Association of Body Mass Index with Angiographic Severity of Coronary Artery Disease in Patients with Acute ST- Segment Elevation Myocardial Infarction

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Key words:
Body mass index, Coronary artery disease, Myocardial infarction.

Abstract:

Background: *This study evaluated the association of body mass index (BMI) and angiographic severity of coronary artery disease in patients with acute ST segment elevation myocardial infarction (STEMI).*

Methods: *Data were analyzed from 100 acute STEMI patients who underwent coronary angiogram. The patients were grouped based on BMI; those with normal BMI, 18.5- 24.9 kg/m^2 (group I) and those with increased BMI, >25 kg/m^2 (group II). Each group contained 50 patients. Angiographic severity of the three groups was compared and the relation between BMI and angiographic severity was assessed.*

Results: *The mean BMI of subjects with normal angiographic findings was 20.81 ± 1.03 kg/m^2. The mean BMI of single, double and triple vessel disease were 23.85 ± 2.24, 24.25 ± 2.41 and 32.06 ± 7.86 kg/m^2 respectively. The number of vessel involvement increased in proportion with increased BMI and the differences were statistically significant (p=0.001).*

Conclusion: *Increased BMI is associated with angiographic severity of coronary artery disease in patients with acute ST-segment elevation myocardial infarction.*

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Introduction:

At the beginning of the 20th century, cardiovascular disease accounted for less than 10 percent of all deaths worldwide. At the beginning of the 21th century, CVD accounts for nearly half of all deaths in the developed world and 25% in the developing world. By 2020, it is predicted that coronary artery disease will claim 25 million lives annually.[1] South Asians are prone to develop CAD. Most notable features of CAD in this population are the extreme prematurity and severity; 2-4 fold higher prevalence, incidence, hospitalization and mortality, 5-10 years earlier onset of first myocardial infarction (MI) and 5-10 fold higher rates of MI and death before the age of 40 years.[2]

Like other South Asians, Bangladeshis are unduly prone to develop CAD, which is often premature in onset, angiographically more severe and follows a rapidly progressive course. Genetic predisposition, high prevalence of metabolic syndrome and conventional risk factors play important role. Lifestyle related factors, including poor dietary habits, excess saturated and trans-fat, high salt intake, and low-level physical activity may be important as well.[3] The prevalence of coronary artery disease in Bangladesh was estimated as 3.3 per thousand in 1976 and 17.2 per thousand in 1986 indicating five folds increase of the disease by ten years.[4] Three small scale population based studies showed average prevalence of IHD 6.5 per thousand rural population of Bangladesh[5]. More recent data indicates CAD prevalence between 1.85% and 3.4% in rural and 19.6% in urban population[6].

Obesity has been linked to almost 20% of cases of coronary artery disease.[7] The prevalence of the overweight, obesity and metabolic syndrome (MS) steadily increases worldwide. Metabolic syndrome represents a clustering of cardiovascular risk factors

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that accelerates the process of atherosclerosis and subsequent coronary artery disease.[8]

The body mass index (BMI), or Quetelet index, is a measure for human body shape based on an individual's mass and height. Devised between 1830 and 1850 by the Belgian mathematician Adolphe Quetelet, it is defined as the individual's body mass divided by the square of their height - with the value universally being given in units of kg/m^2. Its popularity date to a paper published in 1972 in the *Journal of Chronic Diseases*, which found the BMI to be the best proxy for body fat percentage among ratios of weight and height.[9,10]

South Asians are at risk of developing obesity related co-morbidities at lower levels of BMI and that they have higher body fat at a given value of BMI than white races. For Asian populations, the WHO expert Consultative Committee suggested BMI cut-offs as e"23–24.9 kg/m^2 and e"25 kg/m^2 for overweight and obesity, respectively.[11] Recent prospective multicentre international study has demonstrated a strong and consistent relationship between an increased BMI and the severity of CAD. Moreover, an increased BMI was significantly related to higher risk of hypertension, diabetes, hyperlipidaemia and non-fatal myocardial infarction.[12]

Methods:

This cross - sectional observational study was conducted in the National Institute of Cardiovascular Diseases (NICVD), Dhaka from January 2014 to December 2014.

