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# Evaluation of Risk Factors, Clinical Presentation, and Outcomes of Acute Myocardial Infarction in Young Adults

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## ABSTRACT

**Background:** Acute Myocardial Infarction (AMI) in young adults is an emerging public health concern due to distinct risk profiles and clinical outcomes compared to older populations. Understanding these differences is essential for prevention and timely intervention. This study aimed to assess the risk factors, clinical presentation, and in-hospital outcomes of AMI in individuals aged 18–45 years.

**Methods:** A six-month cross-sectional study was conducted from 1st April to 30th September 2025, including 127 young AMI patients through non-probability consecutive sampling. Inclusion criteria encompassed adults aged 18–45 years diagnosed with AMI based on clinical evaluation, classical and contemporary ECG changes, and at least two positive cardiac biomarkers (troponin or CK-MB). Both genders were included. Data on sociodemographic, risk factors, clinical features, diagnostics, treatment modalities, and outcomes were collected. Statistical analysis was performed using SPSS v26; ANOVA, chi-square, and t-tests were applied, with $p < 0.05$ considered significant.

**Results:** The mean age was 38.4 ± 4.5 years, with 98 (77.2%) males. The most prevalent risk factors were smoking (70.1%), physical inactivity (59.1%), and dyslipidemia (44.1%). STEMI occurred in 94 (74.0%) patients and was associated with higher troponin I, CK-MB levels, and lower ejection fraction compared to NSTEMI ($p < 0.001$). Physical inactivity correlated significantly with in-hospital heart failure ($p = 0.045$). PCI was associated with the shortest hospital stay ($p < 0.001$).

**Conclusion:** Young adults with AMI carry a high burden of modifiable risk factors, especially smoking and inactivity. STEMI presents more severely, while PCI improves outcomes. Gender-specific risk patterns highlight the need for targeted screening and preventive strategies. Early identification and aggressive modification of risk factors may reduce premature cardiovascular morbidity and mortality.

**Keywords:** Myocardial Infarction, Young Adult, Smoking, Physical Inactivity, Percutaneous Coronary Intervention.

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## INTRODUCTION

Heart attacks, also referred to as acute myocardial infarction (AMI), have long been thought to exclusively affect the elderly[1]. Nonetheless, the prevalence of AMI among young adults, generally referred to as those under 45, has alarmingly increased over the last several decades[2]. Significant clinical and public health ramifications result from this demographic transition, especially in low- and middle-income nations where the prevalence of cardiovascular disease (CVD) is rising and overlapping with younger age groups. While AMI among younger demographics may account for a lesser percentage of all myocardial infarctions, it has a disproportionately large socio-economic impact because it leads to an earlier loss of productive life years, creating greater dependence on the healthcare system[3].

Many of the causes and risk factors for AMI differ greatly in younger adults compared to older adults. While risk factors like smoking, dyslipidemia, hypertension, diabetes mellitus, and family history of premature coronary artery disease are still prominent, they are differentially distributed in the younger population and yield unique contributions[4]. Correlatively, studies have identified modifiable lifestyle-related risk factors as being extremely prevalent in young patients with AMI, such as tobacco use, sedentary behavior, and poor dietary habits[5, 6]. Psychosocial stress, substance abuse (particularly cocaine and amphetamines), and some hypercoagulable states also add their unique contributions to the pathophysiology of AMI in the young[7, 8].

Clinical presentation of AMI in young adults may not always conform to classic patterns, and atypical symptoms such as epigastric pain, fatigue, or syncope may lead to delays in diagnosis and treatment[9]. In addition to different symptomatic presentations, young patients may also have different angiographic profiles, with a higher prevalence of single-vessel disease and non-obstructive coronary artery disease due to vasospasm, spontaneous coronary artery dissection, or direct thrombophilia[10, 11].

Outcomes following AMI in young individuals may be better in terms of short-term mortality and left ventricular function as a result of fewer comorbidities and superior physiological reserves[12]. However, long-term outcomes may be compromised by poor medication adherence, psychosocial stressors, and recurrent risk behaviors[13]. Furthermore, the psychological sequelae of a life-threatening cardiac event at a young age can be considerable and could benefit from integrated care models that can address both physical and mental health[14, 15].

