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Predictors of Myocardial Infarction Among Patients Presenting with Chest Pain to the Emergency Department of a Tertiary Care Hospital in Peshawar, Pakistan

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Abstract

Background: Chest pain is one of the most common complaints among patients presenting to emergency departments and represents a major diagnostic challenge for healthcare providers. Myocardial infarction (MI) is a serious cause of chest pain that requires rapid diagnosis and timely management to reduce mortality and complications. **Objective:** To determine predictors of myocardial infarction among patients presenting with chest pain in the emergency department. **Methods:** A prospective cohort study with 72-hour follow-up was conducted among 138 patients presenting with chest pain to the emergency department of Lady Reading Hospital, Peshawar, using non-probability convenience sampling. Data were collected through a structured, pre-tested proforma covering demographic characteristics, clinical symptoms, cardiovascular risk factors, ECG findings, troponin levels, and final diagnosis, and analyzed using SPSS version 26. Frequencies, percentages, the chi-square test, and binary logistic regression analysis were applied, with $p \leq 0.05$ considered statistically significant. **Results:** Increasing age, sweating, smoking status, abnormal ECG findings, and elevated troponin levels were significantly associated with myocardial infarction. On binary logistic regression, patients with sweating had 4.7 times higher odds of MI (AOR = 4.707, 95% CI: 1.466–15.110, p = 0.009), ST-segment depression on ECG was associated with markedly increased odds of MI (AOR = 25.829, 95% CI: 3.483–191.524, p = 0.001), and elevated troponin was associated with 9.2 times higher odds of MI (AOR = 9.236, 95% CI: 1.913–44.582, p = 0.006). The overall model was statistically significant (Omnibus χ^2 =

84.006, df = 15, p < 0.001). **Conclusion:** Demographic factors, sweating, abnormal ECG findings, and elevated troponin levels are important predictors of myocardial infarction among chest pain patients presenting to the emergency department. Early identification of these predictors may improve triage accuracy and patient outcomes.

Keywords: *Chest pain, myocardial infarction, troponin, ECG, acute coronary syndrome*

Introduction

Chest pain is one of the most common reasons people seek emergency care and remains one of the most diagnostically challenging presentations clinicians encounter, ranging from minor musculoskeletal strain to immediately life-threatening events such as acute coronary syndrome and myocardial infarction. Because myocardial infarction carries a heavy burden of death and long-term disability, early recognition and prompt treatment are essential to reducing mortality and improving outcomes.(1) Distinguishing cardiac from non-cardiac causes of chest pain remains genuinely difficult given the overlap in symptoms across conditions,(4) and multicenter data indicate that a small but clinically important proportion of acute myocardial infarction cases are still missed at initial emergency department evaluation, with increasing age among the factors associated with such missed or delayed diagnoses.(2,3)

Cardiovascular disease remains the world's leading cause of death, with the World Health Organization estimating that around 17.9 million lives are lost to cardiovascular causes every year.(5) This burden has grown steadily, driven by population growth, ageing, urbanization, and rising rates of obesity, diabetes mellitus, hypertension, and smoking.(6) In South Asia, including Pakistan, myocardial infarction tends to occur at younger ages than in Western populations, a pattern linked to genetic vulnerability and a high prevalence of metabolic risk factors.(7)

The landmark Interheart study, drawing on data from 52 countries, identified smoking, hypertension, diabetes mellitus, abdominal obesity, psychosocial stress, and abnormal lipid levels as major independent predictors of myocardial infarction across diverse populations.(8) Alongside risk-factor assessment, the 12-lead electrocardiogram (ECG) and cardiac troponin remain central to diagnosis: myocardial infarction is defined as myocardial injury in the presence of acute ischemia, confirmed through elevated cardiac biomarkers together with compatible clinical or ECG findings, and guidelines recommend immediate reperfusion once ST-segment elevation is identified.(9,10) Troponin remains the most sensitive and specific biomarker of myocardial injury in current clinical practice.(11,12) More recently, artificial intelligence and deep learning approaches applied to ECG interpretation have shown promising accuracy for myocardial infarction detection, in some cases approaching the performance of human cardiologists, raising the possibility of AI-assisted triage in busy emergency settings.(13,14)

