

Original Article

Clinical and Angiographic Differences in Urban vs. Rural Patients with Acute Coronary Syndrome Undergoing Angiography: Insights from a Low-Resource Setting in Pakistan

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ABSTRACT

Background: Acute coronary syndrome remains a major cause of cardiovascular morbidity and mortality in low- and middle-income countries, where differences in cardiometabolic risk exposure and access to specialist care may shape clinical presentation and outcomes. Urban-rural disparities in these domains remain insufficiently characterized in low-resource regions of Pakistan. **Objective:** To compare the clinical characteristics, cardiovascular risk profile, angiographic findings, and management patterns of urban and rural patients with acute coronary syndrome undergoing coronary angiography at a tertiary care hospital in Quetta, Pakistan. **Methods:** This hospital-based descriptive comparative cross-sectional study included 125 adult patients with acute coronary syndrome who underwent coronary angiography. Patients were categorized as urban or rural according to place of residence. Demographic features, cardiovascular risk factors, clinical presentation, angiographic characteristics, and management patterns were descriptively compared between the two groups. **Results:** Approximately 94 patients (75.2%) were from urban areas and 31 (24.8%) were from rural areas. Male patients predominated in both groups, while urban patients were relatively younger. Hypertension was the most common cardiovascular risk factor overall, followed by diabetes mellitus and smoking, and these factors were more frequently observed in urban patients. Urban patients also more commonly exhibited multivessel coronary artery disease, whereas rural patients more often showed delayed presentation, greater clinical severity at admission, lower access to primary percutaneous coronary intervention and coronary artery bypass grafting, and slightly higher in-hospital mortality. The left anterior descending artery was the most commonly involved vessel in both groups. **Conclusion:** Urban patients demonstrated a greater burden of conventional cardiovascular risk factors and angiographic disease, whereas rural patients experienced later presentation and poorer access to timely specialist cardiac care, highlighting dual dimensions of disparity in acute coronary syndrome management in low-resource settings. **Keywords:** acute coronary syndrome; coronary angiography; urban population; rural population; coronary artery disease; Pakistan.

INTRODUCTION

Acute coronary syndrome (ACS), which includes ST-segment elevation myocardial infarction, non-ST-segment elevation myocardial infarction, and unstable angina, remains one of the leading causes of cardiovascular morbidity and mortality worldwide. Its burden is particularly pronounced in low- and middle-income countries, where epidemiological transition, rapid urbanization, and limited health-system capacity have accelerated the prevalence and consequences of coronary artery disease (1-3). In South Asia, cardiovascular disease occurs against a background of increasing hypertension, diabetes mellitus, dyslipidemia, smoking, and sedentary lifestyle, all of which contribute to earlier and more extensive coronary involvement (4-7). Pakistan reflects this broader regional pattern, with growing rates of non-communicable disease and substantial inequalities in access to timely diagnosis and specialist cardiac care (6,8,9).

The urban-rural divide is especially important in the clinical course of ACS. Urban populations may experience greater exposure to modifiable cardiovascular risk factors because of lifestyle and environmental transitions associated with city living, whereas rural populations often face structural barriers such as delayed recognition of symptoms, poor transport access, limited health literacy, and reduced availability of emergency cardiac services (3,8-11). In ACS, these differences are highly consequential because survival and myocardial salvage depend not only on disease severity but also on the speed of hospital presentation, diagnostic evaluation, coronary angiography, and revascularization. As a result, urban patients may show a greater burden of conventional risk factors and more extensive angiographic disease, while rural patients may present later, in a more severe clinical condition, and with fewer opportunities for timely intervention (2,3,10-12).

