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Clinico-Epidemiological Profile of Myocardial Infarction Patients in a Tertiary Care Centre: Insights from the Kumaon Region of Uttarakhand

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Abstract:

Myocardial Infarction (MI) is a major health concern globally and in the Kumaon region of Uttarakhand, India. This cross-sectional study, conducted from January 2023 to June 2024 at a tertiary care center, examined the clinical and epidemiological profiles of 104 patients diagnosed with ST-Elevation MI (STEMI) or Non-ST-Elevation MI (NSTEMI). The study population included 78.8% males and 21.2% females, with a mean age of 60.18 years. Most patients presented with typical anginal pain (92.3%), while dyslipidemia (62.5%) and tobacco use (52.88%) were the most common risk factors. STEMI accounted for 71.15% of cases, with anterior-lateral wall MI as the predominant subtype. Alarmingly, 57.6% of patients arrived at the hospital beyond the critical 12-hour window for thrombolysis. The findings highlight the burden of MI in males and middle-aged individuals, emphasizing the need for addressing modifiable risk factors and improving public awareness and healthcare access in the region, particularly in hilly areas.

Keywords: Myocardial Infarction, STEMI, NSTEMI, Kumaon Region, Coronary Artery Disease, Dyslipidemia.

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Introduction:

Cardiovascular diseases (CVDs) are among the leading causes of mortality worldwide, contributing significantly to the global burden of disease. A substantial proportion of deaths attributed to CVDs are due to coronary artery disease (CAD), which has emerged as a critical public health challenge, particularly in developing countries (Reddy, 2004). The projected increase in cardiovascular mortality, from 9 million in 1990 to an estimated 19 million by 2020, underscores the growing impact of CVDs, with CAD accounting for a large share. Alarmingly, the proportion of deaths due to CVDs is expected to rise from 25% in 1990 to over 40% by 2020.

India has witnessed a concerning surge in the prevalence of CAD, particularly in urban areas, where the prevalence has increased six- to eight-fold among individuals aged 35–64 years. The rising incidence of CAD in young Indians is especially alarming, with rates of 11–16% compared to 2–5% in the young populations of Western countries (Guha *et. al.*, 2017). Myocardial infarction (MI), a severe manifestation of CAD, is a life-threatening event that can lead to hemodynamic deterioration or sudden death if not managed promptly.

MI is broadly categorized into ST-elevation MI (STEMI) and non-ST-elevation MI (NSTEMI). It occurs due to reduced or completely obstructed coronary blood flow, often caused by atherosclerotic plaque rupture, thrombosis, or other mechanisms like coronary vasospasm or embolism (Scheen, 2018). Chest pain is the most common presenting symptom of MI, typically described as heavy pressure or a burning sensation, often radiating to the jaw, neck, or upper limbs. Diagnostic criteria for MI include characteristic symptoms, electrocardiographic changes, and elevated cardiac biomarkers.

Epidemiological studies have revealed a higher risk of MI in young Indians compared to other ethnic groups. Data from various regions of India indicate that a higher proportion of ACS cases in the country involve STEMI, with delayed hospital presentations and limited access to evidence-based treatments leading to higher morbidity and mortality. Socioeconomic disparities further compound the challenges, as a significant number of patients hail from low-income backgrounds and face barriers to timely and affordable care.

Risk factors for MI, identified through global studies such as the INTERHEART Study, include smoking, hypertension, diabetes, dyslipidemia, obesity, and physical inactivity, among others. Despite the significant burden of CVDs in low- and middle-income countries, much of the knowledge about risk factors is derived from studies in developed countries. This gap underscores the need for region-specific data to better understand the interplay of risk

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factors in different populations. In a study of ethnic differences in patients with Myocardial Infarction (MI) in England, it was observed that young Indians had ten times more risk of developing MI as compared to the white population (Malik *et. al.,* 2013).

