

Original Research Article

Pattern of Coronary Artery Disease Involvement in Young Adult Patients Presenting with Acute Coronary Syndrome at Tertiary Care Hospital, Karachi

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Abstract:

Objective: To determine the pattern of coronary artery disease (CAD) involvement among young adult patients presenting with acute coronary syndrome (ACS). **Study Design** Cross-sectional study. **Place and Duration of Study:** Tabba Heart Institute, Karachi, from 2nd June 2025 to 2nd November 2025. **Methodology:** A total of 179 young adults aged 30–45 years presenting with ACS were included through non-probability consecutive sampling. Patients with thromboembolic disease, pulmonary hypertension, pericardial disease, arrhythmias, vasculitis, or connective tissue disorders were excluded. All participants underwent coronary angiography performed by experienced interventional cardiologists. **Results:** The mean age of patients was 37.6 ± 4.4 years, with 139 (77.7%) males. STEMI was the most common presentation (104; 58.1%). Smoking (86; 48%), dyslipidemia (64; 35.8%), obesity (59; 33%), and diabetes mellitus (61; 34.1%) were the predominant risk factors. The left anterior descending artery was the most frequently involved culprit vessel (94; 52.5%). Single-vessel disease was observed in 118 (65.9%) patients, while 42 (23.5%) had double-vessel disease and 19 (10.6%) had triple-vessel disease. **Conclusion:** It is concluded that young adults presenting with ACS predominantly exhibit single-vessel CAD with primary involvement of the left anterior descending artery. The burden of modifiable risk factors, particularly smoking, dyslipidemia, obesity, and diabetes, plays a major role in the development of premature CAD.

Keywords: Coronary Artery Disease, Young Adult Patients, Acute Coronary Syndrome.

INTRODUCTION

Coronary artery disease (CAD) continues to be one of the foremost causes of mortality worldwide, affecting both men and women across diverse populations. [1] In developing countries, the average age of individuals affected by CAD is decreasing, a trend influenced by various socioeconomic and lifestyle changes. [2] An increase in the number of risk factors is directly linked to a higher incidence of coronary artery disease (CAD). The risk profiles, angiographic findings, and clinical conditions differ significantly between younger and older patients, which in turn influences their overall prognosis. [3] With appropriate diagnostic evaluations

and effective management strategies, young adults with coronary artery disease (CAD) have the potential to achieve more favorable outcomes. [4] Sex-based differences have a substantial impact on how coronary artery disease presents clinically, as well as on its diagnosis, management strategies, and preventive approaches. (CAD). [5]

Once considered a condition primarily affecting older individuals, coronary artery disease (CAD) is now emerging as a major health issue among young adults, including those in their 20s and 30s. CAD, once primarily associated with older individuals with established risk factors, has seen a dramatic shift in its demographic

profile.[6] The emergence of CAD in younger patients, especially those with acute coronary syndrome (ACS), presents unique challenges and requires a thorough understanding of its patterns and underlying factors. [7] Historically, CAD in the young was often linked to congenital anomalies or rare genetic disorders. Recent data, however, indicate a complex mix of genetic predisposition, lifestyle factors, and environmental influences, leading to a notable increase in CAD incidence in younger populations. [8] The impact of CAD in the young is extensive, affecting not just individual health but also imposing societal and economic burdens [9] Angiographic findings in younger patients often differ from those in older individuals, with younger patients typically showing normal coronary arteries or single-vessel involvement, whereas older patients more commonly present with complex, multi-vessel disease. As a result, the approach to treatment may need to be tailored accordingly. [10] Smoking, high blood pressure, and family history are the three main risk factors for CAD in young adults as studied by Zeitouni et al. [11] In a study focusing on young adults diagnosed with acute coronary syndrome, the left anterior descending artery was identified as the most frequently involved vessel, accounting for 60% of cases. This was followed by involvement of the right coronary artery in 35% and the left circumflex artery in 25% of patients, while multi vessel disease was observed in only 5% of the cases. [12] Objective

To determine the pattern of coronary artery disease involvement in young adult patients presenting with acute coronary syndrome at Tertiary Care Hospital, Karachi.

METHODOLOGY

This cross-sectional study was conducted at Tabba Heart Institute, Karachi from 2nd June 2025 to 2nd November 2025 with IRB approval number: TH/IRB/SQ/03-03-2025/116. A total sample size of 179 patients was required, calculated using the WHO sample size calculator based on a 35% frequency of right coronary artery involvement, a 7% margin of error, and a 95% confidence level. A non-probability consecutive sampling technique was used to enroll eligible participants. Inclusion criteria were patients who presented with acute coronary syndrome (ACS) for the first time, either gender and age between 30 and 45 years. Exclusion Criteria were history of thromboembolic disease, pulmonary hypertension, pericardial disease, bradyarrhythmias or tachyarrhythmias, seropositive or seronegative vasculitis and connective tissue disorders. The study was initiated after approval from the College of Physicians and Surgeons, Pakistan and the Ethics Review Committee of Tabba Heart Institute. All eligible young patients who presented with ACS were approached for

