Research Article

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Prevalence of Metabolic Syndrome Components among EarlyAge onset Acute Coronary Syndrome Patients in Bangladesh

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ABSTRACT

Aim: *Metabolic Syndrome (MetS), a significant risk factor for coronary artery disease (CAD), is now highly prevalent in South Asian countries, including Bangladesh. The diseases also affect young people. A large number of young populations with acute coronary syndrome (ACS) have MetS. The aim of this study was to determine the prevalence of MetS and the combination of components in patients with early age onset ACS (age ≤50 years).*

Methods: *This prospective study comprised 678 consecutive patients age ≤50 years hospitalized for ACS during 2012-2013. The patients were categorized according to the criteria stated in the latest joint statement for the global definition of MetS.*

Results: *Among 678 ACS patients, 236 (34.8%) patients have filled the criteria of MetS. The mean age was 42.4 ± 0.28 years. The prevalence of MetS was higher in females than in males (48.8% vs. 30.4%, $p < 0.001$). One component of MetS was found in 26.4%, two components in 29.8%, three or more components in 34.8% of young ACS study participants. Among the various components of MetS, low HDL and high TG were the crucial common components of MetS in young ACS patients in Bangladesh (low HDL: 51.9%, high TG: 44.8%).*

Conclusions: *We conclude that the prevalence of MetSin patients with early age onset ACS (age ≤50 years) is high in Bangladesh. Since Low HDL and high TG are the most common components of MetSin our study, these biochemical parameters would be a clinical target for early treatment. Strategies are needed for the early detection and treatment of cardio-metabolic risk factors to prevent coronary artery disease progression and prognosis.*

Keywords
Bangladesh, Metabolic syndrome, Premature acute coronary syndrome.

Introduction
The metabolic syndrome (MetS) is a group of metabolic disorders, mainly including abdominal obesity (AO), diabetes mellitus (DM), decreased high-density lipoprotein (HDL), hypertension, and atherogenic hypertriglyceridemia [1-3]. The MetS is also known as insulin resistance syndrome, Syndrome X, the obesity dyslipidemia syndrome, or the deadly quartet [4,5]. MetS has emerged as a major epidemic of the 21stcentury [6]. In 2015, 56.4 million deaths were occurred globally, out of these 56.4 million deaths, Non-communicable diseases (NCDs) were the cause of 39.5 million global deaths [7]; and out of these NCDs, MetS was the biggest NCD causing these deaths[31].It is widespread in all ages, from teenage to older, regardless of class, socioeconomic status, race, and family background [8-10]. The term MetS has arisen from findings that cardiovascular risk factors are collected in obese people [11]. Indeed,individuals with MetS are at higher risk for cardiovascular diseases (CVD) and have an increased risk of CVD mortality [12]. The list of NCDs continues to grow in length and complexity. Globalization at a breakneck pace, urbanization, society's aging, and a surge in chronic diseases all raise new threats to existing health care systems [13,14]. CVD is preventable, but physical inactivity, nicotine misuse, and poor eating practices (as a result of the loss of conventional food routines in modern technological cultures) are increasing prevalence in the majority of countries [15].

Since inflammatory and thrombotic behaviors are part of this condition, atherosclerotic CVD is the clinical outcome of greatest significance [16]. Then, CVDs are the number one cause of death worldwide: more people die from CVDs each year than from any other disease. An unprecedented 17.9 million people died in 2016 from CVDs, representing 31 percent of all deaths worldwide, out of which 85 percent of the deaths are due to heart disease and stroke [17].

The emergence of MetS is one of the main risk factors for coronary artery diseases (CAD), with a rapidly growing prevalence rate. It has multiple cardiovascular risk factors that include AO, impaired blood glucose, high blood pressure and low HDL-cholesterol (HDL-C) [18,19]. Each of these components alone increases the risk of CAD [20,21], and if there are several factors present in a person simultaneously, the risk of cardiac events is greatly increased.Besides,insulin resistance, which is the crucial component of DM, is also eventually resulting in CAD [22,23]. Acute coronary syndrome (ACS) is characterized by unstable angina (UA) and evolving myocardial infarction (MI), which is typically classified as ST-segment elevation MI (STEMI) or new-onset Left Bundle Branch Block (LBBB), or ACS without ST-segment elevation (NSTEMI) [24]. ACS also indicates a degree of coronary artery damage caused by atherosclerosis, thrombosis, plaque rupture, and inflammation. Non-modifiable risk factors include advanced age, male gender, and a family history of ischemic heart disease. As modifiable risk factors, smoking, DM, hypertension (HT), dyslipidemia, obesity, and a sedentary lifestyle have been established [24]. However, details on the relationship between the family history of NCDs and ACS are limited. The Framingham Heart Study outlined the risk factors associated with the progression of IHD, including critical evidence for primary and secondary IHD prevention [25].