Patients with acute ST-segment elevation myocardial infarction (STEMI) underwent coronary angiogram (CAG) were included in the study. Patients with BMI< 18.5, age< 25 years or > 65 years, previous myocardial infarction, valvular heart disease or with congenital heart disease, cardiomyopathy, suspected myocarditis or pericarditis, prior PCI or CABG, thromblyzed after 24 hours of acute STEMI were excluded from the study.

A total of 100 patients with acute STEMI were included in the study. Coronary angiogram was done during same hospital period.

On the basis of BMI, study subjects were categorized into two groups: 50 patients of acute STEMI with normal BMI (18.5 – 24.9 kg/m^2) were considered as group I and 50 patients of acute STEMI with increased BMI (e" 25 kg/m^2) were considered as group II.

Meticulous history was taken and detailed clinical examination will be performed and recorded in predesigned structured proforma. Risk factors profile included tobacco consumption, hypertension, diabetes, and dyslipidaemia, family history of CAD was noted. Demographic data such as age, sex, height (cm), weight (kg) was recorded. BMI was calculated by the formula, BMI = Weight in kg / (Height in meter).

A 12 lead resting ECG was done at a paper speed of 25 mm/s and 10 mm standardization at admission. Transthoracic echocardiography was done by 2D & M-mode and Doppler echocardiography modalities. Left ventricular ejection fraction (LVEF) was measured.

Coronary angiography was done by conventional method during same hospitalization. Interpretation of coronary angiogram was done by visual estimation by two cardiologists to assess the severity of coronary artery disease. Severity of coronary stenosis was graded according to the number of major epicardial vessel with significant stenosis (vessel score) and Gensini score.

Results:

The mean age of patients was 46.4±8.9 years. Male patients was predominant in the whole study population (male: female = 11.5: 1).

This study found that, the most common risk factor was smoking (86%), followed by family history of coronary artery disease (79%), hypertension (47%), Tobacco chewing (43%), diabetes mellitus (38%), and dyslipidaemia (36%). This study found that, mean LDL cholesterol levels in group I and group II were 114.8 + 6.1 and 117.7 + 6.8 mg/dl, respectively and mean triglyceride levels in group I and group II were246.6 + 45.4 and 267.8 + 46.5, respectively. The difference of LDL cholesterol and triglyceride levels in group I and group II were statistically significant (p- value 0.02 and 0.02, respectively). Total cholesterol and HDL cholesterol levels were also more in group II than group I, but the differences between the two groups were not statistically significant.

Among group I, highest percentage was of vessel score 1 in 58% followed by vessel score 2 in 18% and

12% patient had vessel score 3. On the contrary, among group II, highest percentage was of vessel score 2 (36%) followed by vessel score 1 in 32% and vessel score 3 in 24%. Vessel score 0 was seen in 12% patients of group I and 8% patients of group II. Vessel score 0 had no statistical association in both groups (p=0.50). Vessel score 1 was significantly higher in group I (p=0.008) than group II. Vessel score 2 was significantly higher in group II than group I (p=0.04). Three vessel involvement was observed more in group II than group I, but it was not statistically significant (p=0.11).

The mean level of BMI (kg/m^2) was observed 25.82 ± 5 .06 and 23.18 ± 4.77 in severe and moderate CAD respectively. The difference of mean BMI between the severe and moderate CAD groups was statistically significant (p=0.02).

The average Gensini score in Group II patients was 18.6, whereas average Gensini score in Group I patients was 10.2, which was statistically significant (p= 0.01). There was also a positive correlation between BMI and coronary artery disease severity in terms of Gensini score (r=0.53). It was observed that, the Pearson's correlation was statistically significant (p=0.01) by correlation t-test.

Multivariate logistic regression analysis revealed diabetes mellitus, hypertension, dyslipidaemia, waist-hip ratio and increased BMI as the significant predictors of severe CAD with ORs being 1.08, 1.12, 1.05, 1.14, 1.03 and 1.26 respectively.