In Pakistan, rising rates of smoking, diabetes, hypertension, obesity, and physical inactivity have contributed to a growing burden of myocardial infarction, compounded by late presentation and overcrowded, under-resourced emergency departments.(15) However, local evidence on the specific predictors of myocardial infarction among Pakistani chest pain patients remains limited, and risk-prediction tools developed in Western populations may not translate reliably to this setting given differences in demographic profile, healthcare infrastructure, and risk-factor distribution. This study was therefore undertaken to determine the predictors of myocardial infarction among patients presenting with chest pain to the emergency department of a tertiary care hospital in Peshawar, Pakistan.

Methods

Study Design and Setting

This was a prospective cohort study with 72-hour follow-up, conducted in the Emergency Department of Lady Reading Hospital, a tertiary care hospital providing emergency medical services to a large population in Peshawar, Khyber Pakhtunkhwa, Pakistan. The study was conducted over a period of four months following approval of the synopsis by the Institutional Research Ethics Committee.

Sample Size and Sampling Technique

A total of 138 patients presenting with chest pain were enrolled, with sample size calculated using the WHO sample size formula for prevalence studies [$n = Z^2 \times P(1-P)/d^2$], assuming an average prevalence of myocardial infarction of 10% ($P = 0.10$), a 95% confidence level ($Z = 1.96$), and a 5% margin of error ($d = 0.05$), yielding a required sample of 138 patients; this was cross-checked using the OpenEpi sample size calculator. Patients were enrolled using a non-probability convenience sampling technique.

Inclusion and Exclusion Criteria

Patients aged 18 years and above presenting with chest pain who were willing to participate were included. Patients with trauma-related chest pain, known psychiatric illness, previously confirmed myocardial infarction, or critical instability precluding provision of information were excluded.

Data Collection

Data were collected using a structured, pre-tested questionnaire developed after review of relevant literature. Patients were approached after initial triage assessment, and written informed consent which including consent for telephone follow-up and then info was obtained prior to data collection. Information recorded at presentation included demographic characteristics (age, gender, marital status, body mass index), presenting symptoms and duration/severity/radiation of chest pain, associated symptoms (nausea, vomiting, sweating, dyspnea, palpitations, dizziness), vital signs (blood pressure, heart rate, respiratory rate, oxygen saturation, temperature), cardiovascular risk factors (hypertension, diabetes mellitus, dyslipidemia, smoking status, family history of ischemic heart disease), triage category, initial ECG findings, and troponin levels. The final diagnosis of myocardial infarction was confirmed from hospital medical records based on ECG changes, cardiac biomarker results, and physician diagnosis. Participants were followed for 72 hours after triage assessment via telephone calls and review of hospital records to determine clinical outcomes, including whether myocardial infarction was diagnosed, whether the patient was admitted or discharged, and whether adverse cardiac events occurred. Confidentiality of all collected information was maintained throughout.

Statistical Analysis

Data were entered and analyzed using the SPSS version 26. Descriptive statistics were used to summarize the data, with categorical variables presented as frequencies and percentages. The chi-square test was used to assess associations between categorical variables and myocardial infarction, and binary logistic regression analysis was performed to identify independent predictors of myocardial infarction. A p-value of ≤ 0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Research Ethics Committee prior to initiation of the study, and permission was obtained from the administrations of Peshawar Institute of Cardiology and Lady Reading Hospital prior to data collection. Written informed consent was obtained from all participants; participation was voluntary and participants could withdraw at any stage without consequence. Confidentiality and privacy of all participants were strictly maintained, and personal identifiers were not disclosed.

Results

A total of 138 patients presenting with chest pain to the emergency department were enrolled in the study.