Given the rising burden of MI in India and the specific challenges faced by populations in hilly regions like the Kumaon region of Uttarakhand, this study was conducted to analyze the clinico-epidemiological profile of MI patients. The objective is to identify key risk factors and at-risk populations to facilitate timely interventions and improve outcomes in this vulnerable group. Escosteguy *et al.* (2003) observed 20.6% in-hospital MI mortality in Brazil, linked to age, diabetes, and Killip class, while ASA and beta-blockers reduced risk. **Hariharan S (2010)** in his study revealed that atypical symptoms are more common in females and diabetic patients. Most of the patients belong to killip class-1 most common age group affected was more than 60 years. **Marino et al. (2016)** stated that the pre-implementation profile of ACS care revealed high STEMI mortality (21%) and limited reperfusion therapy (46%). **Sajjanar et al. (2021)** suggested that young ACS predominantly affects men, with chest pain as the primary symptom, and is commonly associated with single-vessel disease involving the left anterior descending artery. **Blanco et al. (2023)** highlighted key demographic and lifestyle risk factors for AMI in Itajubá, offering a basis for targeted prevention strategies to improve quality of life and life expectancy.

Material & Methods:

This cross-sectional, institution-based, observational, single-center study was conducted in the Department of General Medicine at Government Medical College and Dr. Sushila Tiwari Government Hospital, Haldwani, Uttarakhand. The study was carried out over an 18-month period, from January 2023 to June 2024. The study population comprised all indoor and outdoor patients presenting to the Department of General Medicine who were newly diagnosed with acute myocardial infarction (AMI) during the study period.

All patients fulfilling the inclusion criteria were enrolled in the study, resulting in a total of 104 cases. Patients aged 16 years or older, who were newly diagnosed with AMI as per the diagnostic criteria of the American College of Cardiology, and who provided informed consent were included. Patients with unstable angina, previously diagnosed coronary artery disease, or those unwilling to participate were excluded.

Data collection involved enrolling patients diagnosed with ST-Elevation Myocardial Infarction (STEMI) or Non-ST-Elevation Myocardial Infarction (NSTEMI) based on electrocardiographic findings and qualitative troponin assays. Diagnosis of AMI adhered to criteria specifying acute myocardial injury with clinical evidence of myocardial ischemia, supported by a rise and fall of cardiac troponin levels above the 99th percentile upper reference limit, along with symptoms of ischemia or relevant imaging evidence.

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All enrolled patients underwent a detailed evaluation, including demographic information, clinical presentation, risk factor assessment, and relevant laboratory investigations. Physical examinations, including vital signs and systemic evaluations, were recorded. Risk factors such as smoking, alcohol consumption, diabetes mellitus, hypertension, dyslipidemia, and family history of coronary artery disease were meticulously documented. Electrocardiography (ECG) and biochemical investigations, including lipid profiles and fasting blood glucose levels, were performed to corroborate the diagnosis. Patients presenting within the thrombolysis window were managed accordingly, and all were referred for further angiographic evaluation and management as required.

Results & Discussion:

This study analyzed the clinico-epidemiological profile of 104 patients diagnosed with acute myocardial infarction (AMI) at a tertiary care center in the Kumaon region of Uttarakhand. Among the study population, 82 (78.8%) were males**,** and 22 (21.2%) were females, yielding a male-to-female ratio of 3.7:1. This male predominance attributes this disparity to hormonal protection in premenopausal women and lifestyle factors such as higher smoking and alcohol consumption rates among men. The mean age of the participants was 60.18 ± 9.40 years**,** with most patients **(**64.4%**)** in the 45–65 years age group, followed by 24.1% in the over-65 category. The youngest patient was 40 years old, and the oldest was 85 years. These findings align with national data, which suggest that AMI predominantly affects middle-aged and elderly individuals in India. Early onset of cardiovascular disease in South Asian populations due to genetic predisposition and higher exposure to risk factors has been well-documented, further emphasizing the need for preventive strategies.

Table 1: Age and Gender Wise Distribution of Patients In Study Population.