The prevalence of MetSand CAD is overgrowing not only in western countries, but South Asians. In the western world,the prevalence of MetS has been raised during the last three decades [22], only among US young adults aged >=18, the prevalence of metabolic syndrome increased by more than 35 percent between 1988–1994 and 2007–2012, which was just 25.3 percent initially [26]. In South Asians, it is predicted that MetS has developed in 20–25 percent [27], and many more may be susceptible to it. Urbanization, economic growth, erratic meal scheduling, and nutritional westernization were proposed as probable causes involved in the development of this disease [28]. In South Asian developing countries, including Bangladesh, the prevalence of acute coronary syndrome (ACS), which is a kind of CAD, is growing. There is a large number of young people aged ≤50 with MetS having ACS. However, the cardiovascular risk resulting from different combinations of MetS components is not uniform; each component is an independent risk factor for ACS, and all of them interact synergistically, raising more risk.

This highlights the epidemiological significance of MetS, which can help identify a subgroup of individuals with increased risk of ACS among the overall population at the low absolute risk of coronary events. Thus, this study aims to determine the prevalence of MetS and its components among early age onset ACSpatients in Bangladesh.

Methods
Study design and population
This prospective, tertiary hospital-based, cross-sectional research was conducted in Bogura, Bangladesh, during 2012-2013. We enrolled a total of 1500 consecutive young patients who were admitted to the Saheed Ziaur Rahman Medical College Hospital Bogura Coronary Care Units, Bangladesh, with ACS diagnosis.

Ethics and informed consent
The study was approved by the review board of the research committee in our institution prior to patient enrolment (BOG.ACS-12). Each participant was provided with full information about the study and was assured of strict confidentiality. Only participants who consented to participate were included in the study.

Diagnosis for ACS
In patients with acute MI or UA, standard criteria were used to diagnose ACS. First, the acute MI was identified by a positive serial troponin-T blood test result (≥0.1 ng/mL) in the setting of symptoms and electrocardiographic (ECG) changes consistent

with either STEMI or NSTEMI. The diagnosis of UA was made if the patient had a negative blood test for troponin but had one of the following characteristics: new-onset angina (<2 months) of at least Class III by the Canadian Cardiovascular Society, extended (>20 min) rest angina, recent (<2 months) worsening of angina pectoris, or angina during two weeks of an acute MI. For the data collection, a standardized questionnaire was used.

Anthropometric and other variables

The well-trained examiners tested the participants and reported their anthropometric measurements as follows: body weight was measured to the nearest 0.1 kg with a balanced calibrated scale; height was measured to the nearest 0.1 cm with a portable stadiometer; after weight and height measurements; body mass index (BMI) was measured.Before breakfast, the waist circumference was measured in centimeters at the broadest diameter between the iliac crests and the xiphoid sternum process. Blood pressure was assessed in a sitting position from the right arm with a regular mercury manometer. Blood pressure was measured twice for each patient, first, after 5 minutes making the person relaxed, and second, reading at an interval of 15 minutes; the mean of these two readings was taken and registered.

MetS diagnostic criteria

In this study, we have followed the latest joint statement to define the MetS. It identifies a global criterion for the elevated waist circumference depending on population and specific definitions of different countries.A single set of cutoff points is used in five components except for waist circumference, where national or regional cutoff points are taken. Out of these five components, if any patient has three or more components, it is diagnosed as having MetS [29]. The five components are:

1. Patients having abdominal obesity with waist circumference ≥90cm in men and ≥80cm in women,specific for Asians.
2. Low levels of HDL-C<1.03 mmol/L (<40 mg/dL) in men and <1.29 mmol/L (<50mg/dl) in women or on drug treatment for low HDL-C.
3. High levels of triglyceride (TG)≥1.7 mmol/L (≥150 mg/dL) or on drug treatment for hypertriglyceridemia.
4. Increased levels of fasting glucose ≥5.6 mmol/L (≥100 mg/dL).
5. Elevated blood pressure on repeated readings (systolic ≥130 and/or diastolic ≥85 mmHg) on active treatment for hypertension or taken under standard conditions.

For cardiac biomarkers, including troponin-T and creatine kinase-MB, three sets of serial blood samples were obtained from all patients by venous puncture. Following 12 hours of overnight fasting, serum lipids and blood glucose were measured by taking a sample of 5 ml of blood from the right brachial vein and sent to the ShaheedZiaurRahman Medical College biochemistry laboratory. All biochemical parameters were assessed on VitalabSelectra-E.

Statistical analysis

The research population's clinical and laboratory characteristics are provided in two ways: with and without metabolic syndrome. The Student's "t" test for continuous variables and the chi-square (2) test for categorical variables were used to evaluate the significant differences between metabolic and non-metabolic syndrome individuals. Based on MS and non-MetS, logistic regression analyses were performed to evaluate the relationship between each component of lifestyle, physical, and biochemical risk variables.