Demographic and Clinical Characteristics

The majority of participants belonged to the 60–74-year age group (34.8%), followed by the 45–59-year age group (31.2%); patients aged 18–44 years comprised 24.6%, and those aged 75 years and above comprised 9.4%. Males constituted 50.7% of participants and females 49.3%. Half of the participants (50.0%) had a normal BMI (18.5–24.9 kg/m²), 23.9% were overweight (25.0–29.9 kg/m²), 21.0% were obese (>30 kg/m²), and 5.1% were underweight (<18.5 kg/m²). Most participants were married (70.3%), 16.7% were single, and 13.0% were widowed. Employed individuals formed the largest occupational group (40.6%), followed by housewives (31.2%), unemployed individuals (19.6%), students (8.0%), and retired individuals (0.7%).

Table 1. ***Demographic and Clinical Characteristics of Study Participants (n = 138)***

Age group: Young adults (18–44 yrs)	34	24.6
Age group: Middle-aged (45–59 yrs)	43	31.2
Age group: Young old (60–74 yrs)	48	34.8
Age group: Aged (75+ yrs)	13	9.4
Gender: Male	70	50.7
Gender: Female	68	49.3
BMI: <18.5 kg/m²	7	5.1
BMI: 18.5–24.9 kg/m²	69	50.0
BMI: 25.0–29.9 kg/m²	33	23.9
BMI: >30 kg/m²	29	21.0
Marital status: Single	23	16.7
Marital status: Married	97	70.3
Marital status: Widowed	18	13.0
Occupation: Employed	56	40.6
Occupation: Unemployed	27	19.6
Occupation: Student	11	8.0
Occupation: Housewife	43	31.2
Occupation: Retired	1	0.7

Chest Pain Characteristics and Associated Symptoms

Gradual onset of chest pain was reported by 55.1% of patients and sudden onset by 44.9%. Nearly half (47.8%) experienced pain lasting more than 60 minutes, 30.4% for 30–60 minutes, and 21.7% for less than 30 minutes. Pain was severe (score 7–10) in 52.9% of patients, moderate in 29.0%, mild in 17.4%, and absent in 0.7%. The most common nature of pain was sharp (37.0%), followed by heaviness (19.6%), pressure (16.7%), tightness (15.2%), and burning (11.6%). No radiation of pain was reported by 38.4% of patients; radiation was most often to the back (23.2%), followed by the shoulder (16.7%), left arm (15.2%), jaw (4.3%), and right arm (2.2%). Associated symptoms were common: shortness of breath (75.4%), dizziness (63.0%), sweating (61.6%), nausea (60.1%), and palpitations (60.1%).

Vital Signs and Cardiovascular Risk Factors

Regarding blood pressure, stage 2 hypertension (>140/>90 mmHg) was most common (38.4%), followed by hypotension (21.7%), normal blood pressure (19.6%), hypertensive crisis (>180/120 mmHg, 9.4%), stage 1 hypertension (8.0%), and elevated blood pressure (2.9%). Tachycardia and normal heart rate were equally common (47.1% each), while bradycardia was present in 5.8%. Tachypnoea was present in 54.3% of patients, normal respiratory rate in 44.9%, and bradypnea in 0.7%. Normal oxygen saturation (95–100%) was present in 61.6%, insufficient oxygen levels (91–94%) in 22.5%, and low oxygen saturation (<91%, including hypoxemia <85%) in 15.9%. Normal body temperature was recorded in 67.4%, hyperthermia in 29.0%, and hypothermia in 3.6%. Regarding risk factors, a history of hypertension was present in 67.4% of patients, diabetes mellitus in 37.0%, and dyslipidemia in 31.2%. Most patients were non-smokers (70.3%), with 15.9% current smokers and 13.8% ex-smokers. A family history of ischemic heart disease was present in 47.1% of patients.

ECG Findings, Troponin, and Final Diagnosis

ST-segment elevation was the most common ECG finding (46.4%), followed by normal ECG (29.7%), ST depression (16.7%), and T-wave inversion (7.2%). Troponin was elevated in 61.6% of patients, normal in 14.5%, and not applicable (not measured) in 23.9%. Acute coronary syndrome was diagnosed in 65.2% of patients. On final diagnosis after evaluation, myocardial infarction was the most common diagnosis (52.2%), followed by gastrointestinal causes such as gastritis/GERD (12.3%), anxiety/panic-related pain (10.9%), NSTEMI (8.0%), musculoskeletal pain (5.1%), other causes (5.8%), stable angina (2.2%), respiratory causes (2.2%), and unstable angina (1.4%). For the purpose of association analysis, myocardial infarction (including NSTEMI) was present in 83 of 138 patients (60.1%).

