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Biochemical and Clinical Risk Factors of Acute Myocardial Infarction in Very Young vs Older Patients: A Comparative Analysis

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Abstract

Background: *Acute myocardial infarction (AMI) in very young adults is increasingly reported, yet the risk profile may differ significantly from older patients. This study aimed to compare biochemical and clinical risk factors of first AMI in very young (≤30 years) versus older (≥50 years) patients in Bangladesh.*

Methods: *This cross-sectional observational study was conducted across four tertiary care hospitals in Dhaka over 18 months (July 2022 to December 2023). A total of 160 patients diagnosed with first AMI were enrolled and divided equally into two groups based on age: Group I (≤30 years, n=80) and Group II (≥50 years, n=80). Clinical risk factors, conventional and emerging biochemical markers were assessed and statistically compared using chi-square, t-test, and Mann-Whitney U test as appropriate.*

Results: *Male predominance was observed in both groups, with no significant difference in gender distribution (p=0.137). Group I patients had significantly higher prevalence of smoking, dyslipidemia, obesity, family history of CAD, and substance abuse (p<0.05), whereas hypertension and diabetes were more prevalent in Group II (p<0.05). Biochemically, Group I showed significantly higher levels of troponin-I, CRP, TC, TG, LDL-C, and homocysteine, along with lower HDL-C and vitamin D levels (p<0.05). Fasting blood glucose and serum sodium were significantly higher in Group II.*

Conclusion: *Very young patients with first AMI exhibit distinct risk factor profiles, marked by modifiable lifestyle-related and biochemical parameters. Early identification and targeted prevention strategies are essential to mitigate cardiovascular risk in this population.*

Keywords: *Acute myocardial infarction, young adults, risk factors, biochemical markers, Bangladesh.*

1. INTRODUCTION

Acute myocardial infarction (AMI) remains one of the leading causes of morbidity and mortality worldwide, accounting for significant global health and economic burdens [1]. Traditionally considered a disease of middle-aged and older adults, AMI is increasingly being reported in younger populations, particularly in low- and middle-income countries [2]. The early onset of coronary artery disease (CAD) in very young individuals (≤30 years) presents unique challenges in clinical management and long-term outcomes, often leading to premature disability and death during the most productive years of life [3]. While older adults typically present with a well-established constellation of risk factors—including hypertension, diabetes mellitus, dyslipidemia, and sedentary lifestyle—the clinical profile and risk factors in very young patients with AMI may differ significantly [4]. Emerging evidence suggests that non-traditional and biochemical markers such as hyperhomocysteinemia, hyperuricemia, and vitamin D deficiency may play more prominent roles in the pathogenesis of AMI in younger individuals [5]. Lifestyle factors such as smoking, drug abuse, and psychological stress are also more prevalent in this demographic, further complicating risk assessment and prevention strategies.

The underlying pathophysiological mechanisms leading to AMI in young adults often differ from those in older patients [6]. While atherosclerosis remains the dominant cause in both age groups, younger patients more frequently present with non-obstructive coronary artery disease, endothelial dysfunction, or thrombophilic disorders [7]. Moreover, the clinical presentation in younger patients may be atypical or misinterpreted, resulting in delays in diagnosis and treatment [8].

Despite the growing incidence of AMI in the very young, there is a paucity of comparative studies focusing on biochemical and clinical differences between young and older patients [9]. Understanding these differences is critical for developing age-specific preventive strategies and therapeutic interventions [10]. Moreover, early identification of modifiable biochemical risk factors could offer an opportunity for targeted public health measures aimed at reducing the burden of premature cardiovascular disease.

In Bangladesh, the prevalence of cardiovascular risk factors is on the rise, fueled by urbanization, unhealthy dietary habits, physical inactivity, and rising rates of obesity and diabetes [11]. However, data comparing risk profiles of very young and older patients with AMI within this context remain limited [12]. A comprehensive comparison of clinical presentations, electrocardiographic findings, echocardiographic parameters, and biochemical markers between these two distinct age groups may provide valuable insights into the age-related variations in the manifestation and progression of AMI [13].

This study aimed to comparatively analyze the clinical characteristics and biochemical risk factors associated with first acute myocardial infarction in very young adults (≤30 years) and older adults (≥50 years) presenting to tertiary care hospitals in Dhaka, Bangladesh. By identifying distinctive patterns in each group, this research seeks to contribute to the optimization of preventive and therapeutic strategies tailored to age-specific cardiovascular risk profiles.