Despite increased awareness of the problem, there is still limited data on AMI in young adults, especially in developing countries where early screening for cardiovascular disease and risk profiling is often lacking. AMI has increasingly emerged as a common reason for hospitalization in young adults, with significant implications at the societal and economic levels. The potential for a high burden of illness related to premature cardiovascular disease presents enough of a rationale to identify the elements specific to the young and adult population and the associated outcomes. Much of the existing literature focuses primarily on older adults, and very little has been published with respect to young adults. Accordingly, there is limited evidence to support suffering and death in young adults with AMI or acute coronary syndromes (ACS). This research study will-attempt to complement the body of evidence with a complete evaluation of AMI in young patients in order to add to the litany of evidence for clinical practice and public health policy surrounding prevention, early diagnosis, and improving long–term care. Specifically, this research study examined the risk factors, clinical presentation, and short-term outcomes of acute myocardial infarction in young adults aged 18–45 years.

## METHODS

This cross-sectional observational study was carried out at the Punjab Institute of Cardiology, Lahore, Pakistan, and was conducted for a duration of 6 months, starting from 1st April to 30th September 2025. Ethical approval for the research was obtained from the Ethical Review Committee (ERC) of Punjab Institute of Cardiology, Lahore, under approval number RTPGME-Research-328, dated 18th March 2025.

Sample size was calculated using OpenEpi, Version 3, which is an open-source, free statistical software package for epidemiological calculations. Based on a 95% confidence level, a 5% margin of error, and an expected prevalence of AMI in young adults at 10%,[16]the minimum sample size was calculated to be 127 participants. A design effect of 1 was used; simple random sampling was assumed.

A non-probability consecutive sampling design was used to select participants. The research sample consisted of young adults aged 18 to 45 years of age and admitted with a medical history indicating a diagnosis of AMI, which was diagnosed by a clinical assessment, with classical and contemporary electrocardiographic changes, and at least two positive cardiac biomarkers such as troponins or CK-MB. Participants of both genders were included. Participants were excluded if they presented to the ED with a suspected diagnosis of acute myocardial infarction; were aged over 45 years of age; were

diagnosed with chronic ischemic heart disease or a previous history of MI; were diagnosed with congenital or structural heart disease; or were lost to follow-up at any time during hospitalization.

The study participants or legal guardians were informed of the study's objectives, and written informed consent was obtained for all participants or guardians who consented to participate. It was ensured throughout the study that confidentiality and privacy of patient information were strictly adhered to, as governed by ethical standards and the institutional environment.

The data collection of the study was obtained using a structured proforma, which was developed for the purpose of this study. The tool was developed after a review of relevant literature and validated by a panel of cardiologists. The proforma captured socio-demographic information (including age, sex, residence, occupation, and marital status), clinical risk factors (such as smoking, hypertension, diabetes, dyslipidemia, obesity, physical inactivity, substance abuse, and family history of coronary artery disease), presenting symptoms (such as chest pain, radiation, sweating, and nausea), and diagnostic findings (including ECG patterns, biomarker levels, and echocardiographic data). Treatment modalities (e.g., thrombolysis or percutaneous coronary intervention), in-hospital complications (e.g., arrhythmias, heart failure), and discharge outcomes were also recorded. Data were obtained through direct patient interviews and review of medical records by trained research assistants, and all entries were cross-verified by the principal investigator.

Data were entered using the Statistical Package for the Social Sciences (SPSS), Version 26. Descriptive statistics were applied to summarize socio-demographic variables, clinical risk factors, presenting symptoms, diagnostic findings, treatment modalities, complications, and outcomes. Categorical variables such as gender, residence, marital status, smoking, hypertension, diabetes, and in-hospital complications were presented as frequencies and percentages. Continuous variables, including age, cardiac biomarkers (Troponin I, CK-MB), ejection fraction, and duration of hospital stay, were expressed as means ± standard deviations (SD) after confirming normal distribution using the Shapiro-Wilk test.

To evaluate associations between categorical variables, such as gender and risk factors or physical inactivity and complications, the Chi-square test was applied. Fisher's Exact Test was used when expected cell counts were less than five. For comparing continuous variables between two independent groups, such as STEMI versus NSTEMI patients, the Independent Samples t-test was utilized. In comparing means across more than two groups, specifically hospital stay duration by treatment modality (thrombolysis, PCI, and conservative), a One-way ANOVA was applied. 'A p-value $\leq 0.05$ was considered statistically significant throughout the analyses.