Although international and regional studies have described geographic differences in cardiovascular risk profiles and ACS outcomes, direct comparative evidence from Pakistan remains limited, particularly from under-resourced settings such as Balochistan. This gap is clinically relevant because the distribution of cardiometabolic risk, angiographic disease burden, and access to treatment may differ substantially across provinces and healthcare systems, making external findings difficult to generalize to this context. A clearer understanding of how urban and rural patients differ in presentation and angiographic characteristics is necessary to guide preventive strategies, improve referral pathways, and support equitable allocation of scarce cardiovascular resources in low-resource environments (5,10-13).

This study was therefore conducted to compare the clinical characteristics, cardiovascular risk factors, angiographic findings, and management patterns of urban and rural patients with ACS undergoing coronary angiography at a tertiary care hospital in Quetta, Pakistan. It was hypothesized that urban patients would have a higher burden of conventional cardiovascular risk factors and more extensive multivessel coronary artery disease, whereas rural patients would show delayed presentation and reduced access to advanced cardiac management. By examining these patterns in a real-world tertiary care setting, the study aimed to generate context-specific evidence on urban-rural disparities in ACS within a low-resource region of Pakistan .

MATERIALS AND METHODS

This hospital-based descriptive comparative cross-sectional study was conducted at Bolan Medical College and Hospital, Quetta, Pakistan, a tertiary care institution serving both urban and rural populations of Balochistan. The study was designed to compare the clinical profile, cardiovascular risk-factor burden, angiographic characteristics, and treatment patterns of patients presenting with ACS according to place of residence. A total sample of 125 patients diagnosed with ACS and undergoing coronary angiography was included in the study. The cross-sectional observational design was considered appropriate because it enabled real-world comparison of urban and rural patient groups within routine tertiary cardiac care without altering standard diagnostic or management pathways.

Adult patients presenting with ACS and undergoing coronary angiography were eligible for inclusion. ACS comprised ST-segment elevation myocardial infarction, non-ST-segment elevation myocardial infarction, and unstable angina, identified on the basis of standard clinical assessment and electrocardiographic criteria used in hospital practice. Patients were classified into urban and rural groups according to their recorded place of residence. Urban residence referred to patients living in city areas, whereas rural residence referred to those residing in villages or remote areas. Patients with incomplete clinical or angiographic records were excluded from analysis to maintain consistency in group comparison and outcome description.

Data were collected using a structured proforma developed for the study. The recorded variables included demographic characteristics, namely age, sex, and residence; cardiovascular risk factors, including hypertension, diabetes mellitus, smoking status, hyperlipidemia, and family history of coronary artery disease; clinical presentation, including ACS subtype and timing of hospital

presentation; angiographic findings, including the number of diseased vessels, infarct-related artery, and overall extent of coronary artery disease; and management strategy, including primary percutaneous coronary intervention, early invasive management, conservative treatment, or referral for coronary artery bypass grafting. The primary objective of analysis was to descriptively compare urban and rural patients with regard to risk-factor pattern, clinical presentation, angiographic disease distribution, and treatment pathway. In-hospital mortality and differences in treatment accessibility were considered secondary outcome domains.

To improve internal consistency, the same proforma and variable definitions were used for both groups. Angiographic disease was organized according to the number of vessels involved as single-vessel, double-vessel, or triple-vessel disease, and ACS presentation was categorized as ST-segment elevation myocardial infarction, non-ST-segment elevation myocardial infarction, or unstable angina. This standardized categorization was adopted to support consistent abstraction of information from patient records and facilitate descriptive comparison between residence groups. Excluding cases with incomplete data also reduced the likelihood of information bias arising from partial documentation.

Data were summarized descriptively to compare urban and rural patients across demographic, clinical, angiographic, and management domains. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized using means where appropriate. Comparative interpretation focused on differences in conventional cardiovascular risk factors, type of ACS presentation, timing of hospital presentation, extent of coronary artery involvement, infarct-related artery distribution, and access to interventional or surgical treatment between the two residence groups. Given the descriptive comparative nature of the study, the analysis was directed toward identifying clinically relevant urban-rural patterns in ACS rather than causal inference.