Association Between Predictors and Myocardial Infarction

On bivariate analysis, myocardial infarction was significantly associated with age group (χ^2 = 11.653, p = 0.009), being most frequent among patients aged 60–74 years (75.0%) and 45–59 years (62.8%), and least frequent among those aged 18–44 years (47.1%) and 75+ years (30.8%). Myocardial infarction was also significantly associated with ECG findings (χ^2 = 44.206, p < 0.001), being present in 82.8% of patients with ST elevation and 73.9% of those with ST depression, compared with only 19.5% of patients with a normal ECG. A significant association was likewise found with troponin level (χ^2 = 30.143, p < 0.001): myocardial infarction was present in 75.3% of patients with elevated troponin, compared with 10.0% of those with normal troponin. No statistically significant association was found between myocardial infarction and

gender (χ^2 = 1.163, p = 0.281; present in 64.7% of females vs. 55.7% of males), nature of chest pain (χ^2 = 1.650, p = 0.800), sweating (χ^2 = 1.921, p = 0.166; 64.7% with sweating vs. 47.2% without), hypertension history (χ^2 = 0.587, p = 0.444), diabetes mellitus history (χ^2 = 0.702, p = 0.402), or smoking status (χ^2 = 1.135, p = 0.567).

Table 2. ***Bivariate Association Between Selected Variables and Myocardial Infarction***

Age group (60–74 yrs)	36/48 (75.0)	11.653	0.009
Gender (female)	44/68 (64.7)	1.163	0.281
Nature of chest pain	—	1.650	0.800
Sweating (present)	55/85 (64.7)	1.921	0.166
Hypertension history	58/93 (62.4)	0.587	0.444
Diabetes mellitus history	33/51 (64.7)	0.702	0.402
Smoking status	—	1.135	0.567
ECG: ST elevation	53/64 (82.8)	44.206	<0.001
Troponin (elevated)	64/85 (75.3)	30.143	<0.001

Binary Logistic Regression Analysis

Binary logistic regression, including age, gender, sweating, shortness of breath, smoking status, hypertension history, diabetes mellitus history, ECG findings, and troponin level, was performed to identify independent predictors of myocardial infarction. The overall model was statistically significant (Omnibus χ^2 = 84.006, df = 15, p < 0.001). Age remained a significant predictor overall (p = 0.049), with the strongest effect in the 60–74-year age group (AOR = 10.391, 95% CI: 1.665–64.835, p = 0.012). Sweating was significantly associated with myocardial infarction (AOR = 4.707, 95% CI: 1.466–15.110, p = 0.009). Smoking status was significant overall (p = 0.042). Among ECG findings, ST depression showed the strongest association with myocardial infarction (AOR = 25.829, 95% CI: 3.483–191.524, p = 0.001). Elevated troponin was strongly associated with myocardial infarction (AOR = 9.236, 95% CI: 1.913–44.582, p = 0.006). Gender, shortness of breath, hypertension history, and diabetes mellitus history were not independent predictors in the adjusted model (p > 0.05).

Table 3. ***Binary Logistic Regression Analysis for Predictors of Myocardial Infarction***

Age (overall, df=3)	—	0.049	—
Age: 60–74 vs. reference	10.391	0.012	1.665–64.835
Sweating (yes vs. no)	4.707	0.009	1.466–15.110
Smoking status (overall, df=2)	—	0.042	—
ECG findings (overall, df=3)	—	<0.001	—
ECG: ST depression	25.829	0.001	3.483–191.524
Troponin (overall, df=2)	—	<0.001	—
Troponin: elevated	9.236	0.006	1.913–44.582
Gender (male vs. female)	0.396	0.087	0.137–1.145
Hypertension history	0.798	0.688	0.266–2.396
Diabetes mellitus history	1.388	0.578	0.438–4.396

Discussion

This study aimed to identify predictors of myocardial infarction among patients presenting to the emergency department with chest pain. Age, sweating, smoking status, ECG findings, and troponin level emerged as significant predictors.