## RESULTS

**Table 1: Socio-Demographic Characteristics of Study Participants (n = 127)**

| Variable | n (%)/Mean ± SD |
|---|---|
| **Age (in years)** | 38.4 ± 4.5 |
| **Gender** | |
| Male | 98 (77.2%) |
| Female | 29 (22.8%) |
| **Residence** | |
| Urban | 84 (66.1%) |
| Rural | 43 (33.9%) |
| **Marital Status** | |
| Married | 102 (80.3%) |
| Unmarried | 25 (19.7%) |
| **Occupation** | |
| Employed | 64 (50.4%) |
| Unemployed | 29 (22.8%) |
| Student | 12 (9.4%) |
| Self-employed | 22 (17.3%) |

The mean age of the study participants was 38.4 ± 4.5 years, with the majority falling between the ages of 30 and 45. Out of the total 127 participants, 77.2% were male and 22.8% were female, indicating a male predominance in the occurrence of acute myocardial infarction (AMI) among young adults. Regarding residence, 66.1% belonged to urban areas, while 33.9% were from rural settings. A large proportion of the participants were married, 80.3%, while 25 19.7% were unmarried. In terms of occupational status, 50.4% were employed, 22.8% were unemployed, 9.4% were students, and 17.3% were self-employed (**Table 1).**

Among the young adults diagnosed with acute myocardial infarction (AMI), the most prevalent clinical risk factor was smoking, reported in 89 participants (70.1%), highlighting a major modifiable contributor to early-onset cardiovascular disease. Physical inactivity was the second most common risk factor, seen in 75 individuals (59.1%), indicating the growing impact of sedentary lifestyles. Dyslipidemia was identified in 56 patients (44.1%), while hypertension was present in 41 patients (32.3%), and obesity (defined as BMI ≥ 30 kg/m²) was noted in 39 participants (30.7%). Diabetes

mellitus was reported in 28 cases (22.0%), and substance abuse, including the use of amphetamines or similar agents, was identified in 17 individuals (13.4%). Additionally, 38 participants (29.9%) reported a family history of coronary artery disease (CAD), underscoring the relevance of genetic predisposition in this age group **(Figure 1).**