2. METHODOLOGY & MATERIALS

This cross-sectional observational study was conducted in multiple tertiary care hospitals in Dhaka, Bangladesh, including the Department of Cardiology at Dhaka Medical College & Hospital, Sir Salimullah Medical College & Mitford Hospital, the National Institute of Cardiovascular Diseases (NICVD), and Bangladesh Specialized Hospital (BSH). The study was carried out over 18 months from July 2022 to December 2023. A total of 160 patients diagnosed with first acute myocardial infarction (AMI) were enrolled and divided equally into two groups: Group I (≤30 years) and Group II (≥50 years), each consisting of 80 patients.

2.1. Sample Selection

2.2.1. Inclusion Criteria

- Patients diagnosed with first acute myocardial infarction (either STEMI or NSTEMI)
- Age groups ≤30 years (very young adults) and ≥50 years (older adults)

2.1.2. Exclusion Criteria

- Age between 31 and 49 years
- Previous history of myocardial infarction or coronary revascularization (PCI, CABG)
- Presence of congenital or valvular heart disease
- Known cases of chronic kidney disease (CKD), heart failure, malignancy, gout, or inflammatory diseases such as rheumatoid

arthritis (RA), systemic lupus erythematosus (SLE), or osteoarthritis (OA)
- Chronic alcoholism
- Pregnancy

2.2. Data Collection Procedure

Data collection used a pre-formed semi-structured questionnaire based on patient interviews, clinical examination, and investigations. ECG and echocardiographic assessments documented ST changes, arrhythmias, LVEF, regional wall motion abnormalities (RWMA), and diastolic dysfunction. Venous blood samples were collected in the morning after overnight fasting under aseptic conditions to evaluate biochemical markers. Serum uric acid was measured using an enzymatic kinetic method, vitamin D via radioimmunoassay, and homocysteine through fluorescence polarization immunoassay. Tests included fasting lipid profile, troponin-I, CRP, Hb%, serum creatinine, and electrolytes. Data accuracy was verified before entry into the dataset.

2.3. Ethical Consideration

The study was approved by the Ethical Review Committee of Dhaka Medical College. Written informed consent was obtained from participants after explaining the study's objectives, procedures, risks, and their right to withdraw without consequence. Confidentiality was maintained strictly, with access limited to authorized personnel. No financial compensation was provided, and participation was voluntary.

2.4. Statistical Analysis

Data were checked, cleaned, and analyzed using Statistical Package for the Social Sciences (SPSS), version 26.0. Descriptive statistics were presented as mean ± standard deviation for normally distributed continuous variables, and median for non-normal distributions. Independent t-test and Mann–Whitney U-test compared continuous variables between age groups. Categorical variables were expressed as frequencies and percentages and analyzed using the Chi-square test or Fisher's exact test. A p-value < 0.05 was considered significant.

3. RESULTS

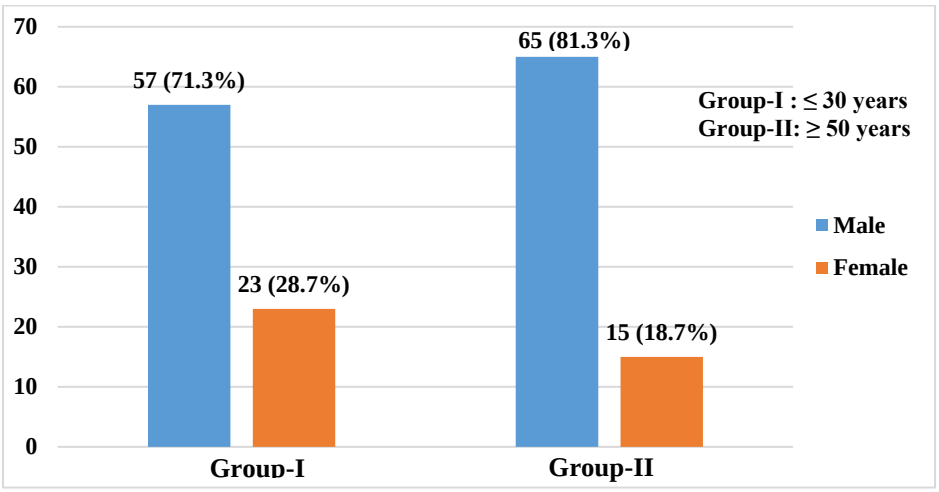

Figure1. *Bar diagram showing comparison of gender distribution between two age groups (N=160)*

In Group-I, there were 57 male and 23 female patients. In contrast, 65 were male and 15 were female patients in Group-II. In both groups male gender was predominant. There was no statistically significant difference of gender distribution between the two age groups (p = 0.137).