Results

A total of 678 young participants in Bangladesh were analyzed using a cross-sectional study, and further research was carried out on the basis of a case-control system out of initial 1500 enrolled young patients. Out of these 678 patients, 61 patients (9.0%) have no component of MetS, 179 patients (26.4%) presented with one out of five MetS components, 202 patients (29.8%) presented with two components of MetS, and 236 patients (34.8%) presented with three or more than three MetS components and diagnosed as MetS-Patients (Fig 2). In addition, 678 patients had ACS, and then we divided the subjects of the study into two categories, such as a group of ACS patients with MetS (n = 236, 34.8%) and ACS patients without MetS (n = 442, 65.2%).

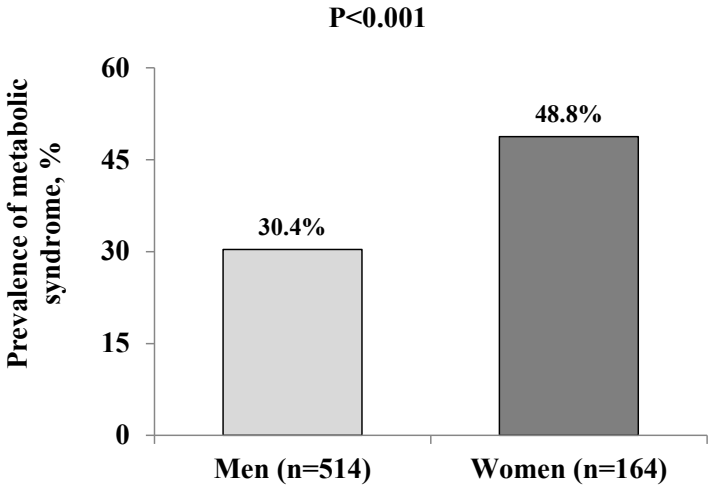

Figure 1: The prevalence of the metabolic syndrome in men and women with acute coronary syndrome.

STEMI was diagnosed in 355 patients (53.5%), NSTEMI was present in 38 patients (5.7%), and unstable angina was seen in 189 patients (28.5%).

The mean age of the participants is 42.4 ± 0.28 years ranging from 16 to 50 years while the maximum number of patients, 414 patients (61.1%), were seen in the age group more than 40 years. The mean of BMI is 23.0 ± 0.13 kg/m^2. Most of the participants are from urban areas (50.5%), while fewer are from rural areas (49.5%), as described in Table 1.

Among these ACS patients having MetS, the prevalence was higher in females (48.8%) compared to males (30.4%) participants with statistical significance (Fig1). The higher prevalence in our study may be due to other coronary risk factors in females, as we have

Table 1: Socio-demographics and clinical characteristics of patients with or without metabolic syndrome