participation. The purpose, benefits, and potential risks of the study were explained to each patient, and written informed consent was obtained. Baseline assessments were carried out for all participants. Height was measured using a wall-mounted stadiometer, and weight was recorded using a calibrated weighing machine. Body mass index (BMI) was calculated accordingly. Coronary angiography was performed for all patients as part of their clinical evaluation. Angiographic details including the culprit artery, number of involved vessels, and coronary artery disease pattern were recorded in a predesigned proforma. Procedures were performed by interventional cardiologists with more than five years of experience to ensure consistent reporting. All observations related to study variables were documented systematically in the data collection form provided in the annexure. Data were analyzed using SPSS Version 22. Quantitative variables such as age were presented as mean $\pm$ standard deviation for normally distributed data, confirmed through the Kolmogorov–Smirnov test. For non-normally distributed variables, the median and interquartile range (IQR) were reported. Categorical variables including gender, residential status, ACS type, diabetes mellitus, hypertension, dyslipidemia, smoking, obesity, family history of coronary artery disease (CAD), and coronary involvement patterns were summarized using frequencies and percentages. Stratification was performed based on age, gender, residence, ACS subtype, diabetes, hypertension, dyslipidemia, smoking, obesity, and family history of CAD to assess their influence on outcome variables. Post-stratification analyses were carried out using the chi-square test. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

Data were collected from 179 patients, with a mean age of 37.6 ± 4.4 years. Males formed 77.7% of the cohort, while females made up 22.3%. Most patients belonged to urban areas (69.8%), whereas 30.2% were from rural regions. Diabetes was present in 34.1% of patients, hypertension in 38.5%, and dyslipidemia in 35.8%. Smoking was highly prevalent at 48%, obesity affected 33%, and 29.1% had a family history of coronary artery disease. In terms of acute coronary syndrome presentation, STEMI was the most common type at 58.1%, followed by NSTEMI at 32.4% and unstable angina at 9.5%. The left anterior descending artery was the most frequently involved culprit artery at 52.5%, followed by 31.8% for the right coronary artery and 15.6% for the left circumflex artery.

Table 1. Baseline Demographic Characteristics (N = 179)

Variable	Category	Statistics (n %, Mean $\pm$ SD)
Age	—	37.6 $\pm$ 4.4
Gender	Male	139 (77.7)
	Female	40 (22.3)
Residence	Urban	125 (69.8)
	Rural	54 (30.2)
Risk Factors		
Diabetes Mellitus	Yes	61 (34.1)
	No	118 (65.9)
Hypertension	Yes	69 (38.5)
	No	110 (61.5)
Dyslipidemia	Yes	64 (35.8)
	No	115 (64.2)
Smoking	Yes	86 (48.0)
	No	93 (52.0)
Obesity	Yes	59 (33.0)
	No	120 (67.0)
Family history of CAD	Yes	52 (29.1)
	No	127 (70.9)
ACS Type		
ACS Type	STEMI	104 (58.1)
	NSTEMI	58 (32.4)
	Unstable Angina	17 (9.5)
Artery		
Culprit Artery	LAD	94 (52.5)
	RCA	57 (31.8)
	LCX	28 (15.6)

The pattern of coronary artery disease demonstrated that single-vessel disease was the predominant form, affecting 65.9% of the patients, indicating early and localized atherosclerotic involvement in this young population. Double-vessel disease was identified in 23.5% of cases, while triple-vessel disease was observed in only 10.6% of the cohort, reflecting that extensive multi-vessel involvement was relatively uncommon in these younger individuals.

Table 2. Pattern of Coronary Artery Disease

Vessel Involvement	Category	(n %)
Number of Vessels	Single-vessel disease	118 (65.9)

	Double-vessel disease	42 (23.5)
	Triple-vessel disease	19 (10.6)

Diabetes ranged from 32.8% to 35.3%, hypertension from 37.5% to 41.2%, and dyslipidemia from 32.8% to 37.5% across the groups. Smoking was more common in STEMI patients (52.9%) than in NSTEMI (41.4%) or unstable angina (41.2%). Obesity remained around one-third in all categories, and family history of coronary artery disease varied only slightly between 27.9% and 35.3%.

Table 3. Cardio metabolic Risk Factors by ACS Presentation

Risk Factor	STEMI (n=104)	NSTEMI (n=58)	Unstable Angina (n=17)
Diabetes Mellitus	36 (34.6)	19 (32.8)	6 (35.3)
Hypertension	39 (37.5)	23 (39.7)	7 (41.2)
Dyslipidemia	39 (37.5)	19 (32.8)	6 (35.3)
Smoking	55 (52.9)	24 (41.4)	7 (41.2)
Obesity	35 (33.7)	19 (32.8)	5 (29.4)
Family history of CAD	29 (27.9)	17 (29.3)	6 (35.3)

Diabetes showed a p-value of 0.96, hypertension 0.89, dyslipidemia 0.84, smoking 0.28, obesity 0.92, and family history of coronary artery disease 0.78. This pattern indicates that risk factors did not significantly differ between patients with STEMI, NSTEMI, and unstable angina, suggesting that the type of ACS in young adults is not strongly influenced by individual risk variables.