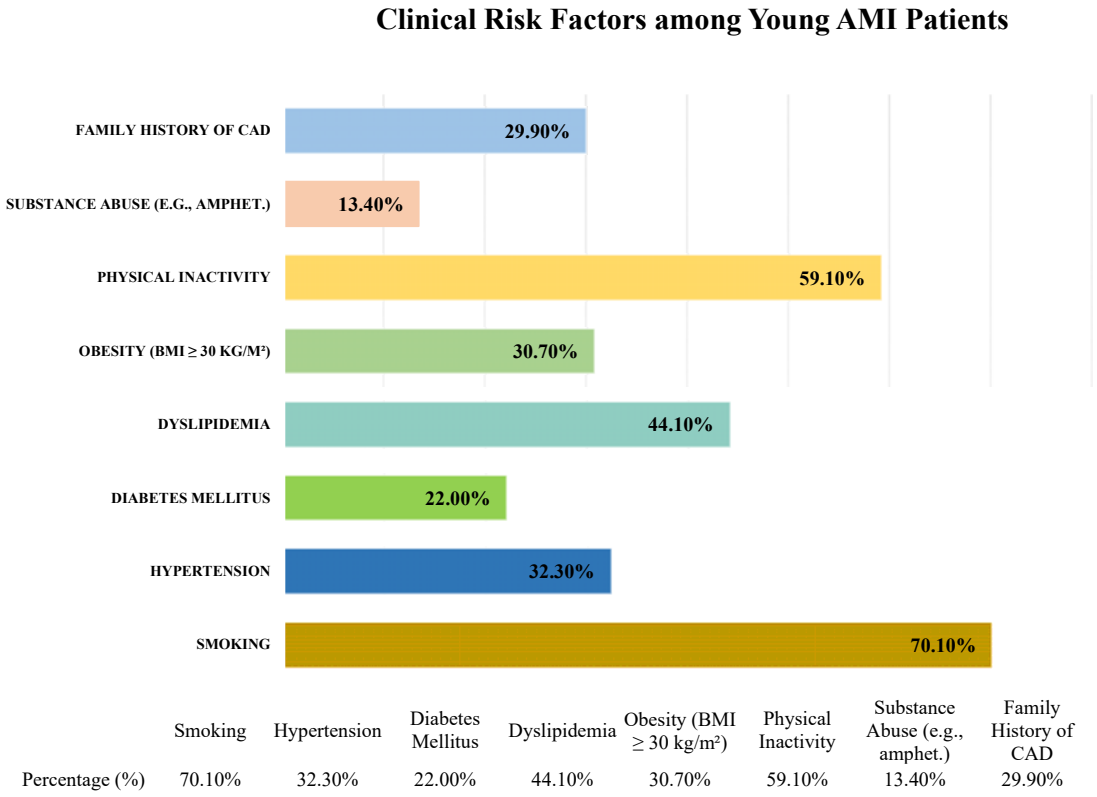


**Figure 1: A bar graph showing the distribution of Clinical Risk Factors among Young AMI Patients**

**Table 2: Comparison of Age and Biomarkers by AMI Type**

| Variable | STEMI (n = 94) | NSTEMI (n = 33) | p-value |
|---|---|---|---|
| **Mean Age (years)** | 38.2 ± 4.6 | 38.9 ± 4.3 | 0.147 |
| **Troponin I (ng/mL)** | 14.5 ± 5.2 | 8.2 ± 2.6 | <0.001 |
| **CK-MB (IU/L)** | 78.9 ± 18.4 | 62.5 ± 14.2 | <0.001 |
| **Ejection Fraction (%)** | 45.6 ± 8.9 | 55.7 ± 6.2 | <0.001 |

***An independent samples t-test was applied, and p ≤ 0.05 is considered significant***

All patients in the study presented with chest pain (100%), making it the most consistent and defining symptom of acute myocardial infarction (AMI) in young adults. Radiation of pain to the left arm or jaw was reported in 84 patients (66.1%), while excessive sweating was noted in 97 cases (76.4%),

reflecting sympathetic overactivity. Nausea and vomiting were experienced by 63 participants (49.6%), and dyspnea or shortness of breath was reported in 52 individuals (40.9%). Less common symptoms included palpitations (31 cases; 24.4%) and syncope (11 cases; 8.7%). These findings suggest that while chest pain is universally present, a substantial proportion also exhibit atypical or associated symptoms that could delay diagnosis if not carefully evaluated.

On electrocardiogram (ECG), ST-Elevation Myocardial Infarction (STEMI) was the predominant pattern, observed in 94 patients (74.0%), while Non-ST-Elevation Myocardial Infarction (NSTEMI) was seen in 33 cases (26.0%). The mean cardiac troponin I level was 12.8 ± 5.6 ng/mL, and the mean CK-MB level was 74.2 ± 18.9 IU/L, both elevated significantly, confirming myocardial injury. Echocardiographic assessment showed a mean ejection fraction of 48.5 ± 9.3%, indicating mild to moderate left ventricular dysfunction in many patients. These diagnostic parameters underscore the severity and extent of myocardial damage even in young individuals.

Regarding management strategies, thrombolysis was the most common intervention, administered to 76 patients (59.8%). Primary percutaneous coronary intervention (PCI) was performed in 39 cases (30.7%), reflecting resource availability and patient presentation time. Conservative medical management was chosen for 12 patients (9.4%), typically those presenting late or with contraindications to invasive therapy. These patterns reflect standard AMI care protocols adapted to the clinical context.

During hospitalization, arrhythmias were observed in 21 patients (16.5%), making them the most frequent complication. Heart failure occurred in 18 cases (14.2%), while cardiogenic shock developed in 9 patients (7.1%), indicating a subset with severe hemodynamic compromise. Other complications included reinfarction in 6 patients (4.7%) and pericarditis in 3 cases (2.4%). These findings suggest that even in younger individuals, AMI can be associated with significant acute morbidity.

A gender-wise comparison of key cardiovascular risk factors among young AMI patients revealed several statistically significant differences. Smoking was found to be significantly more prevalent in males (82.7%) compared to females (27.6%), with a p-value < 0.001, indicating a strong association between male gender and smoking habits. Interestingly, hypertension was more common among females (48.3%) than males (27.6%), and this association was also statistically significant ($p = 0.032$). Although diabetes mellitus showed a higher prevalence in females (34.5%) compared to males (18.4%), this difference did not reach statistical significance ($p = 0.061$), suggesting a potential

trend. Dyslipidemia was almost equally distributed between males (43.9%) and females (44.8%), with no significant association (p = 0.927).