Variable Total (N=678)		ACS Patients		*P Value*
		Subjects with MS (N=236)	**Subjects without MS (N=442)**	
Number of Patients	678 (100)	236 (34.8)	442 (65.2)	
Age (years)	42.4 ± 0.28	42.8 ± 0.44	42.2 ± 0.36	0.259
Gender				
Male	514 (75.8)	156 (66.1)	358 (81.0)	<0.001*
Female	164 (24.2)	80 (33.9)	84 (19.0)	
Residence				
Urban	337 (50.5)	133 (57.3)	204 (46.9)	0.010*
Rural	330 (49.5)	99 (42.7)	231 (53.1)	
Body mass index (kg/m^2)	23.0 ± 0.13	24.2 ± 0.22	22.4 ± 0.16	<0.001*
Waist circumference (cm)	81.3 ± 0.40	86.1 ± 0.62	78.8 ± 0.46	<0.001*
Pulse/minute	78.1 ± 0.46	78.1 ± 0.79	78.0 ± 0.56	0.930
Family income (BDT)	12225 ± 229	12767 ± 440	11930 ± 259	0.080
Body mass index category				
Normal (<25 kg/m^2)	541 (79.8)	163 (69.1)	378 (85.5)	<0.001*
Overweight (25-30 kg/m^2)	114 (16.8)	63 (26.7)	51 (11.5)	
Obese (>30 kg/m^2)	23 (3.4)	10 (4.2)	13 (2.9)	
Sedentary lifestyle	184 (26.0)	65 (30.1)	119 (24.2)	0.090
Smoking History				
Current Smokers	396 (58.4)	123 (52.1)	273 (61.8)	0.027*
Ex smoker	19 (2.8)	4 (1.7)	15 (3.4)	
Blood Pressure (mmHg)				
Systolic blood pressure	120.7 ± 0.84	130.0 ± 1.43	115.6 ± 0.95	<0.001*
Diastolic blood pressure	76.5 ± 0.53	81.7 ± 0.95	73.6 ± 0.58	<0.001*
Biochemical risk factors				
FBG (mmol/L)	5.98 ± 0.09	7.13 ± 0.17	5.36 ± 0.08	<0.001*
Total cholesterol (mg/dL)	179.2 ± 2.0	190.4 ± 3.68	173.2 ± 2.32	<0.001*
Triglyceride (mg/dL)	162.0 ± 3.29	209.0 ± 6.69	137.0 ± 2.95	<0.001*
HDL cholesterol (mg/dL)	42.2 ± 0.47	39.1 ± 0.67	43.9 ± 0.61	<0.001*
LDL cholesterol (mg/dL)	104.6 ± 1.80	109.5 ± 3.32	101.9 ± 2.11	0.045*
Creatinine (mg/dL)	1.16 ± 0.02	1.19 ± 0.04	1.15 ± 0.02	0.313
Uric Acid (mg/dL)	5.72 0.08	5.84 ± 0.12	5.66 ± 0.10	0.255
Cardiac Troponin-1 (ng/ml)	21.33 ± 3.90	25.89 ± 8.02	18.89 ± 4.19	0.395
Acute coronary syndrome				
STEMI	355 (53.5)	121 (52.6)	234 (53.9)	0.191
N. STEMI	38 (5.7)	17 (7.4)	21 (4.8)	
Unstable angina	189 (28.5)	58 (25.2)	131 (30.2)	
Others	82 (12.4)	34 (14.8)	48 (11.1)	
Family history of diabetes				
Non Diabetic	592 (88.8)	197 (84.9)	395 (90.8)	0.022*
Diabetic	75 (11.2)	35 (15.1)	40 (9.2)	
Previous history of angina				
No	640 (94.7)	225 (95.3)	415 (94.3)	0.573
Yes	36 (5.3)	11 (4.7)	25 (5.7)	
Previous history of MI				
No	659 (97.5)	231 (98.3)	428 (97.1)	0.325
Yes	17 (2.5)	4 (1.7)	13 (3.0)	
Metabolic syndrome components				
Elevated waist circumference	190 (28.02)	132 (55.9)	58 (13.1)	<0.001*
Elevated triglyceride	304 (44.8)	187 (79.2)	117 (26.5)	<0.001*
Reduced HDL cholesterol	352 (51.9)	179 (75.9)	173 (39.1)	<0.001*
Elevated blood pressure	266 (39.2)	148 (62.7)	118 (26.7)	<0.001*
Elevated fasting blood glucose	207 (30.5)	127 (53.8)	80 (18.1)	<0.001*

Values are presented as mean ± SE for continuous variables and n (%) for categorical variables. * P<0.05.

ACS: acute coronary syndrome; MS: metabolic syndrome; N: number; SE: standard error; FBG: fasting blood glucose; HDL: high density lipoprotein; LDL: low density lipoprotein; MI; myocardial infraction.

Table 2: Characteristics of respondents by age and MS components.

Variable	Age <= 30	31-35	36-40	41-45	Age >45	Total
Waist circumference (cm)	76.2 ± 1.6	81.3 ±1.2*	82.2 ± 0.8*	81.9 ± 0.7*	81.5 ± 0.7*	81.3 ± 0.4
Systolic blood pressure (mmHg)	111.4 ± 2.3	116.4 ± 2.0	121.6 ± 2.0*	121.7 ± 1.7*	123.0 ± 1.4*	120.7 ± 0.8
Diastolic blood pressure (mmHg)	71.6 ± 1.6	74.7 ± 1.3	75.4 ± 1.1	78.1 ± 1.2*	77.7 ± 0.8*	76.5 ± 0.5
Triglyceride (mg/dL)	144.9 ± 12.5	167.1 ± 10.2	166.5 ± 7.4	158.9 ± 5.6	164.2 ± 5.9	162.1 ± 3.3
HDL cholesterol (mg/dL)	40.4 ± 1.4	41.6 ± 1.8	42.4 ± 1.2	42.3 ± 0.8	42.7 ± 0.8	42.2 ± 0.5
FBG (mmol/L)	5.3 ± 0.3	5.5 ± 0.2	5.9 ± 0.2	6.1 ± 0.2	6.24 ± 0.2	6.0 ± 0.1

Based on One way ANOVA. Values are presented as Mean ± SE; Significance level, * P < 0.05. MS: metabolic syndrome; SE: standard error; HDL: high density lipoprotein; FBG: fasting blood glucose.

Table 3: Multivariate logistic regression analysis for risk factors based on metabolic syndrome and without metabolic syndrome.

