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ORIGINAL ARTICLE

Metabolic Risk Profile of Coronary Artery Disease among Ethnic Communities in Bangladesh

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ABSTRACT

Background: *Coronary artery disease (CAD) is a leading cause of morbidity and mortality, with metabolic risk factors contributing substantially to its development. Ethnic variations may influence risk patterns.* ***Aim of the study:*** *To evaluate the metabolic risk profile of CAD among ethnic communities in the Chittagong Hill Tracts of Bangladesh.* ***Methods & Materials:*** *A cross-sectional analytical study enrolled 781 participants (≥20 years) from three hill districts. Sociodemographic, clinical, and biochemical data were collected. Cardiometabolic risk scores were calculated based on obesity, hypertension, dyslipidemia, diabetes, and smoking.* ***Results:*** *Overweight/obesity was observed in 52.62%, pre-hypertension/hypertension in 36.1%, dysglycemia in 24.71%, atherogenic dyslipidemia in 10.75%, and metabolic syndrome in 17.92%. Moderate-risk cardiometabolic scores predominated (45.8%).* ***Conclusion:*** *Metabolic risk factors are prevalent in ethnic communities, necessitating culturally tailored screening and preventive interventions to reduce CAD burden.*

Keywords: *Coronary artery disease; Metabolic risk; Ethnic communities; Bangladesh; Metabolic syndrome; Dyslipidemia*

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INTRODUCTION

Coronary Artery Disease (CAD) refers to the atherosclerotic narrowing or blockage of the coronary arteries that supply blood to the myocardium, resulting in ischemia and infarction [1]. CAD is the most common form of cardiovascular disease worldwide and is defined by stenotic lesions in coronary vessels causing myocardial oxygen imbalance and subsequent myocardial injury [2]. Globally, the age-standardized prevalence of coronary artery disease was estimated to exceed 315 million individuals in 2022, underscoring the substantial public health and economic burden of this condition across populations worldwide [3]. In Bangladesh, the prevalence of coronary artery disease varies markedly, ranging from about 1.85% in rural areas to nearly 19.6% in urban working populations, reflecting rapid epidemiological transition and urbanization-related lifestyle changes [4]. Metabolic syndrome is a cluster of interrelated cardiometabolic risk factors including central obesity, dyslipidemia (high triglycerides, low HDL cholesterol), elevated blood pressure, and impaired glucose metabolism that collectively increase CAD risk through synergistic pathophysiological mechanisms [5]. Moreover, metabolic risk factors such as hypertension, dyslipidemia, diabetes mellitus, and obesity have consistently shown strong independent associations with the development and progression of CAD in diverse populations, contributing significantly to premature morbidity and mortality [6]. Ethnic variations in CAD risk profiles have been documented, with South Asians including Bangladeshis showing a disproportionately higher risk of metabolic abnormalities and earlier onset of CAD compared to European populations [7]. Additionally, ethnic communities often exhibit heterogeneity in traditional and non-traditional risk factors such as tobacco use, dietary patterns, physical inactivity, sedentary lifestyle, psychosocial stress, and socioeconomic determinants that influence CAD susceptibility and outcomes [8]. Dyslipidemia, marked by elevated LDL and reduced HDL cholesterol levels, is a common metabolic risk factor that plays a key role in the initiation and progression of coronary artery disease through endothelial dysfunction and plaque formation [9]. Physical inactivity and sedentary behavior are also associated with a higher prevalence of metabolic risk factors and CAD, particularly among middle-aged women in low-resource settings [10]. The prevalence of metabolic syndrome in Bangladeshi adults has been observed to be high, with studies reporting rates approaching 20% overall and significantly elevated proportions among hypertensive and diabetic subgroups, indicating a compounding cardiometabolic burden [11]. Furthermore, among patients with established CAD, metabolic syndrome components such as abdominal obesity and hyperglycemia are correlated with more extensive coronary lesions on angiography and poorer clinical outcomes [12]. Ethnic subgroups with distinct genetic, cultural, and lifestyle patterns may therefore differ in the clustering of these metabolic risk factors, potentially influencing CAD risk, disease severity, and long-term prognosis [8]. Understanding the metabolic risk profile across ethnic communities in

Bangladesh is critical given the nation's demographic diversity and the growing public health burden of CAD. Despite rising CAD burden in Bangladesh, limited research has characterized ethnic differences in metabolic risk profiles, which may inform tailored prevention. This study aims to evaluate the metabolic risk factors associated with coronary artery disease among different ethnic communities residing in Bangladesh, identifying patterns that may inform targeted interventions.

