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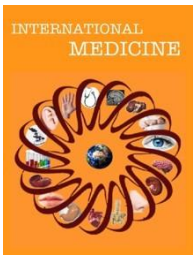

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Original Research

Clinical Profile and Risk Factors of Acute Coronary Syndrome in Young Adults

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Abstract

Background: Acute coronary syndrome (ACS) has traditionally been regarded as a disease of older adults, but its incidence among young adults is rising globally, particularly in low- and middle-income countries. The risk factor profile and clinical presentation in this population differ in important ways from older patients, with implications for prevention and early detection. ***Objective:*** To describe the clinical profile, ACS subtype distribution, angiographic findings, and prevalence of modifiable and non-modifiable risk factors among young adults presenting with ACS, and to examine the association between individual risk factors and angiographic disease severity. ***Methods:*** This hospital-based cross-sectional observational study included 104 consecutive patients aged 20–45 years admitted with ACS to a tertiary care cardiology department. Clinical presentation, electrocardiographic findings, coronary angiographic profile, and risk factor history were recorded using a structured proforma. The association between individual risk factors and angiographic disease severity (multivessel versus single-vessel/normal coronaries) was assessed using the chi-square test. ***Results:*** The mean age was 36.4 ± 4.8 years with a strong male predominance (85.6%). ST-elevation myocardial infarction was the most common presentation (71.2%), and single-vessel disease was the predominant angiographic pattern (50.0%). Smoking (58.7%) was the most prevalent risk factor, followed by dyslipidemia (51.9%), family history of premature coronary artery disease (37.5%), and hypertension (31.7%); 66.3% of patients had two or more modifiable risk factors. Diabetes mellitus ($p = 0.004$), smoking ($p = 0.018$), dyslipidemia ($p = 0.029$), and risk factor clustering ($p < 0.001$) were significantly associated with multivessel disease. ***Conclusion:*** ACS in young adults is characterized by a high prevalence of modifiable risk factors, predominantly smoking and dyslipidemia, frequently occurring in clusters that are associated with more severe angiographic disease. These findings underscore the importance of early risk factor screening and aggressive lifestyle modification in this demographic.

Keywords: *Acute coronary syndrome; young adults; myocardial infarction; risk factors; coronary angiography; premature coronary artery disease.*

Introduction

Acute coronary syndrome (ACS), encompassing unstable angina, non-ST-elevation myocardial infarction (NSTEMI), and ST-elevation myocardial infarction (STEMI), has historically been considered a disease predominantly affecting middle-aged and elderly individuals.(1) However, an increasing body of evidence over the past two decades indicates a notable demographic shift, with a rising proportion of ACS cases now occurring in adults aged 45 years or younger, a phenomenon observed across both high-income and low- and middle-income countries.(2) This trend is of particular concern given the substantial long-term morbidity, productivity loss, and psychosocial impact associated with premature cardiovascular disease, which by convention is defined as coronary artery disease occurring before the age of 55 years in men and 65 years in women.(3)

The landmark INTERHEART study, a large international case-control study spanning 52 countries, established that nine readily measurable and largely modifiable risk factors—smoking, dyslipidemia, hypertension, diabetes, abdominal obesity, psychosocial stress, diet, physical inactivity, and alcohol consumption—collectively account for over 90% of the population-attributable risk for a first myocardial infarction, with this effect proving particularly pronounced in younger patients, where the population-attributable risk approached 93% in men and 96% in women.(4) This finding has been broadly reproduced in regional and national cohorts. Among young adults with coronary artery disease in South Africa, smoking (82%), dyslipidemia (79%), and dysglycemia (75%) were the most prevalent risk factors, with nearly half of subjects meeting criteria for metabolic syndrome.(5) Similarly, an Indian tertiary care study of patients with a mean age of 35 years found smoking (55.7%) and dyslipidemia (52.5%) to be the leading risk factors, with multiple risk factors present in nearly 69% of patients and STEMI accounting for over 80% of presentations.(6)

Although atherosclerotic plaque rupture remains the predominant underlying mechanism of ACS in young adults, as in older populations, the relative contribution of individual risk factors and the underlying pathophysiology can differ meaningfully between age groups. Comparative cohort data indicate that young ACS patients, relative to their older counterparts, tend to have a higher prevalence of smoking and family history of premature coronary artery disease, while traditional metabolic risk factors such as diabetes, hypertension, and longstanding dyslipidemia are comparatively less prevalent, though still clinically significant.(7) Beyond classical atherosclerotic risk factors, young patients with ACS are also more likely than older patients to present with non-atherosclerotic or less common aetiologies, including spontaneous coronary artery dissection, coronary vasospasm associated with recreational stimulant use such as cocaine or cannabis, myocardial infarction with non-obstructive coronary arteries (MINOCA), thrombophilic states, and underlying inflammatory or autoimmune conditions.(8) Recognition of these alternative mechanisms is clinically important, as they carry distinct management and secondary prevention implications compared with conventional atherosclerotic disease.