Myocardial Infarction (STEMI) and Non-ST-Elevation Myocardial Infarction (NSTEMI). The mean age of patients in both groups was similar, with 38.2 ± 4.6 years in the STEMI group and 38.9 ± 4.3 years in the NSTEMI group (p = 0.147), indicating no statistically significant age difference. However, biomarker levels were significantly elevated in STEMI patients, with mean troponin I levels of 14.5 ± 5.2 ng/mL compared to 8.2 ± 2.6 ng/mL in the NSTEMI group (p < 0.001). Similarly, CK-MB levels were significantly higher in the STEMI group (78.9 ± 18.4 IU/L) than in the NSTEMI group (62.5 ± 14.2 IU/L) (p < 0.001). The mean ejection fraction (EF) was also significantly lower in STEMI patients (45.6 ± 8.9%) compared to NSTEMI patients (55.7 ± 6.2%) with a p-value < 0.001 **(Table 2).**

**Table 3: Association of Physical Inactivity and In-Hospital Complications**

| Complication | Physically Inactive (n = 75) | Physically Active (n = 52) | p-value |
|---|---|---|---|
| **Heart Failure** | 15 (20.0%) | 3 (5.8%) | 0.045 |
| **Arrhythmias** | 14 (18.7%) | 7 (13.5%) | 0.594 |

***The Fisher's Exact test was applied, and p ≤ 0.05 is considered significant***

A statistically significant relationship was observed between physical inactivity and the occurrence of heart failure, with 15 out of 75 inactive patients (20.0%) developing heart failure compared to only 3 out of 52 physically active patients (5.8%), yielding a p-value of 0.045. This indicates that physical inactivity was significantly associated with a higher risk of in-hospital heart failure. In contrast, the relationship between physical inactivity and arrhythmias was not statistically significant; arrhythmias occurred in 18.7% of inactive patients versus 13.5% of active patients, with a p-value of 0.594 **(Table 3).**

**Table 4: Comparison of Hospital Stay Duration by Treatment Modality (ANOVA)**

| Treatment Modality | Mean Stay (days) ± SD | p-value |
|---|---|---|
| **Thrombolysis (n = 76)** | 4.9 ± 1.3 | < 0.001 |
| **PCI (n = 39)** | 3.7 ± 1.0 | |
| **Conservative (n = 12)** | 5.4 ± 1.5 | |

***One-way ANOVA test was applied, and p ≤ 0.05 is considered significant***

The results showed a highly significant difference in hospital stay based on treatment modality ($p < 0.001$). Patients who underwent primary percutaneous coronary intervention (PCI) had the shortest mean hospital stay (3.7 ± 1.0 days) compared to those who received thrombolysis (4.9 ± 1.3 days) or conservative medical management (5.4 ± 1.5 days). This finding suggests that PCI, when accessible, not only improves outcomes but also reduces the length of hospitalization, possibly due to more effective and timelier revascularization **(Table 4)**.

## DISCUSSION

The study of young adults (≤45 years) with acute myocardial infarction (AMI) demonstrates that smoking and physical inactivity are the most prevalent modifiable risk factors, and that STEMI results in higher biomarker elevations and worse ventricular function, while PCI is associated with shorter hospital stays[17]. These findings align with multiple recent studies worldwide. A study conducted in Bahrain (2024) found that among young STEMI patients, smoking, undiagnosed dyslipidemia, and familial CAD were key risk factors, similar to our observed high prevalence of smoking (70%), dyslipidemia (44%), and family history (30%). Likewise, a U.S. statewide registry (2024) reported that young STEMI patients had higher rates of obesity, tobacco and substance use, and psychiatric disorders; these patients also underwent more revascularization and experienced lower 1-year mortality, consistent with our findings that PCI reduced hospital stay and improved short-term outcomes[18].

