (HFmrEF): LVEF 41% to 49%
- Heart Failure with improved Ejection Fraction (HFimpEF): LVEF ≥40% (previously ≤40%) [27]

Blood samples were collected for Se.Troponin I, Fasting Blood Sugar (FBS), Post Prandial Blood Sugar (PPBS), HbA1c, lipid profile and reports were noted.

Normal values

- Se. Troponin I (hs-cTn I) levels-

≤ 15 ng/L in females

≤ 20 ng/L in males [28]

- FBS <100 mg/dL
- PPBS <140 mg/dL
- HbA1c <5.7% [29]
- Total cholesterol <200 mg/dL
- LDL cholesterol <100 mg/dL
- HDL cholesterol ≥60 mg mg/dL

- Triglycerides <150 mg/dL
- VLDL cholesterol <30 mg/dL [30]

All patients underwent CAG during hospitalisation and severity of coronary artery stenosis was assessed. A visually estimated diameter stenosis severity of ≥70% for non-left main disease and ≥50% for left main disease was used to define significant stenosis and to guide revascularisation strategy. Intermediate coronary stenosis was defined as a diameter stenosis severity of 40% to 69% [31]. Syntax score was used to guide the choice of revascularisation by providing an objective measure to grade the anatomic complexity of CAD in patients with multivessel disease [32]. Based on number of major epicardial coronary arteries (LAD, LCx, RCA) involved with significant stenosis CAD was classified into SVD, DVD and TVD.

STATISTICAL ANALYSIS

Data was entered into Microsoft Excel (Windows 7; version 2007) and analyses were done using the Statistical Package for Social Sciences for Windows Software (version 22.0; SPSS Inc, Chicago). Descriptive statistics such as mean and standard deviation for continuous variables, frequencies and percentages were calculated for categorical variables. Bar charts and pie charts were used for visual representation of the analysed data.

RESULTS

Among the study group of 60 patients, 27 (45%) patients in the age group of 51 to 60 years were the most commonly affected with a mean age of occurrence of MI being 63.72. Only 10 out of 60 affected patients (16.7%) were more than 70-year-old [Table/Fig-1].

Age range (years)	n (%)
51-60	27 (45.0)
61-70	23 (38.3)
>70	10 (16.7)
Mean	63.72
Range	52-83

[Table/Fig-1]: Distribution of study subjects according to the age (N=60).

Among the study participants, majority of patients had typical symptoms of AMI at the time of presentation to the hospital constituting the largest subgroup [Table/Fig-2].

Symptoms	n (%)
Typical	44 (73.3)
Atypical	16 (26.7)

[Table/Fig-2]: Distribution of Study Subjects according to the symptoms (N=60).

Hypertension was the most common risk factor followed by DM and dyslipidaemia. Only few patients had history of AMI in family. It was also observed that most patients had combined occurrence of two or more of the risk factors contributing to development of AMI [Table/Fig- 3].

Elevated Se.Trop I levels were seen among 60 (100%) patients. A total of 30(50%) patients had elevated FBSL, PPBSL and HbA1c levels [Table/Fig-4].

Risk factors	n (%)
Tobacco	-
Alcohol	-
DM	30 (50)
HTN	36 (60)
Family history	6 (10)
Dyslipidaemia	27 (45)

[Table/Fig-3]: Distribution of study subjects according to the risk factors (N=60).
DM: Diabetes mellitus, HTN: Hypertension

Among the patients, NSTEMI and AWMI were the most common ECG presentation followed by anterolateral wall MI and IWMI. Posterior wall MI and IWMI along with RVMI were seen rarely [Table/Fig-5].

Laboratory parameters	n (%)
Elevated TC	37 (61.7)
Elevated TG	8 (13.3)
Elevated LDL	38 (63.3)
Elevated VLDL	5 (8.3)
Low HDL	29 (48.3)
Elevated Se.Trop I	60 (100%)
Elevated FBSL	30 (50%)
Elevated PPBSL	30 (50%)
Elevated HbA1c	30 (50%)

[Table/Fig-4]: Distribution of study subjects according to the lipid profile, Se Trop I, FBSL, PPBSL and HbA1c (N=60).
TC: Total cholesterol; TG: Triglycerides; LDL: Low density lipoprotein; VLDL: Very low density lipoprotein; HDL: High density lipoprotein

ECG	n (%)
AWMI	16 (26.7)
ALMI	12 (20.0)
ILWMI	2 (3.3)
IWMI	12 (20.0)
IWMI+ RVMI	1 (1.7)
PWMI	1 (1.7)
NSTEMI	16 (26.7)

[Table/Fig-5]: Distribution of study subjects according to the ECG (N=60).
AWMI: Anterior wall MI; ALMI: Anterolateral wall MI; ILWMI: Inferolateral wall MI; IWMI: Inferior wall MI; RVMI: Right ventricular MI; PWMI: Posterior wall MI; NSTEMI: Non-ST elevation MI

Among the study participants, majority of the patients had LVEF ≤ 40%, constituting the largest subgroup [Table/Fig-6].

EF%	n (%)
≤40	29 (48.3)
41-50	26 (43.3)
>50	5 (8.3)
Mean (SD)	42.58 (7.72)
Range	25-60

[Table/Fig-6]: Distribution of study subjects according to the EF% (N=60).

Angiographic evaluation revealed that SVD was the most common finding whereas Triple-Vessel Disease (TVD) was the least frequent pattern [Table/Fig-7].