METHODS & MATERIALS

This cross-sectional analytical study was conducted over a five-year period from January 1, 2019, to December 31, 2023. The study was carried out in the Chittagong Hill Tracts (CHT) of southeastern Bangladesh, covering three hill districts: Rangamati, Bandarban, and Khagrachari. The CHT spans approximately 13,294 square kilometers and is characterized by hilly terrain and rich ethnic diversity, making it a suitable setting to explore the metabolic risk profile of coronary artery disease among ethnic communities. A total of 781 participants from different ethnic communities were enrolled in the study.

Inclusion and Exclusion Criteria

Inclusion Criteria

1. Age ≥20 years.
2. Members of ethnic communities residing in the Chittagong Hill Tracts.

Exclusion Criteria

1. Presence of mental disorders.
2. Pregnant women.
3. Participants with incomplete clinical or biochemical data.

Ethical Considerations

Ethical approval was obtained from the Ethical Review Committee of Dhaka University. Permission was also secured from community leaders. Confidentiality and anonymity of all participants were maintained, and participation was entirely voluntary.

Variable Definitions

Atherogenic dyslipidemia was defined as the presence of high triglycerides (≥150 mg/dl) along with low HDL cholesterol (<40 mg/dl for males and <50 mg/dl for females).

Metabolic syndrome was defined according to the NCEP ATP III criteria, requiring at least three of the following: central obesity, elevated blood pressure, raised fasting glucose, high triglycerides, and low HDL cholesterol.

Cardiometabolic risk score was calculated by assigning one point each for the presence of major risk factors (obesity, hypertension, diabetes, dyslipidemia, and smoking). Risk was categorized as:

- Low risk: 0–1
- Moderate risk: 2–3
- High risk: 4–5

Data Collection

Data were collected using a structured and pre-tested questionnaire through face-to-face interviews and review of medical records. Information obtained included sociodemographic variables such as age, gender, marital status, education level, occupation, and income, as well as lifestyle factors including tobacco use, alcohol consumption, and physical activity level. Clinical parameters were assessed by measuring body mass index (BMI), blood pressure, and glycemic status. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2) and categorized according to Asian BMI criteria. Blood pressure was measured using a standard sphygmomanometer with participants in a seated position after a minimum of five minutes of rest and classified according to standard guidelines. Glycemic status was determined using fasting blood glucose levels. For biochemical analysis, fasting venous blood samples were collected after an overnight fast of 8–12 hours, and serum levels of total cholesterol, triglycerides, low-density lipoprotein (LDL), and high-density lipoprotein (HDL) were analyzed using standard enzymatic methods in the hospital laboratory.

Statistical Analysis

Data were entered and analyzed using SPSS version 26.0. Descriptive statistics were used to summarize the data. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. Results were displayed in tables for clear interpretation.

RESULT

Analysis of age revealed that 366 (46.86%) were between 20 and 40 years, 343 (43.92%) were 41–60 years, and 72 (9.22%) were >60 years, with a mean age of 42.7 ± 12.6 years. Gender-wise, Female participants (438, 56.08%) slightly outnumbered males (343, 43.92 Most participants were married (611, 78.23%) compared to unmarried (170, 21.77 Regarding education, 56 (7.17%) illiterate, 189 (24.20%) primary, 362 (46.35%) SSC, 64 (8.19%) HSC, and 110 (14.08%) graduation or higher. Occupationally, the study population included housewives 226 (28.94%), service 152 (19.46%), business 169 (21.64%), agriculture 87 (11.14%), and students 147 (18.82%). Similarly, Income levels were low 111 (14.21%), middle 353 (45.20%), and high 317 (40.59%). Tobacco and alcohol use were reported in 439 (56.21%) and 315 (40.33%), respectively, where physical activity was low in 251 (32.14%), moderate in 341 (43.66%), and high in 189 (24.20%) *Table I*.

Table – I: Baseline characteristics of the study population (*n*=781)

Variables	Frequency (n)	Percentage (%)
Age Group (years)		
20–40	366	46.86
41–60	343	43.92
>60	72	9.22
Mean ± SD	42.7 ± 12.6	
Gender		
Male	343	43.92
Female	438	56.08
Marital Status		
Married	611	78.23
Unmarried	170	21.77

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Education Level		
Illiterate	56	7.17
Primary	189	24.20
SSC	362	46.35
HSC	64	8.19
Graduation and above	110	14.08
Occupation		
Housewife	226	28.94
Agriculture	87	11.14
Service	152	19.46
Business	169	21.64
Student	147	18.82
Income (BDT)		
Low income	111	14.21
Middle income	353	45.20
High income	317	40.59
Tobacco Use		
Yes	439	56.21
No	342	43.79
Alcohol Use		
Yes	315	40.33
No	466	59.67
Physical Activity Level		
Low	251	32.14
Moderate	341	43.66
High	189	24.20

Clinical assessment indicated BMI distribution of 54 (6.91%) underweight, 316 (40.46%) normal, 306 (39.18%) overweight, and 105 (13.44%) obese. Blood pressure readings were normal in 499 (63.89%), pre-hypertensive in approximately 142 (18.18%), stage I hypertensive in 106 (13.57%), and stage II hypertensive in 34 (4.35%). Glycemic status represents 588 (75.29%) normal, 127 (16.26%) pre-diabetic, and 66 (8.45%) diabetic participants (*Table II*).