Variable	Odds ratio (OR)	95% CI for OR	*P Value*
Socio-demographics, lifestyle and physical risk factors			
Age (years)	1.04	1.01-1.07	0.005*
Gender (Male/Female)	4.19	2.20-7.98	<0.001*
Residence (Urban/Rural)	0.70	0.46-1.06	0.092
Body mass index (kg/m^2)	1.01	0.93-1.08	0.868
Waist circumference (cm)	0.95	0.93-0.98	<0.001*
Pulse/minute	1.03	1.02-1.05	<0.001*
Family income (BDT)	1.0	1.0-1.0	0.792
Smokers (current/past)	0.93	0.51-1.69	0.812
Systolic Blood Pressure (mmHg)	0.98	0.96-0.99	0.002*
Diastolic Blood Pressure (mmHg)	0.99	0.97-1.02	0.490
Family history of diabetes (Non DM/DM)	2.27	1.27-4.07	0.006*
Previous history of angina (No/Yes)	1.58	0.49-5.10	0.444
Previous history of MI (No/Yes)	7.98	1.47-43.40	0.016*
Biochemical risk factors			
Fasting blood glucose (mmol/L)	0.76	0.62-0.93	0.008*
Total cholesterol (mg/dL)	2.30	0.20-27.07	0.508
Triglyceride (mg/dL)	0.84	0.51-1.37	0.476
High density lipoprotein (mg/dL)	0.48	0.04-5.57	0.555
Low density lipoprotein (mg/dL)	0.43	0.04-5.11	0.507
Serum Creatinine (mg/dL)	1.30	0.40-4.28	0.664
Uric Acid (mg/dL)	1.16	0.87-1.54	0.325
Cardiac Troponin-1 (ng/ml)	1.00	0.99-1.01	0.794

Based on multivariate logistic regression. * P < 0.05.
CI: confidence interval; DM: diabetes mellitus; MI; myocardial infraction.

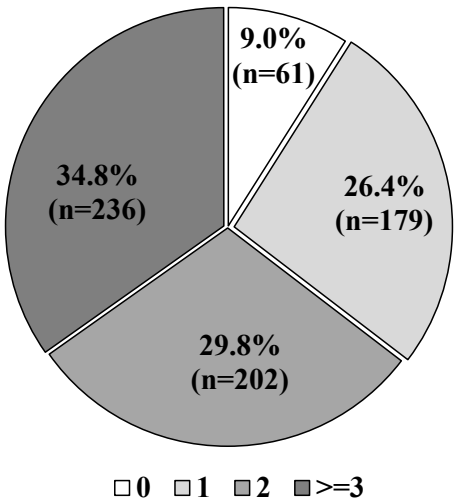

Figure 2: Number of metabolic components among participants

Individual metabolic abnormalities among Bangladeshi population with acute coronary syndrome (N=678). Data are expressed as percentage (number) of patients. ACS: acute coronary syndrome.

selected all patients of ACS for this study (Table 1). In both the study groups, regarding the components of MetS, the difference in elevated waist circumference, elevated triglyceride, reduced HDL cholesterol, elevated blood pressure, and elevated fasting blood glucose were statistically significant with $p < 0.05$ (Fig 3).

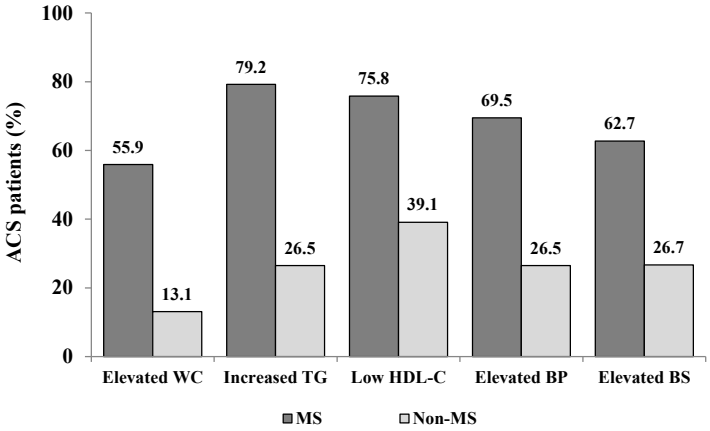

Figure 3: Components of metabolic syndrome

Prevalence of metabolic components with acute coronary syndrome with or without metabolic syndrome. Data are expressed in percentage of patients. ACS: acute coronary syndrome; MS: metabolic syndrome; non-MS: non- metabolic syndrome; WC: waist circumference; TG: triglyceride; HDL-C: high density lipoprotein cholesterol; BP: blood pressure; BS: blood sugar.

However, low HDL, central obesity, and elevated blood sugar were comparatively high in females, whereas elevated blood pressure and increased triglycerides were more significant in males as compared to females (Fig 4). Among the various components of MetS, low HDL-C and high TG was (Low HDL-C 51.9%, high TG 44.8%), the most common components of MetS in young ACS patients in Bangladesh (Fig4), whereas, in females, the single most prevalent component was low HDL-C (Fig4). The HDL-C was the lowest among the youngest i.e., 40.4 ± 1.4 among people <30 years (Table 2) Components of metabolic syndrome (elevated waist circumference, increased triglyceride, low HDL-C, elevated blood pressure, and elevated fasting blood sugar) are higher in the MS group compared to non-MS groups (Figure 3). Age classified MS characteristics shows that mean systolic and diastolic blood pressure, in acute coronary syndrome patients in Bangladesh. Age dependent increase was significant for Waist circumference for 31-35, 36-40, 41-45, Age>45 age group compared to the group age ≤30 years. The mean systolic blood pressure has been shown to be significant for 36-40, 41-45 and >45 age groups compared to the group age ≤30. The mean diastolic blood pressure has been shown to be significant for 41-45 and >45 age groups compared to the group age ≤ 30 (Table 2).