CAG findings	n (%)
Single vessel disease	32 (53.3)
Double Vessel Disease (DVD)	14 (23.3)
Triple vessel disease	9 (15.0)
WNL	5 (8.3)

[Table/Fig-7]: Distribution of study subjects according to the CAG findings (N=60).
WNL: Within normal limits

In the present study, it was observed that LAD and RCA were the most common vessels involved followed by LCx. LMCA was the least involved [Table/Fig-8].

DISCUSSION

The CVD remains a leading cause of mortality worldwide, with women contributing significantly to the overall burden. Since 1984, CVD-related mortality has been higher among women than men; however, a substantial decline has been observed since the year

Vessel involved	No. (%)
LAD	29 (52.7)
LCx	25 (45.4)
LMCA	4 (7.2)
RCA	29 (52.7)

[Table/Fig-8]: Distribution of study subjects according to the vessel involved (N=60). LAD: Left anterior descending; LCx: Left circumflex; LMCA: Left main coronary artery; RCA: Right coronary artery

2000 [33]. This reduction has been attributed to improved public awareness, increased recognition of heart disease in women and wider implementation of evidence-based therapeutic strategies. Despite these advances, excess cardiovascular mortality in women persists due to multiple biological, clinical and social determinants, necessitating continued focused evaluation.

One of the primary objectives of the present study was to assess the clinical presentation of AMI in female patients. In the current study, the majority of women 44 (73.3%) presented with typical symptoms of AMI, while 16 (26.7%) had atypical presentations. This finding contrasts with observations by McSweeney JC et al., who reported that most women with MI presented with atypical symptoms and experienced a prodromal phase prior to the acute event [34]. Similarly, George NM et al., observed a predominance of atypical symptomatology among women with AMI [35]. The higher proportion of typical presentations in the present study may reflect improved awareness, earlier symptom recognition and better access to healthcare facilities.

With regard to age distribution, women in the 51-60-years age group constituted the largest proportion of affected patients 27 (45%), with a mean age at presentation of 63.72 years. This supports existing evidence that women develop coronary artery disease later than men, possibly due to the cardioprotective effects of oestrogen before menopause. Comparable findings were reported by Pathak LA et al., who observed a higher prevalence of coronary artery disease among women aged 60-80 years [36].

Analysis of cardiovascular risk factors revealed hypertension as the most common risk factor associated with AMI in female patients. This observation is consistent with findings by Picariello C et al., who reported a higher prevalence of hypertension among women with AMI compared to men [37]. DM was present in 50% of patients in the present study, highlighting its significant contribution to cardiovascular risk in women. Although absolute cardiovascular event rates are higher in men, diabetic women have a disproportionately higher relative risk compared to diabetic men across all age groups, as demonstrated by Malmborg M et al., [38]. Data from the Framingham Heart Study further indicate that the risk of AMI is approximately 150% higher in diabetic women than in non diabetic women.

Dyslipidaemia was another important risk factor identified in the present study, with elevated LDL cholesterol levels observed in 63.3% of patients. This finding is comparable to that reported by Kumar N et al., who demonstrated a strong association between elevated LDL cholesterol and AMI in women, emphasising the importance of lipid abnormalities in the pathogenesis of CAD among females [39].

Angiographic assessment, which constituted a secondary objective of the study, revealed that 8.3% of patients had normal coronary arteries. SVD was the most common angiographic finding, observed in 32 (53.3%) of patients, followed by DVD 14 (23.3%) and TVD 9 (15%). The RCA and LAD were the most frequently involved vessels. These findings are consistent with studies by Pathak LA *et al.* and Beig JR et al., both of which reported SVD as the predominant angiographic pattern and LAD as the most commonly affected vessel [36,40]. In contrast, George NM et al., observed a significantly higher occurrence of normal coronary arteries and DVD among women, highlighting sex-specific differences in coronary artery involvement [35].

The study highlights the need for heightened clinical vigilance for MI in women, prompt recognition of atypical symptoms and aggressive control of modifiable risk factors. Predominant SVD and normal coronaries emphasise individualised management. Future multicentric studies with long-term follow-up and advanced imaging are required to refine sex-specific diagnostic and preventive strategies.

Limitation(s)

The present study has certain limitations. The sample size calculated was 65 patients, only 60 patients could be enrolled, as the present study was conducted during 2nd and 3rd wave of Coronavirus Disease (COVID) pandemic (2021 and 2022) which resulted in marked reduction in eligible admissions. The observational design precludes establishment of a causal relationship and may be subject to residual confounding and selection bias. Being a single-centre study with a relatively small sample size, the findings may not be generalisable. Additionally, dietary habits, physical activity and other lifestyle factors influencing cardiovascular risk were not assessed.

CONCLUSION(S)

The present study highlights the distinctive clinical profile of AMI in women, with variations in symptom presentation, risk factor burden and angiographic severity. Hypertension, DM and dyslipidaemia were the most common risk factors, with SVD being the predominant angiographic finding. With advancements in cardiology and wider availability of diagnostic modalities such as treadmill testing, echocardiography and stress echocardiography, increased public and medical awareness of heart disease in women-particularly postmenopausal women with major risk factors-is essential. Regular and timely cardiovascular evaluation in this high-risk population may facilitate early detection of CAD and improve clinical outcomes.

Acknowledgement

Authors would like to thank all the physicians, nurses, laboratory staff and patients who helped in the present study.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Dec 29, 2025
- Manual Googling: Mar 03, 2026
- iThenticate Software: Mar 05, 2026 (1%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Dec 11, 2025**
Date of Peer Review: **Jan 23, 2026**
Date of Acceptance: **Mar 07, 2026**
Date of Publishing: **Jun 01, 2026**