Original Article

Association of Waist and Hip Ratio with the Angiographic Severity of Coronary Artery Disease in Patients with Non ST Segment Elevation Myocardial Infarction

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Abstract:

Background: Obesity is a proven independent risk factor for coronary artery disease. There are different methods for evaluation of obesity. The aim of this study is to evaluate the association between waist hip ratio and the severity of CAD in non-ST-segment elevation myocardial infarction patients.

Methods: This cross-sectional observational study was done at the National Institute of Cardiovascular Diseases (NICVD), Dhaka. A total of 100 patients with NSTEMI who underwent coronary angiogram during the indexed hospitalization period were included in this study. On the basis of WHR, study patients were divided into two groups 50 patients of NSTEMI with normal WHR (Male <0.90, Female <0.80) were assigned as group I and 50 patients of NSTEMI with increased WHR (Male ≥0.90, Female ≥0.80) were assigned as group II.

Results: The mean age of patients was 49.6±7.9 years and 52.3±8.7 years in Group I and Group II respectively with a male predominance in both the groups. No significant difference was found in between two groups in terms of demographic characteristics and traditional risk factors for CAD. Different parameters of angiographic severity of CAD were significantly higher in patients with increased WHR. Patients with non critical CAD (14% vs 0%, *P* = 0.02) and single vessel disease (58% vs 24%, *P* = 0.005) were more frequent in Group I, on the contrary double vessel disease (24% vs. 56%, *P* = 0.001) and triple vessel disease (4% vs. 20%, *P* = 0.03) were significantly more frequent in patients of Group II. Patients with moderate to severe CAD (Gensini score ≥36) were found more in Group II than that of in Group I (24% vs. 76%, *P* <0.001) and there was statistically significant higher Gensini score was found in Group II (21.96±19.72 vs. 44.18±28.91, *P* <0.001). Significant positive correlation was found in between WHR and coronary artery disease severity measured by vessel score (r = 0.41, *P* < 0.001) and Gensini score (r = 0.31, *P*< 0.001). Multivariate regression analysis yielded that the risk of having significant CAD are 3.45 times more in patients with increased WHR than those of normal WHR (95% CI: 1.229-12.979, *P* = 0.01).

Conclusion: Abdominal obesity, as evidenced by increased WHR, may be considered as a predictor of the severity of CAD in patients with acute NSTEMI.

Keyword: *Waist-hip ratio (WHR), Coronary artery disease (CAD), NSTEMI.*

(Bangladesh Heart Journal 2022; 37(2): 122-129)

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DOI: https://doi.org/10.3329/bhj.v37i2.63136

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Introduction

Coronary artery disease (CAD) is a common and leading cause of death all over the world. Like other South Asians, Bangladeshis are disproportionately prone to develop CAD, which is often premature in onset, angiographically more severe and follows a rapidly progressive course[1]. Previous studies suggest that, Non-ST elevated Myocardial Infarction (NSTEMI) occur more frequently than ST elevated Myocardial Infarction (STEMI) [2]. Non-ST elevation ACS (NSTEMI and UA) characterized by partial or near complete occlusion of a coronary artery. Also NSTE-ACS patients suffer more recurrent events and worse long-term outcomes[3, 4].

Obesity has association with all cause mortality from cardiovascular disease (CVD), along with diabetes is an important component of metabolic syndrome[5]. The deposition of adipose tissue is associated with systemic inflammation which has a direct effect on CAD risk[6]. Visceral adipocytes differ from subcutaneous adipocytes in their release of secretory proteins potentially protective for diabetes and show lower expression levels in visceral than subcutaneous tissue[7]. Over the last two decades the prevalence of overweight and obesity in Dhaka city has increased at least five folds and it was much higher among those with better socioeconomic status[8].

Currently used general and central obesity anthropometric measures for assessing adiposity related risk include, body mass index (BMI), waist circumference (WC), hip circumference (HC), waist-hip ratio (WHR) and waist-height ratio (WHtR)[6]. BMI is often used to reflect total obesity, whereas the WC, WHR and WHtR are used as surrogates for intra-abdominal adiposity[9]. BMI does not differentiate between fat and fat free mass so for is inadequate for identifying individuals at increased risk of CAD[6]. Waist and hip circumferences measures different aspects of body composition and fat distribution and have independent and often opposite effects on CVD risk factors[10] . The larger waist circumference may be associated with a higher risk of developing CVD or CVD mortality. Because of the opposing effects of waist and hip circumferences, the WHR has become a popular method of assessing atherogenic risk[11].