Age Range	Cases		P-value
	MALES	FEMALES	0.493
<45 yrs	5	0	
45-65 yrs	52	15	
>65 yrs	25	7	
Total	82	22	
Mean±SD	60.18±9.40 years		
Min	40 years		
Max	85 years		

Geographically, 57 (54.8%) of the patients were from hilly areas**,** while 47 (45.2%) resided in non-hilly regions. Patients from hilly areas were disproportionately represented, likely due to

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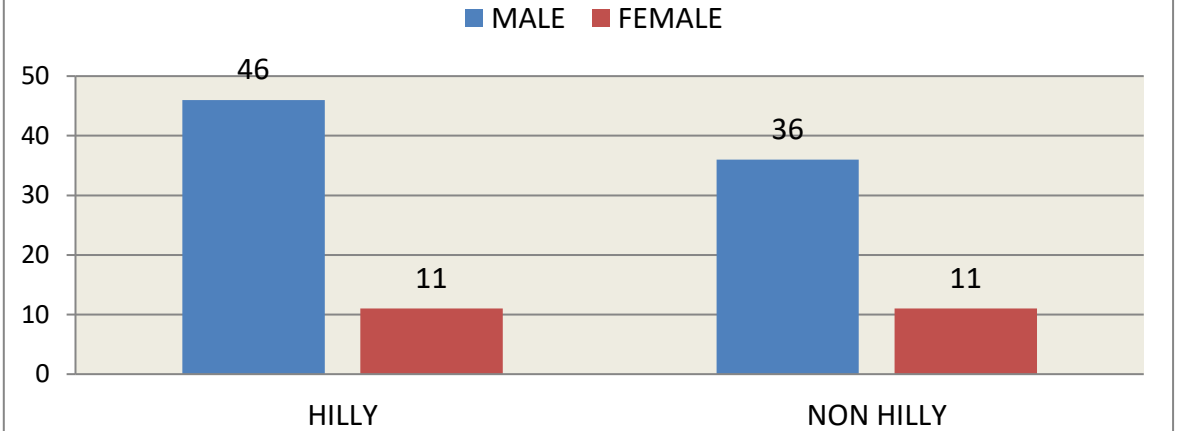
the tertiary care center being the primary referral hospital for the region. However, patients from hilly areas also experienced significant delays in reaching the hospital, with 71.9% arriving more than 12 hours after symptom onset. In contrast, patients from non-hilly regions demonstrated relatively better access, with 40.4% arriving within 6–12 hours**.** These findings underscore the need to improve healthcare infrastructure, transportation, and awareness in remote areas to reduce delays in care. This is represented in Figure 1.

Figure 1: Region Wise Distribution of Patients In The Study Population



The time taken to reach the hospital varied notably based on geographical location, literacy level, and socioeconomic status, highlighting disparities in healthcare accessibility. Patients from hilly regions experienced the longest delays, with 71.9% arriving more than 12 hours after symptom onset, compared to 40.4% from non-hilly areas. Only 5.2% of patients from hilly regions arrived within the thrombolysis window of 6 hours, reflecting the significant logistical challenges faced by these populations, such as poor transportation infrastructure and lack of nearby medical facilities. Conversely, 17.2% of patients from non-hilly areas managed to arrive within 6 hours, indicating comparatively better access to healthcare. These findings underscore the urgent need to improve road connectivity, establish mobile healthcare units, and enhance emergency response systems in remote regions.

Education level also played a critical role in hospital presentation times. Illiterate patients showed the most significant delays, with none arriving within 6 hours and 50% presenting after 12 hours**.** Patients with primary and undergraduate education showed slight improvements, with 13%–11% arriving within 6 hours, though the majority still presented after 12 hours. Even among postgraduates, delays remained substantial, with 62.5% arriving after 12 hours, though 12.5% managed to present within the window period. Socioeconomic status further influenced delays, as 71.4% of lower-middle-income patients arrived after 12 hours, compared to 52.7% in the middle group and 42.3% in the upper-middle group. These findings highlight the intersection of education and financial resources in influencing health-

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seeking behavior and the ability to access timely care, emphasizing the need for targeted awareness programs and affordable emergency transport systems. This has been represented in Table 2.