Table 1. *Comparison of risk factors between two age groups (N=160)*

Variables	Groups of first Acute MI patients (N=160)		p-value
	Group-I (n = 80)	Group-I (n = 80)	
	Frequency (%)	Frequency (%)	
Smoking	60 (75)	35 (43.8)	[c]<0.001[s]
Diabetes mellitus	27 (33.8)	42 (52.5)	[c]0.017[s]
Hypertension	38 (47.5)	60 (75)	[c]<0.001[s]
Dyslipidemia	58 (72.5)	41 (51.3)	[c]0.006[s]

Obesity	30 (37.5)	15 (18.8)	**^{c}0.008^{s}**
Family h/o CAD	37 (46.3)	16 (20)	**$^{c<}$0.001^{s}**
Smokeless tobacco	5 (6.3)	11 (13.8)	^{c}0.114^{ns}
Substance abuse	11 (13.8)	2 (2.5)	**$^{c<}$0.001^{s}**

Data presented as Frequency and percentage over the columns

Group-I: ≤ 30 years

Group-II: ≥ 50 years

s = significant

ns = non-significant

p-values were obtained by chi-square test (c).

Group-I patients had higher prevalence of smoking, dyslipidemia, obesity, family history of CAD and substance abuse. Conversely, hypertension and DM were more prevalent in Group-II (Table-I:).

Table 2. *Comparison of biochemical parameters between two age groups (N=160)*

Variables (unit)	Groups of first Acute MI patients (N=160)		p-value
	Group-I (n = 80)	Group-II (n = 80)	
	Mean±SD	Mean±SD	
Hemoglobin (gm/dl)	14.42±0.98	14.35±0.83	^{t}0.634^{ns}
FBS (mmol/L)	6.32±2.27	8.20±3.29	**$^{t<}$0.001^{s}**
S. creatinine (mg/dl)	1.04±0.24	1.09±0.25	^{t}0.214^{ns}
Na^{+} (mmol/L)	138.45±3.06	136.97±3.70	**^{t}0.007^{s}**
K^{+} (mmol/L)	4.10±0.38	4.11±0.38	^{t}0.960^{ns}
Cl^{-} (mmol/L)	100.57±3.22	101.22±2.56	^{t}0.160^{ns}
	Median	Median	
Troponin-I (ng/ml)	8.63	6.80	**$^{u<}$0.001^{s}**
CRP (mg/l)	53	38	**$^{u<}$0.001^{s}**
TC (mg/dl)	194	184	**$^{u<}$0.001^{s}**
TG (mg/dl)	186	146	**$^{u<}$0.001^{s}**
HDL-C (mg/dl)	35	42	**$^{u<}$0.001^{s}**
LDL-C (mg/dl)	146	113	**$^{u<}$0.001^{s}**

Data presented as Mean±SD and Median over the columns.

Group-II: ≥ 50 years

s = significant

ns = non-significant

p-values were obtained by independent student t-test & Mann Whitney u test.

FBS, serum sodium, troponin-I, CRP, total cholesterol (TC), triglycerides (TG), HDL-C and LDL-C all showed statistically significant differences between the two age groups ($p < 0.05$) (Table-II).

Table 3. *Comparison of emerging biochemical risk factors between two age groups (N=160)*

Variables (unit)	Groups of first Acute MI patients (N=160)		p-value
	Group-I (n = 80)	Group-II (n = 80)	
	Median	Median	
Serum vit-D (ng/ml)	16	28	**$^{u<}$0.001^{s}**
Serum uric acid (mg/dl)	6.30	5.85	^{u}0.651^{ns}
S. homocysteine (µmol/L)	8.30	7.15	**^{u}0.001^{s}**

Data presented as Median over the columns.

Group-I: ≤ 30 years

Group-II: ≥ 50 years

s = significant

ns = non-significant

p-values were obtained by Mann Whitney u test.

Group-I patients showed lower serum vitamin-D level and higher serum homocysteine level compared to Group-II patients. Serum uric acid level had no statistically significant difference between the two age groups ($p > 0.05$) (Table-III).

4. Discussion

This comparative study investigated biochemical and clinical risk factors associated with acute myocardial infarction (AMI) in two distinct age groups: very young patients (≤30 years) and older patients (≥50 years). Our findings highlight notable differences in risk profiles between these age groups, emphasizing the unique pathophysiological features of AMI in younger individuals.