Table-I

Baseline clinical and biochemical characteristics of each group

	Group I (n =50)	Group II (n =50)	P Value
Age in years (Mean ± SD)	45.7 ± 8.6	47.2 ± 9.2	0.44
SmokerTobacco chewer	86%(43)44% (22)	86% (43)42% (21)	1.000.84
Hypertensive	36% (18)	58% (29)	0.03
Diabetics 28% (14)	48% (24)	0.04	
Dyslipidaemia	26% (13)	46% (23)	0.04
Family history of CAD	74% (37)	84% (42)	0.22
Body Mass Index (kg/m^2) (Mean ± SD)	22.15 ± 0.95	26.15± 1.25	0.001
Waist circumference (cm)	83.08 ± 2.65	89.28± 4.39	0.001
Waist – hip ratio	0.92 ±0.12	1.07 ±0.14	0.001
Random blood sugar (mmol/L)	9.2 + 3.7	13.6 + 4.3	0.03
S. creatinine	1.20 + 0.37	1.27 + 0.41	0.41
Total cholesterol (mg/dl)	220.2 + 51.1	225.8+47.7	0.57
Triglyceride (mg/dl)	246.6+45.4	267.8 + 46.5	0.02
LDL cholesterol (mg/dl)	114.8 + 6.1	117.7 + 6.8	0.02
HDL cholesterol (mg/dl)	31.8 + 3.2	30.1 +3.7	0.34

Table-II

Distribution of the study patients according to vessel score (n=100).

Vessel Score	Group I (n= 50)		Group II (n=50)		p value
	Number	%	Number	%	
Score – 0	6	12.0	4	8.0	0.50^{NS}
Score – 1	29	58.0	16	32.0	0.008^{S}
Score – 2	9	18.0	18	36.0	0.04^{S}
Score – 3	6	12.0	12	24.0	0.11^{NS}

Table-III

Relationship between significant CAD and mean BMI of the study patients (n=100).

BMI (kg/m^2)	Severe CAD (n=74) (≥70%)	Moderate CAD (n=26) (<70%)	p value
Mean ± SD	25.82 ± 5.06	23.18 ± 4.77	0.02

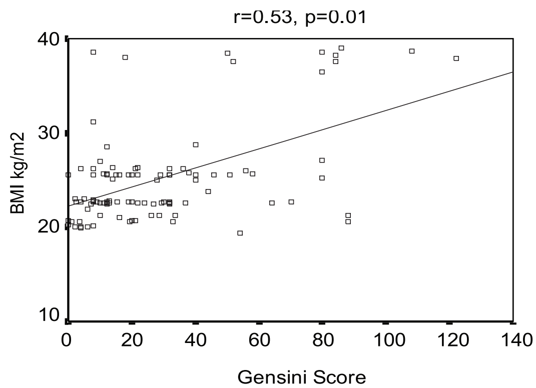

Fig-I: *Correlation between BMI and Gensini score*

Table-IV

Multivariate logistic regression of determinants of significant CAD (by stenosis).

Variables of interest	β	S.E.	p value	OR	95% CI
Age (>55yrs)	0.079	0.033	0.29^{NS}	0.94	0.147 -1.501
Smoking	0.809	0.737	0.27	2.25	0.530 – 9.526
Diabetes mellitus	0.526	0.372	0.03^{S}	1.12	1.075 – 1.804
Hypertension	0.435	0.304	0.02^{S}	1.05	1.021 – 1.817
Dyslipidaemia	0.616	0.407	0.01^{S}	1.14	1.109 – 1.460
Waist Circumference	0.031	0.091	0.73	0.97	0.811 – 1.158
Waist-hip ratio	0.128	0.109	0.02^{S}	1.03	1.001 – 1.089
Increased BMI	0.232	0.107	0.03^{S}	1.26	1.021 – 1.556

Discussion:

The mean age of the studied patients was 46.4 ± 8.9 years ranging from 25 to 64 years. The mean age of group II was more than group I, but the difference between two groups was not statistically significant (p=0.44). Another similar study in Bangladesh had the patients with mean age of 49 ± 10.2 years[13]. In this study, male - female ratio was 11.5:1. No significant association was found between the groups in terms of sex distribution.