Table 4 Association of Cardio metabolic Risk Factors with ACS Type (N = 179)

Risk Factor	STEMI n (%)	NSTEMI n (%)	UA n (%)	p-value

Diabetes Mellitus	36 (34.6)	19 (32.8)	6 (35.3)	0.96
Hypertension	39 (37.5)	23 (39.7)	7 (41.2)	0.89
Dyslipidemia	39 (37.5)	19 (32.8)	6 (35.3)	0.84
Smoking	55 (52.9)	24 (41.4)	7 (41.2)	0.28
Obesity	35 (33.7)	19 (32.8)	5 (29.4)	0.92
Family history of CAD	29 (27.9)	17 (29.3)	6 (35.3)	0.78

DISCUSSION

This study evaluated the pattern of coronary artery disease involvement among young adults presenting with acute coronary syndrome, providing important insights into the evolving cardiovascular risk landscape in Pakistan. The mean age of 37.6 years highlights the concerning shift of CAD into a much younger demographic, reflecting trends seen across South Asian populations where premature atherosclerosis is increasingly documented. The predominance of male patients aligns with global reports indicating that young men carry a disproportionately higher burden of early ACS compared with women, likely attributable to smoking habits, lipid abnormalities, and delayed health-seeking behavior observed in this group. Risk factor distribution in this study paints a distinctly metabolic and lifestyle-driven profile. Smoking was present in nearly half the cohort, while one-third were obese and over one-third had dyslipidemia. These findings reinforce the hypothesis that modifiable metabolic risk factors are accelerating early atherosclerosis¹². A similar pattern has been consistently demonstrated in previous research, where central obesity, dyslipidemia, and tobacco exposure were strongly linked to premature coronary events. The relatively high prevalence of diabetes and hypertension in this young age group also suggests earlier onset of cardio

metabolic disease, echoing previous research that observed clustering of metabolic syndrome among South Asian populations at younger ages compared with Western cohorts¹³. The clinical presentation was dominated by STEMI, accounting for 58.1% of cases. This reflects the aggressive nature of coronary events in young adults, where plaque rupture and thrombotic occlusion are more common than stable plaque buildup. Previous research has reported similar trends, noting that STEMI tends to present earlier in life in regions with high smoking rates and poor lipid control¹⁴. The strong representation of NSTEMI and unstable angina in the remaining cohort indicates heterogeneity in plaque behavior but still underlines the vulnerability of young coronary arteries to rapid destabilization. The distribution of risk factors across ACS categories demonstrated that smoking and dyslipidemia were slightly more common among STEMI patients than among NSTEMI and unstable angina groups. Although differences were modest, this trend supports previous research suggesting that smoking accelerates thrombotic events and makes plaque rupture more likely, particularly in the LAD territory¹⁵. The relatively consistent distribution of diabetes and hypertension across ACS types suggests that these factors act as background drivers of atherosclerosis rather than acute triggers of plaque destabilization. Overall, these findings underline the urgent need for earlier risk assessment, targeted lifestyle modification, and aggressive control of modifiable risk factors in young adults¹⁶. The high rates of smoking, dyslipidemia, and obesity represent clear intervention points. Moreover, the predominance of single-vessel LAD disease highlights a critical window for early therapeutic planning, including timely revascularization and long-term secondary prevention¹⁷⁻¹⁹. The results of this study align with previous research indicating that early CAD in South Asian populations is not only increasingly common but also strongly preventable if identified at the right stage.

Limitations

This study had several limitations that should be considered when interpreting the findings. First, it was conducted at a single tertiary cardiac center, which may limit the generalizability of the results to broader community settings. Patients presenting to specialized institutes often differ from those seen in rural or peripheral facilities, potentially introducing referral bias. Second, the cross-sectional design restricted the ability to assess long-term outcomes, disease progression, or recurrence of coronary events, making it impossible to infer causality between risk factors and angiographic findings. Third, although the sample size was adequate for descriptive analysis, some subgroup comparisons particularly across ACS types may still have been underpowered. Lastly, because all angiographic

procedures were performed by different interventional cardiologists, minor variations in interpretation could not be fully excluded despite standardized reporting criteria.

CONCLUSION

It is concluded that acute coronary syndrome is emerging as a significant cardiovascular burden among young adults, with STEMI being the most common presentation and the left anterior descending artery most frequently involved. The predominance of single-vessel disease indicates that early atherosclerotic changes in this age group tend to be focal rather than diffuse. The study further highlights that modifiable risk factors particularly smoking, dyslipidemia, obesity, and diabetes play a major role in driving premature coronary artery disease

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