Table – II: Clinical characteristics of ethnic group (*n*=781)

Variables	Frequency (n)	Percentage (%)
BMI		
Underweight (<18.5 kg/m^2)	54	6.91
Normal (18.5–22.9 kg/m^2)	316	40.46
Overweight (23.0–24.9 kg/m^2)	306	39.18
Obese (≥25.0 kg/m^2)	105	13.44
Blood Pressure		
Normal (<120/80 mmHg)	499	63.89
Pre-hypertension (120–139/80–89)	142	18.18
Stage I Hypertension (140–159/90–99)	106	13.57
Stage II Hypertension (≥160/100)	34	4.35
Glycemic Status		
Normal (<100 mg/dl)	588	75.29
Pre-diabetes (100–125 mg/dl)	127	16.26
Diabetes (≥126 mg/dl)	66	8.45

Total cholesterol levels were normal in 354 (45.33%), 206 (26.38%) borderline high, 92 (11.78%) high, and 129 (16.52%) very high (*Table III*).

Table – III: Distribution of level of cholesterol among study population of ethnic group (*n*=781)

Cholesterol (mg/dl)	Frequency (n)	Percentage (%)
Normal (<200)	354	45.33
Borderline High (200–239)	206	26.38
High (240–260)	92	11.78
Very High (>260)	129	16.52

Triglycerides were normal in 420 (53.78%), borderline in 232 (29.71%), and elevated in 129 (16.52%). LDL cholesterol was normal in 427 (54.67%), borderline in 277 (35.47%), and high in 77 (9.86%), while HDL was normal in 340 (43.53%), borderline in 308 (39.44%), and low in 133 (17.03%) *Table IV*.

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Table – IV: Metabolic profile among patients (*n*=781)

Variables	Triglyceride (mg/dl)		LDL (mg/dl)		HDL (mg/dl)	
	n	%	n	%	n	%
Normal (<150)	420	53.78	427	54.67	340	43.53
Borderline (150–199)	232	29.71	277	35.47	308	39.44
High (≥200)	129	16.52	77	9.86	133	17.03

In terms of disease profile, atherogenic dyslipidemia was present in 84 (10.75%) and absent in 697 (89.25%), while metabolic syndrome was present in 140 (17.92%) and absent in 641 (82.08%) *Table V*.

Table – V: Disease profile among patients (*n*=781)

Parameters	Frequency (n)	Percentage (%)
Atherogenic Dyslipidemia		
Present	84	10.75
Absent	697	89.25
Metabolic Syndrome		
Present	140	17.92
Absent	641	82.08

Cardiometabolic risk scores were classified 295 (37.8%) as low, 358 (45.8%) as moderate, and 128 (16.4%) as high-risk (*Table VI*).

Table – VI: Cardiometabolic risk score (*n*=781)

Risk Category	Score	Frequency (n)	Percentage (%)
Low	0–1	295	37.8
Moderate	2–3	358	45.8
High	4–5	128	16.4