Table 2: Correlation of Time Taken To Reach Hospital With Multiple Epidemiological Variables In Study Population

VARIABLE		Time Taken									Total
		<6 HR			6-12 HR			>12 HR			
		M	F	Total N (%)	M	F	Total N (%)	M	F	Total N(%)	
GEOGRAPHICAL REGION	HILLY	2	1	3(5.2)	10	3	13(22.8)	35	6	41(71.9)	57
	NON HILLY	6	2	8(17.2)	18	2	20(42.5)	11	8	19(40.4)	47
	TOTAL	8	3	11(10.5)	28	5	33(31.7)	46	14	60(57.6)	104
LITERACY	ILLITERATE	0	0	0	2	1	3 (50)	3	0	3 (50)	6
	PRIMARY	2	1	3(13.0)	8	1	9(39.1)	8	3	11(47.8)	23
	UNDERGRADUATE	2	2	4(11.1)	10	1	11(30.5)	16	5	21(58.3)	36
	GRADUATE	2	0	2(8.6)	4	2	6(26.0)	13	2	15(65.2)	23
	POST GRADUATE	2	0	2(12.5)	0	4	4(25)	6	4	10(62.5)	16
SOCIOECONOMIC STATUS	LOWER MIDDLE	1	0	1(2.3)	8	3	11(26.1)	23	7	30(71.4)	42
	MIDDLE	2	1	3(8.3)	12	2	14(38.8)	14	5	19(52.7)	36
	UPPER MIDDLE	5	2	7(26.9)	8	0	8(30.7)	9	2	11(42.3)	26

Clinically, 92.3% of the patients reported typical anginal chest pain, making it the most common symptom, followed by diaphoresis (57.7%)**,** dyspnea (45.2%)**,** and palpitations (24.1%)**.** Atypical symptoms, such as abdominal pain and dizziness, were reported in 7.7% of cases, primarily among females and elderly patients. These findings are consistent with

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previous studies, including those by Seetharama et al., which also observed a predominance of typical symptoms in male patients and atypical presentations in high-risk subgroups (Table 3).

Electrocardiographic findings revealed that STEMI (ST-Elevation Myocardial Infarction) was the predominant subtype, accounting for 74 (71.15%) of cases. Among STEMI patients, anterolateral wall MI (39.4%) was the most frequent localization, followed by inferior wall MI (14.4%) and anteroseptal MI (13.5%). NSTEMI (Non-ST-Elevation Myocardial Infarction) accounted for 30 (28.84%) of cases. Despite the availability of thrombolysis, only 9 patients (8.6%) underwent this intervention due to significant delays in presentation, with the majority requiring conservative management (Table 4).

Table 3 : Clinical Characterstics of Patients In The Study Population.

VARIABLE		MALE		FEMALE		TOTAL
		N	%	N	%	
CLINICAL SYMPTOMS	TYPICAL PAIN	75	78.2%	21	21.8%	96 (92.3%)
	DIAPHORESIS	48	80%	12	20%	60 (57.7%)
	DYSPNOEA	35	77.8%	10	22.2%	45 (45.2%)
	PALPITATIONS	21	84%	4	16%	25 (24.1%)
	ATYPICAL SYMPTOMS	7	87.5%	1	12.5%	8 (7.7%)
BLOOD PRESSURE	NORMAL	59	84.28%	11	15.71%	70(67.30%)
	HYPERTENSION	20	83.3%	4	16.6%	24(23.07%)
	HYPOTENSION	3	30%	7	70%	10(9.6.%)
PULSE RATE	NORMAL	47	79.66%	12	20.33%	59(56.73%)
	TACHYCARDIA	22	84.6%	4	15.3%	26(25%)
	BRADYCARDIA	13	68.4%	6	31.5%	19(18.26%)
JVP	RAISED	2	50%	2	50%	4((3.8%)
	NORMAL	80	80%	20	20%	100(96.2%)

Table 4: Gender Wise Regional Distribution of Myocardial Infarction In Study Sample And Type of Intervention Done.

	MALE	FEMALE		INTERVENTION DONE

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TYPE OF MI					TOTAL (104)	THROMBOLYSIS (9)	CONSERVATIVE (75)
	N (82)	%	N (22)	%			
INFERIOR WALL MI	14	93.3	1	6.7	15 (14.4%)	1	14
ANTEROLATERAL WALL MI	31	75.6	10	24.4	41 (39.4%)	5	36
INFERIOR MI+ RWMI	4	100	0	0	4 (3.8%)	0	4
ANTERO SEPTAL MI	11	78.6	3	21.4	14 (13.5%)	3	9
NSTEMI	22	26.8	8	36.3	30(28.84%)	All Conservatively Managed	