The clinical and angiographic severity of ACS in young adults also appears to be influenced by the clustering of risk factors rather than any single factor in isolation. Studies have consistently demonstrated that the simultaneous presence of two or more modifiable risk factors—particularly the combination of dyslipidemia, obesity, and smoking—confers a substantially higher risk of multivessel disease and adverse cardiovascular events compared with the presence of an isolated risk factor.(9) This risk factor clustering pattern, alongside the typically high thrombotic burden observed on angiography in younger patients, may partly explain why some young ACS cohorts paradoxically demonstrate more extensive disease at presentation despite their younger age and ostensibly more favourable baseline vascular health.(10)

Given the rising incidence, distinct risk factor profile, and diagnostic challenges posed by atypical presentations and a low index of clinical suspicion in this age group, there remains a continued need for setting-specific data characterizing the clinical profile and risk factor burden of ACS in young adults. Such data are essential for informing targeted screening strategies and prevention programs tailored to this demographic. The present study was therefore undertaken to describe the clinical presentation, ACS subtype distribution, angiographic findings, and prevalence of modifiable and non-modifiable risk factors among young adults presenting with ACS, and to examine the relationship between individual risk factors and angiographic disease severity.

Materials and Methods

Study Design and Setting

This hospital-based cross-sectional observational study was conducted in the Department of Cardiology in collaboration with the Department of General Medicine at a tertiary care teaching hospital over a period of eighteen months. Institutional Ethics Committee approval was obtained prior to commencement of the study, and the study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrolment.

Study Population

A total of 104 consecutive patients aged 20 to 45 years admitted with a diagnosis of ACS were enrolled using consecutive sampling. Inclusion criteria comprised patients within the specified age range presenting with clinical features suggestive of ACS, supported by electrocardiographic changes and/or elevated cardiac biomarkers (troponin-I), and subsequently classified as STEMI, NSTEMI, or unstable angina according to standard diagnostic criteria. Exclusion criteria included patients with a prior documented history of coronary artery disease or revascularization, known structural heart disease unrelated to coronary atherosclerosis, active malignancy, and patients who declined coronary angiography or in whom angiography could not be performed due to hemodynamic instability or other contraindication.

Data Collection

A structured proforma was used to systematically record demographic details, presenting symptoms, time from symptom onset to hospital presentation, electrocardiographic findings, and relevant past medical and family history for all enrolled patients. Risk factor assessment included current or former tobacco/smoking use, dyslipidemia (fasting lipid profile obtained within 24 hours of admission, or known history of dyslipidemia on treatment), hypertension (history of physician-diagnosed hypertension or blood pressure ≥140/90 mmHg on at least two occasions prior to admission), diabetes mellitus (known history or fasting plasma glucose ≥126 mg/dL or HbA1c ≥6.5% at admission), obesity (body mass index ≥27.5 kg/m² using Asian-specific cut-offs), family history of premature coronary artery disease in a first-degree relative, self-reported chronic psychosocial stress, sedentary lifestyle, and history of recreational substance use. All patients underwent coronary angiography during the index admission, with findings classified as single-vessel, double-vessel, triple-vessel, or non-obstructive/normal coronary disease by the attending interventional cardiologist.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. The association between individual risk factors and angiographic disease severity, dichotomized as multivessel disease (double- or triple-vessel) versus single-vessel disease or normal/non-obstructive coronaries, was assessed using the chi-square test. A two-tailed p-value of less than 0.05 was considered statistically significant. All statistical analyses were performed using standard statistical software.

Results

A total of 104 patients aged 20 to 45 years admitted with ACS were enrolled during the study period. Demographic characteristics and clinical presentation are summarized in Table 1.