Multivariate logistic regression analysis was used to evaluate the potential role of age, family history of diabetes, previous history of MI and related others important variables in developing MS.

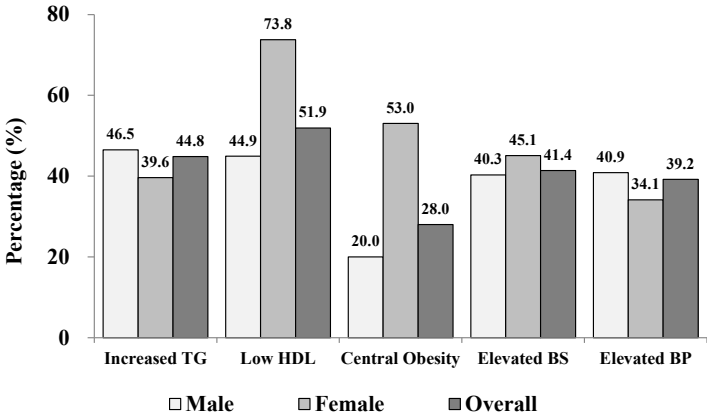

Figure 4: Components of metabolic syndrome in male and female

Individual components of metabolic syndrome in this study. TG: Triglyceride; HDL: High-density lipoprotein; BS: Blood sugar; BP: Blood pressure.

Multivariate logistic regression analysis shows that age, gender, waist circumference, pulse, systolic blood pressure, family history of diabetes, previous history of myocardial infraction and fasting blood glucose are statistically significant.

The likelihood of having ACS also increased with family history of diabetes and previous history of MI where the odds ratio (OR) was highest in those group (yes group). Previous history of MI (OR 7.98, CI 1.47-43.40, p = 0.016) was significant independent risk factor fordeveloping MS. Diabetes in any one of the parents (OR 2.27, CI 1.27-4.07, p = 0.006) was significant independent risk factor for developing MS but Previous history of angina was not significant (OR 1.58, CI 0.49-5.10.84, p = 0.444) (Table 3).

Discussion

The main purpose of this study was to assess the prevalence of MetS among premature ACS patients. The study was done in a Tertiary Care Hospital. The patients were diagnosed on the spot in Coronary Care Unit, where they are classified into Unstable Angina, STEMI, NSTEMI based on ECG findings the presence or absence of cardiac biomarkers.

The diagnosis of MetS was made by using modified NCEP ATP III criteria of the patients attending the coronary care unit [30]. And it is seen that out of 678 patients, 236 (34.8%) were diagnosed with MetS having three or more than 3 of the five definitive components of MetS, moreover, 91% of patients have one or more than 1 MetS component.The prevalence of Met Swas higher in females than in males (48.8%, vs. 30.4%, p<0.001) this similar pattern were also observed in other studies [31,32]. However, in our study, the higher prevalence in females may be due to other coronary risk factors as we have selected all patients of ACS for this study (Table 1).

The unique thing about this study is that we only have premature ACS patients in this study, i.e., all the patients were ≤50 years

while the maximum numbers of patients were 414 patients (61.1%) were seen in the age group more than 40 years. NCEP-ATP III criteria were used for the diagnosis of MetS, but due to the Asian phenotype of obesity, we follow national or regional cutoff points for the obesity component, making it modified NCEP-ATP III criteria for Asians.Therefore, in this study, the definition of MetS comprises the clinical condition meeting at least three or more than 3 MetS components, i.e., central obesity (waist circumference ≥90 cm for males and ≥80 cm for females), low HDL cholesterol (males <40 mg/dL and females <50 mg/dL, or under treatment), high serum triglycerides (≥150 mg/dL, or under treatment), increased blood pressure (≥130/85 mmHg or under treatment), and fasting blood glucose (≥100 mg/dL or under treatment.Among these components, age dependent increase was significant for Waist circumferencefor 31-35, 36-40, 41-45, Age>45 age group, Systolic blood pressure for 36-40, 41-45, Age>45 age groupand Dystolic blood pressure for41-45, Age>45 age group, whereas the HDL-C showed the reverse pattern being the lowest among the youngest group of people i.e., 40.4 ± 1.4 among people <30 years (Table 2). The study has found that the prevalence of MetS in patients with premature ACS was higher, as also observed in other similar studies [33,34], suggesting that MetS is very common among patients with premature ACS.