Biochemical investigations revealed significant lipid abnormalities, with hypertriglyceridemia (52.9%) being the most common, followed by hypercholesterolemia (25.9%)**.** Glycemic control was poor in a substantial proportion of the population, with 27.9% of patients having HbA1c ≥6.5%**,** indicating undiagnosed or poorly managed diabetes. Dyslipidemia (62.5%) emerged as the most significant risk factor, followed by smoking (52.88%)**,** which was notably higher among males. Diabetes mellitus (27.88%) and hypertension (23.07%) were also prevalent. These findings are consistent with those reported in other Indian cohorts, underscoring the role of metabolic and lifestyle factors in AMI risk.

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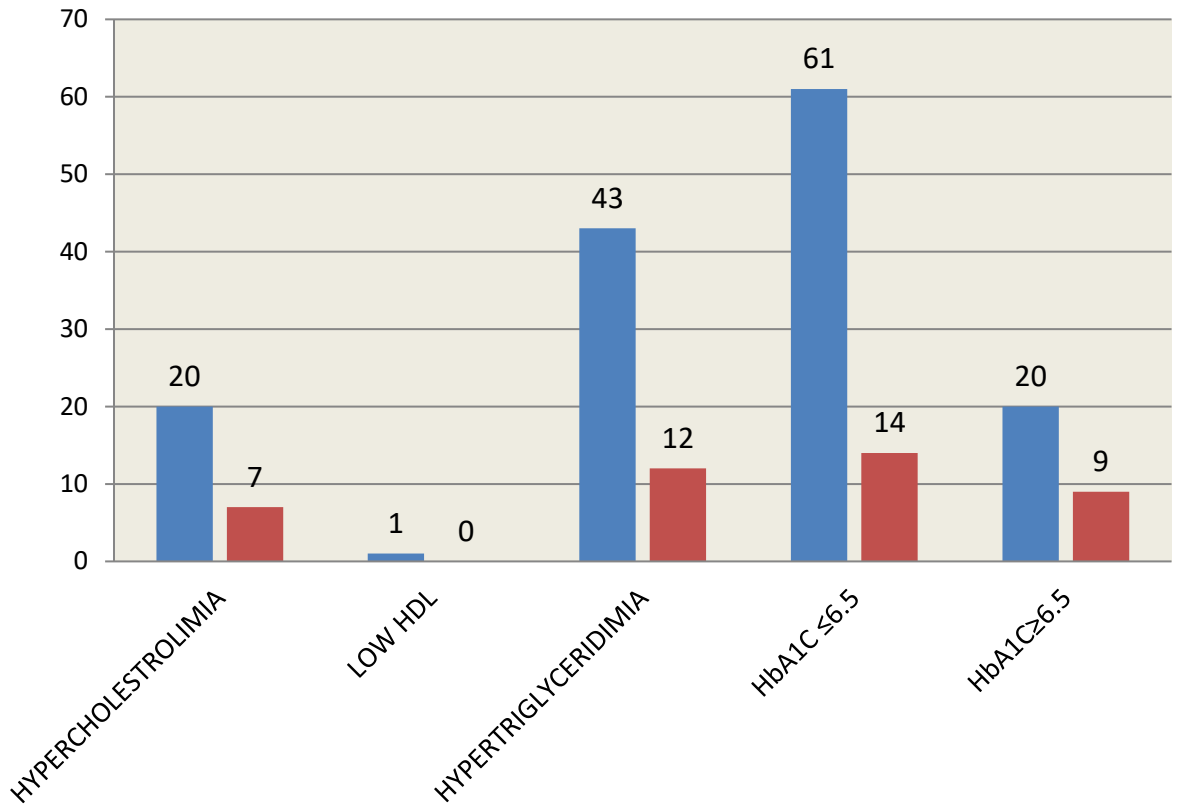
Figure 2: Distribution of Study Population Based on Lipid Profile And Hba1c Levels.