Table 1. Demographic characteristics and clinical presentation of the study population

Variable	Value
Total patients (n)	104
Mean age (years)	36.4 ± 4.8 (range 21-45)
Sex – Male, n (%)	89 (85.6)
Sex – Female, n (%)	15 (14.4)
Urban residence, n (%)	71 (68.3)
Chest pain, n (%)	96 (92.3)
Diaphoresis, n (%)	58 (55.8)
Dyspnea, n (%)	41 (39.4)
Door-to-presentation time >6 hours, n (%)	47 (45.2)

Values are expressed as number (percentage) or mean ± standard deviation.

The study population showed a marked male predominance, with chest pain as the most common presenting symptom, followed by diaphoresis and dyspnea. Nearly half of the patients presented more than six hours after symptom onset, reflecting a delay in seeking medical attention that has been similarly observed in other young ACS cohorts.

The distribution of ACS subtypes, electrocardiographic findings, and angiographic profile is presented in Table 2.

Table 2. ACS subtype distribution and angiographic findings

Diagnosis / Finding	n	%
STEMI	74	71.2
NSTEMI	21	20.2
Unstable angina	9	8.6
Anterior wall MI (among STEMI), n (%)	44	59.5
Single-vessel disease (angiography)	52	50.0
Double-vessel disease	27	26.0
Triple-vessel disease	13	12.5
Normal / non-obstructive coronaries (MINOCA)	12	11.5
LVEF <50% at admission	38	36.5

LVEF = left ventricular ejection fraction; MINOCA = myocardial infarction with non-obstructive coronary arteries.

STEMI was the predominant ACS subtype, with anterior wall involvement being the most frequent electrocardiographic pattern among STEMI cases. Single-vessel disease was the most common angiographic finding, although a substantial minority of patients had multivessel involvement. Notably, 11.5% of patients had normal or non-obstructive coronary arteries on angiography, highlighting the relevance of non-atherosclerotic mechanisms in this age group. Over one-third of patients had reduced left ventricular ejection fraction at admission.

The prevalence of individual modifiable and non-modifiable risk factors among the study population is shown in Table 3.

Table 3. Prevalence of risk factors among young adults with ACS

Risk Factor	n	%
Current tobacco/smoking use	61	58.7
Dyslipidemia	54	51.9
Family history of premature CAD	39	37.5
Hypertension	33	31.7
Obesity (BMI ≥27.5 kg/m²)	31	29.8
Diabetes mellitus	28	26.9
Sedentary lifestyle	46	44.2
Psychosocial stress (self-reported)	35	33.7
Recreational substance use (cannabis/cocaine/amphetamine)	8	7.7
≥2 modifiable risk factors present	69	66.3

Percentages do not sum to 100% as risk factors are not mutually exclusive.

Smoking was the single most prevalent risk factor, present in well over half of the cohort, followed closely by dyslipidemia. Family history of premature coronary artery disease and hypertension were also common. Recreational substance use, while present in only a small minority of patients, was disproportionately represented among the youngest patients in the cohort and among those with non-obstructive coronary disease. Two-thirds of patients had two or more modifiable risk factors present simultaneously, indicating substantial risk factor clustering within this population.

The association between individual risk factors and angiographic disease severity is summarized in Table 4.

Table 4. Association between risk factors and angiographic disease severity

Risk Factor	Multivessel Disease n (%)	Single-vessel/Normal n (%)	p-value
Smoking	39 (63.9)	22 (36.1)	0.018
Dyslipidemia	33 (61.1)	21 (38.9)	0.029
Diabetes mellitus	21 (75.0)	7 (25.0)	0.004
Family history of CAD	22 (56.4)	17 (43.6)	0.041
Hypertension	17 (51.5)	16 (48.5)	0.39
≥2 risk factors clustering	51 (73.9)	18 (26.1)	<0.001

Multivessel disease defined as double- or triple-vessel involvement on coronary angiography. p-values calculated using chi-square test.
Smoking, dyslipidemia, diabetes mellitus, family history of premature coronary artery disease, and the clustering of two or more risk factors were each significantly associated with multivessel angiographic disease. Diabetes mellitus showed the strongest individual association with disease severity, and risk factor clustering showed the strongest overall association, with nearly three-quarters of patients with multivessel disease having two or more concurrent modifiable risk factors. Hypertension alone was not significantly associated with disease severity in this cohort.