Among the studied patients, highest percentage had history of smoking (86%) followed by family history of premature CAD (74%), chewing tobacco (44%), hypertension (36%), history of angina (32%), diabetes mellitus (28%) and dyslipidaemia (26%) in Group I patients. In group II patients, risk factors were observed like as highest percentage has smoking (86%) followed by family history of premature CAD (84%), hypertension (58%), diabetes mellitus (48%), dyslipidaemia (46%), chewing tobacco (42%) and history of angina (32%). Hypertension, diabetes mellitus and dyslipidaemia were significantly more in group II than group I. Dyslipidaemia was commonest (84%) risk factor, followed by smoking (66%) and hypertension (54%) found in another study[13].

In this study, mean BMI of group I was 22.15 ± 0.95(kg/m^2) and mean BMI group II was 26.15 ± 1.25(kg/m^2). Waist circumference found in group II and group I was 89.28 ± 4.39 and 83.08 ± 2.65 cm, respectively. Waist-hip ratio was observed in group II and group I was 1.07 ± 0.14 and 0.92 ± 0.12 respectively. Above all characteristics were significantly higher in group II than group I. The results were compatible with another similar study in Bangladesh[14].

The relationship between BMI, other cardiovascular risk factors, and the prevalence and risk of CAD are complex. Obesity and/or an increased BMI are independently associated with greater risk of insulin resistance, metabolic syndrome, diabetes, hypertension, and dyslipidaemia, and data suggest that the presence of these comorbidities may be more important markers of CAD risk than obesity alone[12].

In this study, it was found that among group II, highest percentage was of vessel score 2 (36%) followed by vessel score 1 in 32% and 24% had vessel score 3. On the contrary among group I, highest percentage was of vessel score 1 (58%) followed by 18% vessel score 2 and 12% patient had vessel score 3. Vessel score 1 was significantly higher in group I than group II. Vessel score 2 was significantly higher in group II than group I. This result is comparable with another study of Bangladesh[17].

Regarding the number of vessels involvement, the mean BMI of subjects with normal angiographic findings was 20.81 ± 1.03. The mean BMI of single, double and triple vessel disease were 23.85 ± 2.24, 24.25 ± 2.41 and 32.06 ± 7.86 respectively. The vessel involvement increased in proportion with increased BMI. These results are similar of the studies done by Labounty[12]and Islam[17].

The mean level of BMI was observed 25.82 ± 5.06 and 23.18 ± 4.77 in severe and moderate CAD respectively. The difference of mean BMI between the severe and moderate coronary artery disease groups was statistically significant. The findings were compatible with another study results[18].

The average Gensini score in group II patients was 18.6, whereas average Gensini score in group I patients was 10.2, which was statistically significant. There was a positive correlation between BMI and severity of coronary artery disease severity in terms of Gensini score. Haque mentioned that obesity was associated with increased cardiovascular risk and severity by its direct effect on heart and indirect effect through insulin resistance[16].

The findings of the present study suggest that, an increased BMI is associated with a significantly increased risk of suspected CAD and its severity in patients with acute STEMI. A higher BMI was also shown to be independently associated with increased risk of intermediate-term risk of myocardial infarction[12].

Conclusions:

From this study it may be concluded that, increased body mass index (BMI) is associated with angiographic severity of coronary artery disease in patients with acute ST-segment elevation myocardial infarction. So, overweight and obesity, as evidenced by increased BMI, may be considered as a reflection of severe coronary artery disease, among the patients with acute ST-segment elevation myocardial infarction.

Study limitations:

Although the result of this study supports the hypothesis, there are some facts to be considered which might affect the result:

1. This was a single tertiary hospital based study with a relatively small sample size.
2. This was a cross sectional, observational study. A prospective cohort study can better compare the prognostic value of BMI in regards to severity of coronary artery disease.
3. Purposive sampling was done instead of random sampling method.
4. This study was done among the patients of acute ST segment elevation myocardial infarction. So, the result cannot be applied to the general population.

This was a non-randomized study. Number of study population was small. It was a single centered study.

Recommendations:

Further prospective studies are needed to define the association between BMI and the severity of coronary artery disease in patients with ST-elevation myocardial infarction (STEMI). Similarly, randomized clinical trials using large number of patients may be used to predict the relationship between BMI and the severity of coronary artery disease.

Conflict of Interest - None.

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