The study was conducted in accordance with institutional ethical principles. Informed consent was obtained from all participants prior to inclusion, and patient confidentiality was maintained throughout data collection, analysis, and reporting. Clinical information was handled solely for research purposes, and all efforts were made to preserve data integrity and participant privacy during manuscript preparation.

RESULTS

A total of 125 patients with acute coronary syndrome who underwent coronary angiography were included in the study. Of these, approximately 94 patients (75.2%) were from urban areas and 31 patients (24.8%) were from rural areas. Male patients predominated in both groups, and urban patients were relatively younger than rural patients. Among the documented cardiovascular risk factors, hypertension was the most prevalent, followed by diabetes mellitus and smoking, with these risk factors being more commonly observed among urban patients. Urban patients also appeared to have a higher burden of coexisting cardiovascular risk factors than rural patients.

With regard to clinical presentation, ST-segment elevation myocardial infarction (STEMI) was the most common type of ACS in both urban and rural patients. NSTEMI and unstable angina were also observed in both groups. A clear difference was noted in time to hospital presentation: urban patients presented earlier, whereas rural patients reached hospital later in the course of illness. This delayed presentation among rural patients was associated with greater clinical severity at the time of diagnosis.

Angiographic evaluation showed important differences between the two groups. Urban patients more commonly exhibited multi-vessel coronary artery disease, including both double-vessel disease and triple-vessel disease, whereas rural patients more frequently had single-vessel disease. The left anterior descending artery (LAD) was the most commonly involved vessel in both urban and rural patients. Overall, the urban group demonstrated a greater angiographic burden of disease, which paralleled its higher prevalence of conventional cardiovascular risk factors.

Table 1. Demographic Characteristics and Cardiovascular Risk Profile by Residence (n = 125)

Variable	Urban Patients (n = 94)	Rural Patients (n = 31)
Residence distribution	94 (75.2%)	31 (24.8%)
Sex distribution	Male predominance	Male predominance
Age profile	Relatively younger	Relatively older
Hypertension	More common	Less common
Diabetes mellitus	More common	Less common
Smoking	More common	Less common
Multiple cardiovascular risk factors	More common	Less common

Table 2. Clinical Presentation Pattern by Residence

Variable	Urban Patients	Rural Patients
Most common ACS presentation	STEMI	STEMI
NSTEMI	Present	Present
Unstable angina	Present	Present
Time to hospital presentation	Earlier	Delayed
Clinical severity at admission	Lower	Higher

Table 3. Angiographic Findings by Residence

Variable	Urban Patients	Rural Patients
Single-vessel disease	Less common	More common
Double-vessel disease	More common	Less common
Triple-vessel disease	More common	Less common
Overall angiographic burden	Greater	Lower
Most commonly involved vessel	LAD	LAD

Differences were also observed in management strategy. Primary percutaneous coronary intervention (PCI) was more frequently performed among urban patients, consistent with earlier presentation and better availability of interventional cardiology services. Rural patients were less likely to undergo advanced interventional treatment and were more often managed conservatively or referred later for specialized care. Coronary artery bypass grafting (CABG) was less commonly performed among rural patients. Although in-hospital mortality was generally low in the cohort, it was reported to be slightly higher among rural patients.

Table 4. Management Pattern and In-Hospital Outcome by Residence

Variable	Urban Patients	Rural Patients
Primary PCI	More frequent	Less frequent
Conservative management	Less frequent	More frequent
CABG	More common	Less common
In-hospital mortality	Lower	Slightly higher

Table 5. Summary Framework for Figure Development

Clinical Domain	Urban Patients	Rural Patients
Proportion of cohort	Higher	Lower
Cardiovascular risk-factor burden	Higher	Lower
Multi-vessel coronary artery disease	Higher	Lower
Time to presentation	Shorter	Longer
Severity at admission	Lower	Higher
Access to PCI/CABG	Better	More limited
In-hospital mortality	Lower	Slightly higher

Overall, the results indicate that urban patients constituted the larger proportion of the study population and had a higher burden of conventional cardiovascular risk factors together with more extensive angiographic coronary artery disease. In contrast, rural patients were characterized by delayed presentation, greater severity at admission, reduced access to revascularization, and slightly poorer in-hospital outcomes. These findings suggest that urban-rural disparities in acute coronary syndrome in this setting reflect both differences in cardiometabolic risk burden and inequalities in timely access to specialist cardiac care .