MetS and its five major coronary artery disease risk factors, without any doubt, lead to atherosclerotic arterial disease, eventually progressing to ischemic heart disease [35]. This similar pattern of prevalence was also observed in the Indian population in ACS patients (29.9%) based on ATP III criteria [36]. Similarly, Zaliunaset al. [37] found MetS more prevalent in women than men (70.2% vs. 52.6%) according to modified NCEP III criteria, and these results were in accordance with a Spanish study done by Jover et al. [38]. The prevalence of MetS in ACS patients has not been well recorded, especially in the South-East Asian community, although there is significant evidence of the adverse effects of MetS. According to Western studies, MetS is generally associated with CAD. Given the notably high prevalence of MetSin this high-risk community, there is a low rate of clinical diagnosis and management of MetS. It reflects the potential for preventive measures, including a healthy diet and exercise in the form of lifestyle modifications. The current study has found that the prevalence of MetS in patients with premature ACS was higher, as also observed in other similar studies [33,34], suggesting that MetS is very common among patients with premature ACS in Bangladesh.

There is a debate on the pathophysiological mechanism by which the MetS raises cardiovascular risk [39]. The meta-analysis also reveals the correlation of MetS with higher cardiovascular risk in women compared to men [40,41].

Additionally, initiatives concerning public awareness of MetS and its connection with CVD are required in order to identify and address this problem early. The adjustment in your lifestyle, such as exercise, leads to weight loss that in effect modifies components of MetS, such as abdominal fat loss, blood pressure reduction, and increased insulinsensitivity.

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Author Contributions

SJ has designed and executed the study. SJ has also drafted the manuscript. AM, SNS, FS, MMI, YM, TS, NS, SK, MAR, NY and MM have assisted in sample collection and analysis. SJ and TS have supervised this manuscript preparation and provided critical editing.

References

1. Huang PL. A comprehensive definition for metabolic syndrome. Dis Models Mech. 2009; 2: 231-237.
2. Titty FVK, Owiredu WKBA, Agyei-Frempong MT. Prevalence of metabolic syndrome and its individual components among diabetic patients in Ghana. J Biol Sci. 2008; 8: 1057-1061.
3. Alberti KGMM, Eckel RH, Grundy SM, et al. Harmonizing the metabolic syndrome: a joint interim statement of the international diabetes federation task force on epidemiology and prevention; national heart, lung, and blood institute; American heart association; world heart federation; international atherosclerosis society; and international association for the study of obesity. Circ. 2009; 120: 1640-1645.
4. Akpalu J, Akpalu A, Ofei F. The metabolic syndrome among patients with cardiovascular disease in Accra, Ghana. Ghana Med J. 2011; 45: 161-166.
5. Gyakobo M, Amoah AGB, Martey-Marbell DA, et al. Prevalence of the metabolic syndrome in a rural population in Ghana. BMC Endocr. Disord. 2012; 12: 25.
6. Nestel P, Lyu R, Low LP, et al. Metabolic syndrome: Recent prevalence in East and Southeast Asian populations. Asia Pac J Clin Nutr. 2007; 16: 362-367.
7. Defronzo RA, Ferrannini E, Zimmet P Alberti G. International Textbook of Diabetes Mellitus. 4th ed, Vol.2. Oxford UK: Wiley-Blackwell. 2015.
8. Cornier MA, Dabelea D, Hernandez TL, et al. The metabolic syndrome. Endocr Rev. 2008; 29: 777-822.
9. Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among US adults: Findings from the third national health and nutrition examination survey. JAMA. 2002; 287: 356-359.
10. King RA, Rotter JI, Motulsky AG. Approach to genetic basis of common diseases. OxfMonogr Med Genet. 2002; 44: 3-17.
11. Ito H, Nakasuga K, Ohshima A, et al. Detection [1] of cardiovascular risk factors by indices of obesity obtained from anthropometry and dual-energy X-ray absorptiometry in Japanese individuals. Int J ObestRelatMetabDisord. 2003; 27: 232-237.
12. Libby PP, Bonow RO, Mann DL, et al. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. 8th edition, Saunders. 2007; 1.