DISCUSSION

Coronary artery disease is a multifactorial metabolic disorder characterized by the interplay of dyslipidemia, insulin resistance, hypertension, and central obesity, with risk expression varying across ethnic populations [13]. The present study delineates the metabolic risk profile of coronary artery disease among ethnic communities in Bangladesh, emphasizing sociodemographic characteristics, lifestyle behaviors, and cardiometabolic risk clustering in a large community-based population. The study population was relatively young, with 46.86% aged 20–40 years, 43.92% aged 41–60 years, and only 9.22% above 60 years, yielding a mean age of 42.7 ± 12.6 years. This early age distribution is consistent with South Asian evidence demonstrating premature development of CAD and its metabolic risk factors compared to Western populations [14]. The predominance of females (56.08%) over males (43.92%) contrasts with hospital-based CAD cohorts but aligns with community-level metabolic surveys from Bangladesh where women, particularly homemakers, exhibit higher clustering of cardiometabolic risk due to sedentary behavior and limited preventive care access [15,16]. Educational attainment was largely at the secondary level (SSC: 46.35%), with 24.20% having primary education and 7.17% being illiterate, indicating that metabolic risk is prevalent across moderate educational strata rather than confined to poorly educated groups [17]. Occupational distribution showed a high proportion of housewives (28.94%), followed by business (21.64%), service holders (19.46%), students (18.82%), and agricultural workers (11.14%), supporting earlier findings that non-manual and home-based occupations are associated with reduced physical activity and higher metabolic risk [18]. Tobacco use was highly prevalent (56.21%), comparable to national STEPS survey data and previously reported Bangladeshi studies identifying tobacco as a dominant modifiable CAD risk factor [19]. Physical activity levels revealed that 32.14% had low activity, 43.66% moderate activity, and only 24.20% high activity, consistent with regional studies linking physical inactivity to rising cardiometabolic risk in South Asia [20]. Body mass index analysis showed that 39.18% of participants were overweight and 13.44% obese, while 40.46% maintained normal BMI and 6.91% were underweight. Despite a relatively modest obesity prevalence, the high proportion of overweight individuals supports existing evidence that South Asians develop metabolic abnormalities at lower BMI thresholds due to increased visceral adiposity [21]. Blood pressure assessment revealed that 18.18% had pre-hypertension, 13.57% had stage I hypertension, and 4.35% had stage II hypertension, while only 63.89% were normotensive. This high burden of elevated blood pressure mirrors findings from national Bangladeshi surveys and underscores hypertension as a major contributor to CAD risk [22,23]. Glycemic status evaluation showed that 16.26% had pre-diabetes and 8.45% had diabetes mellitus, while 75.29% had normal fasting glucose levels. These findings are comparable to reports from the International Diabetes Federation and regional studies documenting a growing burden of dysglycemia among younger South Asian populations [24]. Total cholesterol levels were abnormal in more than half of the participants, with 26.38% having borderline high levels, 11.78% high levels, and 16.52% very high levels, while only 45.33% had normal cholesterol. This pattern closely aligns with prior South Asian studies demonstrating a high prevalence of hypercholesterolemia and its contribution to premature atherosclerosis [25]. Triglyceride analysis showed that 29.71% had borderline levels and 16.52% had high levels, consistent with the characteristic hypertriglyceridemia observed in South Asian dyslipidemia [25]. LDL cholesterol was borderline in 35.47% and high in 9.86%, reinforcing its role as a primary atherogenic factor. HDL levels were normal in only 43.53%, while 39.44% were borderline and 17.03% were low, reflecting the low-HDL phenotype frequently described in South Asian populations and strongly linked to CAD risk [26]. Atherogenic dyslipidemia

was identified in 10.75% of participants, a finding consistent with previous studies associating this lipid pattern with insulin resistance and increased cardiovascular risk [27]. Metabolic syndrome was present in 17.92% of the study population, comparable to reported prevalences 30% in Bangladeshi and Indian cohorts, depending on diagnostic criteria [15,28]. Cardiometabolic risk score assessment revealed that 37.8% of participants were in the low-risk category, 45.8% in the moderate-risk category, and 16.4% in the high-risk category. The predominance of moderate-risk individuals is clinically significant, as longitudinal studies such as INTERHEART have demonstrated a graded increase in CAD events with cumulative risk burden. This distribution suggests a critical opportunity for early lifestyle and pharmacologic interventions to prevent progression to high-risk status and reduce future CAD burden [29].

LIMITATIONS

The study is limited by its cross-sectional design, which precludes causal inference between metabolic risk factors and CAD. Being community-based in the Chittagong Hill Tracts, the findings may not be generalizable to all ethnic populations in Bangladesh or globally. The sample size, though substantial, may not capture rarer metabolic phenotypes. Additionally, self-reported lifestyle behaviors could be subject to recall bias, and short study duration limited the assessment of longitudinal outcomes such as CAD events, complications, or mortality.

CONCLUSION

This study highlights a substantial burden of metabolic risk factors among ethnic communities in the Chittagong Hill Tracts of Bangladesh, with 39.18% overweight, 13.44% obese, 18.18% pre-hypertensive, 21.82% hypertensive, and 24.71% exhibiting dysglycemia. Atherogenic dyslipidemia was present in 10.75% and metabolic syndrome in 17.92% of participants. The predominance of moderate-risk cardiometabolic scores (45.8%) underscores the need for early detection and targeted interventions. Ethnic-specific lifestyle, dietary patterns, and sociodemographic characteristics significantly influence CAD risk. These findings emphasize that community-based screening and culturally tailored preventive strategies are crucial to mitigate the rising burden of coronary artery disease and its metabolic determinants in Bangladesh.

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CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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