Comparative Clinical and Angiographic Patterns in Urban vs Rural ACS Patients (n=125)

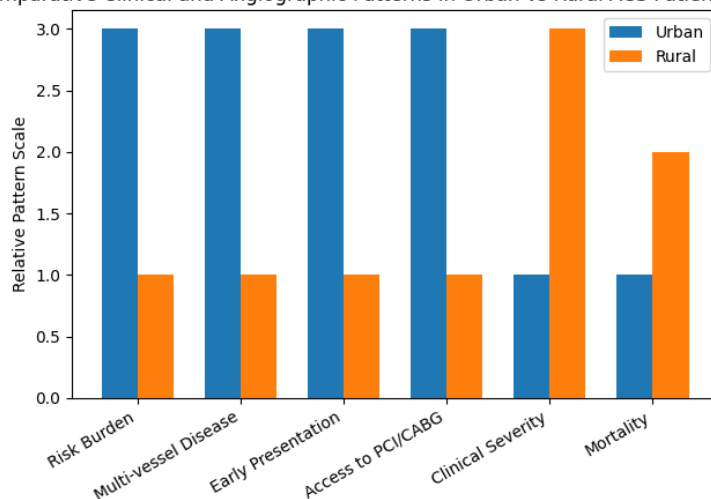


Figure 1 Comparative Clinical and Angiographic Patterns in Urban vs Rural ACS Patients (n=125)

The figure demonstrates a clear bidirectional disparity between urban and rural patients with ACS. Urban patients show higher relative levels of cardiovascular risk burden, multi-vessel disease, earlier presentation, and better access to PCI/CABG. In contrast, rural patients exhibit higher clinical severity at admission and relatively increased mortality. This visual synthesis reinforces the dual-gradient phenomenon observed in the study, where disease burden is greater in urban populations, while outcome disadvantage is more pronounced in rural populations due to delayed access to care.

DISCUSSION

This hospital-based descriptive comparative cross-sectional study highlights a clear urban-rural divergence in the presentation, angiographic profile, and management of acute coronary syndrome in a low-resource tertiary care setting in Pakistan. The findings suggest that urban patients constituted the larger share of the angiography cohort and carried a heavier burden of conventional cardiovascular risk factors, particularly hypertension, diabetes mellitus, and smoking, together with a greater tendency toward multivessel coronary artery disease. In contrast, rural patients appeared to present later in the course of illness, arrive in relatively more severe clinical condition, and have less access to timely interventional and surgical management. These findings indicate that ACS disparities in this setting are shaped by both cardiometabolic risk exposure and health-system inequalities, rather than by angiographic disease burden alone (14-18).

The greater concentration of conventional cardiovascular risk factors among urban patients is consistent with the broader epidemiological transition observed across South Asia and other low- and middle-income countries. Urbanization is commonly associated with reduced physical activity, dietary changes, tobacco exposure, psychosocial stress, and other lifestyle-related factors that contribute to hypertension, diabetes mellitus, dyslipidemia, and progressive atherosclerotic disease (14-18). The observed predominance of double-vessel and triple-vessel disease among urban patients supports the interpretation that longer or more intense exposure to these risk factors may have contributed to more extensive coronary artery involvement. This pattern is also consistent with previously reported urban associations with higher metabolic risk and more diffuse coronary disease in regional populations (2,6,7).