Complications were observed in a significant proportion of patients. Heart failure was the most common, affecting 26.92% of patients, with a higher prevalence in females **(**54.54%**)** compared to males **(**19.15%**).** Other complications included cardiogenic shock (9.6%)**,** arrhythmias **(**1.92%)**,** and hypotension (10.57%)**.** Females were more likely to present with advanced stages of heart failure, such as Killip Class III or IV, reflecting delayed diagnosis and the presence of comorbidities. This has been depicted in Figure 3. These findings suggest that delayed presentation and higher prevalence of comorbid conditions such as diabetes and hypertension in females may contribute to the severity of complications. Early recognition and intervention are crucial to mitigating these complications and improving outcomes, particularly in high-risk groups.

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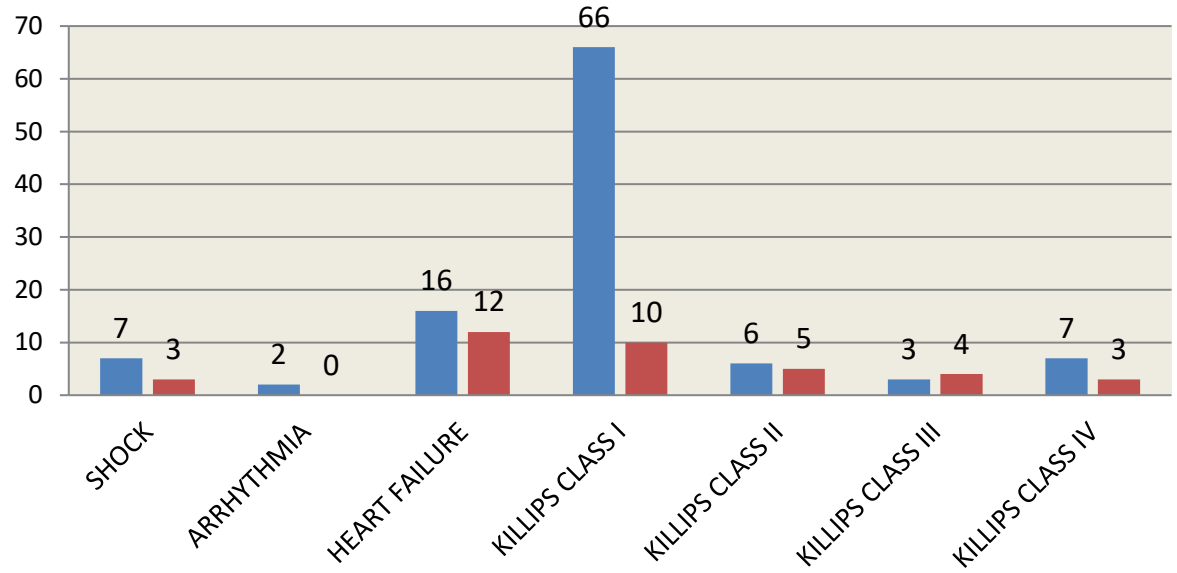
Figure 3: Distribution of Study Population Based on The Basis of Cardio Respiratory Examination



These findings highlight the pressing need for enhanced public health interventions targeting modifiable risk factors such as smoking, dyslipidemia, and diabetes. The delayed presentation of patients, particularly from hilly areas, underscores the importance of community education about AMI symptoms and the critical need for timely medical attention. Improved healthcare infrastructure, early risk stratification, and prompt interventions, including thrombolysis and referral for angiographic evaluation, are essential to reducing morbidity and mortality associated with AMI.

Conclusion:

This study highlights the significant burden of acute myocardial infarction (AMI) in the Kumaon region of Uttarakhand, with a male predominance and a mean age of 60.18 years. Dyslipidemia, smoking, and diabetes were identified as the most common risk factors, with STEMI being the predominant subtype. Delayed presentation was a critical issue, particularly among patients from hilly areas, with over 70% arriving after the crucial 12-hour window for thrombolysis. These delays, compounded by educational and socioeconomic disparities, significantly impacted treatment outcomes.

The study underscores the urgent need for targeted interventions, including improved transportation and healthcare infrastructure in remote areas, community education on early recognition of AMI symptoms, and enhanced access to emergency care. Addressing modifiable risk factors such as smoking and dyslipidemia through public health initiatives is essential to reduce the incidence of AMI. Early diagnosis, timely intervention, and equitable

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healthcare access remain key priorities to improve outcomes and reduce mortality in this high-risk population.

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