Myocardial infarction was more frequent among patients aged 60–74 years, with a statistically significant association between age and myocardial infarction ($p = 0.009$). This is consistent with evidence that the prevalence of myocardial infarction rises sharply with age, becoming especially pronounced beyond the sixth decade of life as atherosclerosis and cardiovascular risk factors accumulate over time, (16) and with multicenter emergency department data linking advancing age to the risk of missed or delayed myocardial infarction diagnosis among chest pain patients. (3)

No statistically significant association was found between gender and myocardial infarction in this study ($p = 0.281$), although myocardial infarction was numerically more frequent among female patients (64.7%) than male patients (55.7%). This finding differs from international literature reporting a male predominance in myocardial infarction, with women more often presenting atypically and experiencing diagnostic delay as a result. (17) This discrepancy may reflect the relatively small sample size of this study and warrants confirmation in larger, multicenter cohorts.

Sweating (diaphoresis) was significantly associated with myocardial infarction on logistic regression, consistent with prior work showing that diaphoresis is among the clinical features most strongly linked to a diagnosis of myocardial infarction in chest pain patients.(18) Traditional cardiovascular risk factors like hypertension and diabetes mellitus were more frequent among patients with myocardial infarction but did not reach statistical significance on bivariate analysis, which may reflect the relatively high background prevalence of these risk factors across the whole study population rather than their absence of clinical relevance.

ECG findings showed a highly significant association with myocardial infarction ($p < 0.001$), with ST-segment elevation the most prevalent abnormality among affected patients, and ST depression carrying the highest adjusted odds of myocardial infarction on regression analysis. This is consistent with international guidelines identifying ST-segment abnormalities as among the most reliable early markers of myocardial infarction, warranting immediate clinical action. (10,19) Elevated troponin was similarly strongly associated with myocardial infarction, in keeping with its established role as the most sensitive and specific biomarker of myocardial injury and its central place in the diagnosis of acute coronary syndrome. (11,20)

The binary logistic regression model was statistically significant overall (Omnibus $\chi^2 = 84.006$, $df = 15$, $p < 0.001$) and explained approximately 61.7% of the variance in myocardial infarction (Nagelkerke $R^2 = 0.617$), with age, sweating, ECG findings, smoking status, and troponin level retained as independent predictors. These findings reinforce the importance of combining focused clinical assessment, ECG interpretation, and cardiac biomarker testing for early identification of high-risk chest pain patients in the emergency department.

Limitations

This study has several limitations. It was conducted at a single tertiary care center using non-probability convenience sampling, which may limit the generalizability of findings to other settings. The sample size ($n = 138$), while adequate for the primary objective, limited the precision of estimates for less common subgroups and may explain why some established risk

factors (e.g., hypertension, diabetes mellitus) did not reach statistical significance. The 72-hour follow-up period, while practical for an emergency department setting, may not capture later cardiac events.

Conclusion

Myocardial infarction was a common diagnosis among patients presenting with chest pain to the emergency department in this study. Increasing age, sweating, abnormal ECG findings, smoking status, and elevated troponin levels were identified as important predictors of myocardial infarction, with ECG abnormalities and elevated troponin levels showing the strongest association. Early recognition of these predictors, through a combination of focused clinical assessment, ECG interpretation, and troponin testing, may improve emergency department triage, facilitate timely management, and reduce complications and mortality associated with myocardial infarction.

Recommendations

- Emergency departments should ensure rapid ECG assessment and troponin testing for all patients presenting with chest pain.
- Structured triage protocols should be implemented to identify high-risk patients at an early stage.
- Healthcare professionals should receive regular training in early recognition of myocardial infarction symptoms and ECG interpretation.
- Public awareness programs should be conducted to educate the population about the symptoms and risk factors of myocardial infarction.
- Larger, multicenter studies should be conducted in Pakistan to develop more accurate, locally validated prediction models for myocardial infarction.

Conflict of Interest

The authors declare no conflict of interest.

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