Discussion

This study demonstrates that ACS in young adults is characterized by a strong male predominance, a predominantly STEMI presentation, and a high burden of modifiable cardiovascular risk factors, with smoking and dyslipidemia emerging as the leading individual risk factors. These findings are broadly consistent with the existing literature on premature coronary artery disease. Our observed smoking prevalence of 58.7% closely parallels the 55.7% reported in an Indian tertiary care cohort of similar age and presentation profile, and is comparable to the 59.5% prevalence of tobacco use reported among young ACS patients at a Malaysian tertiary centre.(6,11) Likewise, our finding that dyslipidemia was present in just over half of patients aligns with the 51.9% to 79% range reported across several young-adult ACS cohorts, reinforcing dyslipidemia as a consistently dominant modifiable risk factor in this age group across diverse populations.(5,6)

The predominance of STEMI as the presenting ACS subtype in our cohort (71.2%) is consistent with the high thrombotic burden characteristic of young-patient coronary events, and mirrors findings from comparative cohort studies showing that young ACS patients tend to present with more acute, thrombotically driven events rather than the more gradual, stable plaque progression typically observed in older patients.(7,10) This pattern likely reflects a combination of acute plaque rupture superimposed on a relatively less calcified, more lipid-laden plaque substrate in younger arteries, producing a more abrupt and complete vessel occlusion when rupture occurs.(8) Our finding that 11.5% of patients had normal or non-obstructive coronary arteries on angiography further underscores the relevance of non-atherosclerotic mechanisms—including coronary vasospasm, spontaneous coronary artery dissection, and thrombophilic states—in this age group, a recognized and increasingly emphasized phenomenon in recent reviews of myocardial infarction in young adults.(8)

Our finding that risk factor clustering was strongly associated with multivessel disease ($p < 0.001$) is consistent with the results of a comparative cohort study, which similarly found that the clustering of two or more key modifiable risk factors—dyslipidemia, obesity, and smoking—conferred a three- to five-fold higher risk of major adverse cardiovascular events in young adults.(9) This supports the broader principle, first articulated at scale in the INTERHEART study, that cardiovascular risk in young individuals is rarely attributable to a single dominant factor but rather emerges from the cumulative and often synergistic effect of multiple coexisting risk factors, a relationship that appears particularly pronounced in younger patients given their otherwise lower baseline vascular risk.(4)

The significant association between diabetes mellitus and multivessel disease observed in our cohort ($p = 0.004$) is also consistent with prior reports demonstrating that, although diabetes is less prevalent in young ACS patients than in their older counterparts, its presence is disproportionately associated with more severe and diffuse coronary involvement when it does occur.(7) This likely reflects the accelerated and diffuse pattern of atherosclerosis associated with dysglycemia, which appears to override the otherwise protective effect of younger age on coronary anatomy. In contrast, the lack of significant association between hypertension and disease severity in our cohort may reflect both the comparatively lower prevalence and shorter duration of hypertension in this age group, since the vascular damage associated with hypertension is generally considered to be more dose- and duration-dependent than the more immediate prothrombotic and dyslipidemic effects of smoking and abnormal lipids.

This study has several limitations. The cross-sectional, single-centre design limits causal inference and may not be fully generalizable to other geographic or socioeconomic settings, given known regional variation in risk factor prevalence. Detailed biochemical screening for emerging risk factors such as lipoprotein(a), homocysteine, or thrombophilia markers was not performed, and recreational substance use was assessed by self-report, which may underestimate true prevalence due to social desirability bias. Additionally, the absence of long-term follow-up data precludes assessment of how these risk factors and angiographic findings translate into longer-term outcomes such as recurrent events or mortality. Future prospective, multicentre studies incorporating extended biochemical risk factor panels and longitudinal outcome data would help to further refine risk stratification strategies for this population.

Conclusion

ACS in young adults is characterized by a strong male predominance, a predominantly STEMI presentation with high thrombotic burden, and a substantial prevalence of modifiable cardiovascular risk factors—particularly smoking, dyslipidemia, and their frequent clustering—which are significantly associated with more extensive angiographic disease. A meaningful minority of patients present with non-obstructive coronary disease, highlighting the need for awareness of non-atherosclerotic mechanisms in this age group. These findings reinforce the importance of early, targeted risk factor screening, public health messaging around tobacco cessation and lipid control, and a low threshold for cardiovascular evaluation in young adults presenting with chest pain, particularly where multiple risk factors coexist.

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