In terms of gender distribution, although males predominated in both groups, the difference was not statistically significant. This finding aligns with existing literature, where male gender consistently appears as a major risk factor for AMI across all age groups due to higher exposure to behavioral risks and protective hormonal effects in premenopausal females [14, 15].

The clinical risk profile differed considerably between groups. Young AMI patients had significantly higher prevalence of smoking (75%), dyslipidemia (72.5%), obesity (37.5%), family history of coronary artery disease (46.3%), and substance abuse (13.8%). These results are consistent with previous studies where smoking was found to be the most prevalent modifiable risk factor in young AMI patients, often attributed to peer influence and a lack of risk perception [16, 17]. Similarly, positive family history of CAD in the young cohort supports a genetic predisposition contributing to early-onset coronary events, as reported by Malik et al., [18].

Conversely, older patients had higher rates of diabetes mellitus (52.5%) and hypertension (75%). These are well-established cardiovascular risk factors that accumulate with age and contribute to atherosclerotic progression [19]. Our findings reinforce the concept that traditional metabolic risk factors dominate in elderly patients, while lifestyle and genetic factors play a more significant role in the younger population.

Biochemical parameters also showed significant distinctions. Fasting blood sugar was higher in the older group, reflecting the greater burden of diabetes. However, Group I patients had significantly higher levels of troponin-I, C-reactive protein (CRP), total cholesterol (TC), triglycerides (TG), and LDL-C, and lower HDL-C levels. Elevated troponin and CRP levels in young patients may indicate a more intense inflammatory and myocardial injury response despite fewer comorbidities. Similar patterns were reported by Khan et al., who noted disproportionately high inflammatory markers in young AMI patients, possibly due to acute plaque rupture on relatively less calcified arteries [20].

Interestingly, serum sodium levels were significantly lower in older patients, which may reflect age-related decline in renal function or comorbidities like heart failure. Electrolyte imbalances are less frequently reported in the context of age-stratified AMI but could contribute to arrhythmogenic risk in older adults [21]. Emerging risk markers such as vitamin D, homocysteine, and uric acid were also evaluated. We observed significantly lower vitamin D levels and higher homocysteine levels in the younger cohort. Hypovitaminosis D has been increasingly implicated in premature atherosclerosis and endothelial dysfunction, especially among South Asians, due to reduced sun exposure and dietary deficiencies [22]. Elevated homocysteine levels among young AMI patients may point toward prothrombotic and proinflammatory mechanisms independent of traditional risk factors, consistent with findings from Begum et al., [23]. Serum uric acid did not significantly differ between groups, echoing the findings by Muhammad et al., who noted limited utility of uric acid as a discriminator of AMI risk across age strata [24].

Overall, our findings underscore the necessity of age-specific preventive strategies. In young adults, aggressive targeting of modifiable lifestyle factors such as smoking, dyslipidemia, obesity, and substance use is paramount. Additionally, family history screening and evaluation of emerging biochemical markers like vitamin D and homocysteine may enhance early identification of at-risk individuals. In contrast, management in older adults should prioritize control of hypertension, diabetes, and metabolic syndrome. The heterogeneity in risk factor profiles between very young and older AMI patients reflects differing pathophysiological mechanisms—acute thrombosis in younger patients versus chronic atherosclerosis in the elderly. This calls for a tailored approach in diagnosis, risk assessment, and management to improve outcomes in both populations.

5. Limitations of the Study

The use of purposive sampling introduces a risk of selection bias, potentially affecting the

representativeness of the study groups. Additionally, the analysis focused only on selected biochemical risk factors, leaving out other potentially relevant markers. Furthermore, the study did not evaluate the outcomes of the first acute myocardial infarction in the two age groups due to the absence of long-term follow-up, which restricts insights into prognosis and recovery.

6. Conclusion

This comparative study reveals distinct biochemical and clinical risk profiles of acute myocardial infarction (AMI) in very young (≤30 years) and older (≥50 years) patients. Young AMI patients showed a significantly higher prevalence of modifiable risk factors such as smoking, dyslipidemia, obesity, and substance abuse, along with elevated levels of troponin-I, CRP, total cholesterol, triglycerides, LDL-C, and homocysteine. Conversely, older patients had a higher prevalence of hypertension and diabetes mellitus and demonstrated lower vitamin D levels. These findings underscore the need for age-specific preventive strategies, including early screening and lifestyle interventions tailored to high-risk young individuals to reduce the burden of premature coronary artery disease.

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Conflicts of Interest

There are no conflicts of interest.

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