In a Gulf-Coast registry (2020), young adults had significantly more smoking, obesity, and family history than older patients, received more guideline-based therapy, and had lower in-hospital adverse events and 12-month mortality, echoing our observation of high prevalence of those risk factors and favorable immediate outcomes[19]. Similarly, a Middle East study of young STEMI patients (<45 years) reported that they were more likely to be male smokers, less likely to have hypertension or diabetes, and that virtually all had at least one risk factor, with many having multiple, paralleling our data on co-existent modifiable risk factors and male predominance[20].

In a Chinese cohort from 2023, young STEMI patients were overwhelmingly male smokers, with high rates of substance use and family history, but lower rates of hypertension and diabetes, concordant with our gender-based differences and the role of smoking and sedentary lifestyle in heart failure risk[21]. Another international registry-based review (2022) found that smoking, dyslipidemia, overweight/obesity, and family history were significantly more prevalent in premature AMI compared to older AMI patients, while metabolic conditions were more common in older cohorts, again mirroring our risk factor distribution[22].

The study in the Jazan region (2023) also found male predominance, high smoking prevalence, obesity, and sedentary behavior as leading risk factors. It additionally noted that physical inactivity predicted higher in-hospital heart failure, similar to our result that inactivity was significantly associated with heart failure ($p=0.045$) but not arrhythmias[23].

Another Kerala, India sub-analysis (2022) of the ACS QUIK trial reported that young AMI patients were more likely to be smokers, receive PCI, and had lower in-hospital and 30-day MACE than older groups[24]. Importantly, young women had worse risk profiles and outcomes, supportive of our findings of poorer female risk factor burden, though our sample size limited gender-stratified outcome analysis.

Furthermore, a preview of the Egyptian study (2021–22) revealed that young STEMI patients undergoing PCI had lower major adverse events at one year and a risk profile defined by smoking and dyslipidemia, consistent with our emphasis on early intervention via PCI, reducing hospital stay and complications[25].

Lastly, our finding that STEMI patients had significantly higher troponin CK-MB levels and reduced ejection fraction compared to NSTEMI patients is supported by broader literature showing greater myocardial injury in STEMI. This gradient in biomarker levels and functional compromise has been consistently documented across cohorts, including those from New York and Middle Eastern STEMI registries[18, 20].

This single-center, cross-sectional study may limit generalizability to other populations with varying healthcare access and socioeconomic factors. The design restricts causal inference between risk factors and outcomes. While the sample size was adequate, it limited subgroup analyses, particularly for gender and treatment comparisons. Additionally, long-term outcomes such as rehospitalization or mortality post-discharge were not assessed. Some variables, like physical activity and substance use, were self-reported, introducing potential recall bias.

Despite these limitations, the study highlights a high burden of modifiable risk factors, especially smoking, dyslipidemia, and inactivity, among young AMI patients. The significant link between inactivity and heart failure emphasizes the need for early lifestyle interventions and structured rehabilitation. Differences in biomarkers and ejection fraction by AMI type support early risk stratification and tailored care. Shorter hospital stays with PCI reinforce the benefit of early invasive management. Finally, gender-based risk variations underscore the importance of targeted screening and awareness, especially in young women.

## CONCLUSION

This study provided useful information about risk factors, clinical presentation, and outcomes of acute myocardial infarction in young adults. The high prevalence of modifiable lifestyle factors, particularly smoking, physical inactivity, and dyslipidemia, highlights the need for an early intervention strategy. Physical inactivity is significantly associated with heart failure, in addition to the beneficial role of PCI in decreasing LOS, providing clear targets for intervention and management. Also, the gender variations in risk profiles noted in the study indicate that more personalized and inclusive screening processes are needed. Overall, these findings reinforce the significance of early identification, risk stratification, and individual care to enhance cardiovascular outcomes in younger populations.

## LIST OF ABBREVIATIONS

**AMI:** Acute Myocardial Infarction

**STEMI:** ST-Elevation Myocardial Infarction

**NSTEMI:** Non-ST-Elevation Myocardial Infarction

**PCI:** Percutaneous Coronary Intervention

**CK-MB:** Creatine Kinase-MB

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## CONFLICT OF INTEREST

None

## ETHICAL APPROVAL

Ethical approval for the study was obtained from the Ethical Review Committee (ERC) of Punjab Institute of Cardiology, Lahore, under approval number RTPGME-Research-328; Dated 18th March, 2025.

## AUTHORS' CONTRIBUTION

All the authors contributed equally as per the ICMJE

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