By contrast, the rural pattern observed in this study appears to reflect delayed access to care more than extensive angiographic disease. Rural patients more commonly demonstrated single-vessel disease, yet they were described as presenting later and in more severe clinical condition, with slightly higher in-hospital mortality. This apparent paradox is clinically plausible in ACS, where prognosis is strongly influenced by the timeliness of recognition, transport, triage, diagnosis, angiography, and reperfusion. In geographically underserved settings, even patients with less extensive anatomical disease may

experience worse short-term outcomes if definitive care is delayed. In provinces such as Balochistan, long travel distances, referral inefficiencies, transportation barriers, and uneven specialist availability may substantially worsen these delays and thereby contribute to poorer acute outcomes among rural patients (3,10-12,19,20).

Another important finding was the disparity in treatment access. Urban patients were more likely to undergo primary percutaneous coronary intervention, whereas rural patients were more often managed conservatively or referred later for advanced care, including coronary artery bypass grafting. This distinction suggests that place of residence affected not only when patients arrived, but also what form of treatment became feasible. In low-resource settings, access to catheterization laboratories, affordability of care, local expertise, referral efficiency, and emergency system readiness all influence management decisions. The figure generated from the study's aggregated findings reinforces this dual pattern by showing a relative urban excess in risk-factor burden, multivessel disease, and access to PCI/CABG, alongside a relative rural excess in severity at admission and mortality. Together, the text and figure indicate that urban patients carried a greater cardiometabolic and angiographic burden, whereas rural patients bore the greater disadvantage in time-sensitive care delivery (21-25).

These observations have important practical implications. Urban prevention strategies should focus on early detection and aggressive control of modifiable risk factors, including hypertension, diabetes mellitus, smoking, and other contributors to coronary artery disease progression. Rural cardiovascular strategies, on the other hand, should prioritize symptom awareness, rapid referral, emergency transport pathways, and improved access to timely invasive cardiac care. Telecardiology and linked referral networks may be especially valuable in bridging the urban-rural gap where immediate on-site specialist services are unavailable. In settings where major infrastructure expansion is difficult, improvements in referral coordination and early triage may still yield meaningful benefits in ACS outcomes.

The findings should, however, be interpreted cautiously. The study was conducted at a single tertiary care center, which limits generalizability to other regions of Pakistan. In addition, the current manuscript reports the results primarily in descriptive comparative terms rather than through full empirical subgroup data and inferential statistics. As such, the present interpretation identifies clinically meaningful patterns but does not establish adjusted associations or causality. Furthermore, because only patients who underwent coronary angiography were included, the study may not reflect the full spectrum of ACS patients who never reached invasive evaluation. Future studies should aim for multicenter recruitment, complete numerical reporting, and fully quantified group comparisons in order to better define the independent contribution of residence to ACS presentation, treatment access, and short-term outcomes.

Despite these limitations, the study contributes useful contextual evidence from an underrepresented low-resource setting. Its principal value lies in showing that urban and rural ACS patients may differ in fundamentally different ways: urban patients by accumulated cardiometabolic risk and greater multivessel disease, and rural patients by delayed care, reduced treatment access, and relatively worse acute clinical status. Recognizing both dimensions of disparity is essential for designing equitable cardiovascular services in Pakistan and similar settings where reducing ACS burden requires not only prevention, but also fair access to urgent specialist care .

CONCLUSION

This study shows that urban patients with acute coronary syndrome undergoing coronary angiography in a low-resource tertiary hospital were more likely to have a higher burden of conventional cardiovascular risk factors and more extensive multivessel coronary artery disease, whereas rural patients were more likely to present later, arrive in relatively more severe clinical condition, receive less timely interventional or surgical care, and experience slightly poorer in-hospital outcomes. These findings suggest that urban-rural disparities in ACS in this setting are driven both by differences in

cardiometabolic risk exposure and by unequal access to time-sensitive specialist cardiac services, highlighting the need for parallel strategies focused on urban risk-factor prevention and rural strengthening of emergency referral and revascularization pathways .

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