13. Horton R. Offline: Chronic diseases—the social justice issue of our time. Lancet. 2015; 386: 2378.
14. The global cardiovascular risk transition: associations of four metabolic risk factors with national income, urbanization, and Western diet in 1980 and 2008.
15. http://www.who.int/whr/2013/report/en/
16. Contemporary Diagnosis and Management of the Metabolic Syndrome. 1st edition, Grundy SM (Ed.), Handbooks in Health Care Company. 2005; 13.
17. https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)#
18. Misra A, Misra R, Wijesuriya M, et al. The metabolic syndrome in South Asians: continuing escalation and possible solutions. Indian J Med Res. 2007; 125: 345-354.
19. Skilton MR, Moulin P, Sérusclat A, et al. A comparison of the NCEP- ATPIII, IDF and AHA/NHLBI metabolic syndrome definitions with relation to early carotid atherosclerosis in subjects with hypercholesterolemia or at risk of CVD: evidence for sex-specific differences. Atherosclerosis. 2007; 190: 416-422.
20. Tillin T, Forouhi NG, McKeigue PM, et al. The role of diabetes and components of the metabolicsyndrome in stroke and coronary heart diseasemortality in U.K. white and African-Caribbeanpopulation. Diabetes Care. 2006; 29: 2127-2129.
21. Nigam A, Bourassa MG, Fortier A, et al. The metabolic syndrome and its components and the long-term risk of death in patients with coronary heart disease. Am Heart J. 2006; 151: 514-521.
22. Lindsay RS, Howard BV. Cardiovascular risk associated with the metabolic syndrome. CurrDiab Rep. 2004; 4: 63-68.
23. Eapen D, Kalra GL, Merchant N, et al. Health care professionals and South Asian patients must be educated on the predilection toward MetS, diabetes mellitus, and premature CVD in the South Asian demographic. Vasc Health Risk Manag. 2009; 5: 731-743.
24. Longmore M. Oxford handbook of clinical medicine (Oxford medical handbooks).9th Edition. Oxford University press. 2014.
25. Mahmood SS, Levy D, Vasan RS, et al. The Framingham Heart Study and the Epidemiology of Cardiovascular Diseases: A Historical Perspective. Lancet. 2014; 383: 999-1008.
26. Moore JX, Chaudhary N, Akinyemiju T. Metabolic Syndrome Prevalence by Race/Ethnicity and Sex in the United States, National Health and Nutrition Examination Survey, 1988–2012. Prev Chronic Dis. 2017; 14: 160287.
27. Eapen D, Kalra GL, Merchant N, et al. Metabolic syndrome and cardiovascular disease in South Asians. Vasc Health Risk Manag. 2009; 5: 731-743.
28. Misra A, Misra R, Wijesuriya M, et al. The metabolic syndrome in South Asians: continuing escalation and possible solutions. Indian J Med Res. 2007; 125: 345-354.
29. Jolliffe CJ, Janssen I. Development of age-specificadolescent metabolic syndrome criteria that are linkedto the adult treatment panel III and InternationalDiabetes Federation criteria. J Am CollCardiol. 2007; 49: 891-898.
30. Expert Panel on Detection, Evaluation, Treatment of High Blood Cholesterol in Adults. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). JAMA. 2001; 285: 2486-2497.
31. Petra G, Jobien O, Yolanda G, et al. Prevalence of metabolic syndrome in patients with coronary heart disease, cerebrovascular disease, peripheral arterial disease or abdominal aortic aneurysm. Atherosclerosis. 2004; 173: 363-369.
32. Ramachandran A, Sehalatha C, Satyavani K, et al. Metabolic syndrome in Asian Indian patients with ischemic heart diseases using ATP ɒ criteria. Diabetes Res Clin Practice. 2003; 60: 199-204.
33. Zeller M, Steg PG, Ravisy J, et al. Prevalence and Impact of metabolic syndrome on hospital out comes in acute myocardial infarction. Arch Intern Med. 2005; 165:1192-1198.
34. Feinberg M, Schwartz A, Tanne D, et al. Impact of the metabolic syndrome on the clinical outcomes on non-clinically diagnosed diabetic patients with acute coronary syndrome. Am. J. Cardiol. 2007; 99: 667-672.
35. Zaffar J, Butt U, Ayaz M, et al. Frequency and characteristics of metabolic syndrome in patients with acute coronary syndrome among Pakistani adults. Pak Heart J. 2014; 47: 175-178.
36. Dhakhada V, Panjwani M, Dabhi A. Study of Association Between Metabolic Syndrome and Acute Coronary Syndrome. Indian J Clin Pract. 2013; 24: 324-327.
37. Zaliūnas R, Slapikas R, Babarskiene R, et al. The prevalence of the metabolic syndrome components and their combinations in men and women with acute ischemic syndromes. Medicina (Kaunas). 2008; 44: 521-528.
38. Misra A, Wasir JS, Pandey RM. An evaluation of candidate definitions of the metabolic syndrome in adult Asian Indians. Diabetes Care. 2005; 28: 398-403.
39. Alberti KG, Eckel RH, Grundy SM, et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. Circ. 2009; 120: 1640-1645.
40. Gami AS, Witt BJ, Howard DE, et al. Metabolic syndrome and risk of incident cardiovascular events and death: a systematic review and meta-analysis of longitudinal studies. J Am CollCardiol. 2007; 49: 403-414.
41. Galassi A, Reynolds K, He J. Metabolic syndrome and risk of cardiovascular disease: a meta-analysis. Am J Med. 2006; 119: 812-819.