Computed tomography scan (CT scan) and Magnetic resonance imaging (MRI) are accurate for measuring body composition[12]. Sonographically based obesity measurements are not superior to anthropometric indices in predicting the presence CAD[13]. de Koning et al. found a 1cm increase in WC was associated with a 2% increase in risk of future CVD[14]. Lakka et al. found abdominal obesity was an independent risk factor for coronary heart disease in middle-aged men[15]. In a study Kaur et al. demonstrated waist related anthropometric measures were important predictors of CAD risk factors among middle aged and older women, as compared to BMI. Dalton et al. demonstrated that WHR was the most useful measures of obesity to use to identify individuals with CVD risks[16]. Yusuf et al. demonstrated that, among the various anthropometric measures commonly used, WHR showed the strongest relation with the risk of MI worldwide both in men and women[17]. Canoy et al. also demonstrated indices of abdominal obesity were more consistently and strongly predictive of coronary heart disease than BMI[18]. In a large study, Czernichow et al. showed that greater WC and WHR were associated with an increased risk for CVD[19] .

NSTEMI patients show greater heterogeneity than patients with STEMI who, as a group, present with a relatively predictable prognosis; however, either presentation is equally dangerous. There remains a lack of supporting evidence on the impact of central obesity on clinical outcomes in patients with NSTEMI, especially when considering WHR. Lee, et al. evaluated the relationship between the WHR, as a surrogate marker of central obesity, and clinical outcomes in patients with non-ST-segment elevation myocardial infarction (NSTEMI) undergoing percutaneous coronary intervention (PCI) and found that central obesity represented by WHR values was associated with poor clinical outcomes among NSTEMI patients[20].

In a recent study done in Bangladesh, Bhowmik et al. found indices of central obesity

better predicted cardio-metabolic risk factors than general obesity defined by BMI[9]. Sabah, et al. found positive correlation between waist to height ratio and severity of coronary artery disease and also with BMI[21]. Another study done by Hossain et.al., found significant association between waist-hip ratio (WHR) and the severity of CAD in patients with acute STEMI[22].

Coronary angiography is undoubtedly the most sensitive and specific method available for assessing CAD. It also has the advantage that, even minor atherosclerotic lesion at a subclinical stage can be detected. Severity of CAD are measured by several scoring system and interpretations are important regarding preventive and therapeutic interventions. A few studies were done to evaluate the association between WHR and angiographic severity of CAD in patients with STEMI. But no study was done regarding patients with NSTEMI in our population. So, this study on association of WHR with angiographic severity of coronary artery disease in patients with NSTEMI

was helpful for understanding the scenario among the Bangladeshi population.

Methods

This cross sectional observational study was carried out in the department of Cardiology at National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh from April, 2018 to May, 2019. All patients admitted with NSTEMI in the department of cardiology, NICVD, fulfilling the inclusion and exclusion criteria were considered for the study. Total 100 patients were selected for data collection. They were divided into two groups, group I (Normal WHR, Male < 0.90, Female < 0.80) 50 patients and in group II (Increased WHR, Male e"0.90, Female ≥0.80) 50 patients.

Detailed history were taken and clinical examination were done and recorded in pre designed structured form including demographic data and risk factor profile. NSTEMI were diagnosed by third universal definition of Myocardial Infarction. Data collection was done after taking informed written consent from each patient. Waist circumference and hip circumference were measured on the day before coronary angiography (CAG). Waist circumference was measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest, using a stretch resistant tape at the end of a normal expiration. Hip circumference was measured around the widest portion of the buttocks, with the tape parallel to the floor.

Routine laboratory investigations (ECG, Troponin-I, RBS, serum creatinine, serum electrolytes, fasting Lipid profile and next morning FBS) were done. Base line investigations for CAG were done. Coronary angiogram was done using Shimadzu BRANSIST alexa F12 MiX package. All procedures were performed by experienced interventional cardiologists through radial or femoral route. Angiographic findings were evaluated by two independent cardiologists blinded to treatment and clinical interpretation. Angiographic severity of coronary artery disease was assessed by visual estimation (in at least two orthogonal views) by which estimation of vessel score and Gensini score was done.

Data were analyzed by using SPSS version 25. (Statistical package for social science) Continuous data were expressed as mean ± SD; dichotomous data were expressed as percentage. Comparison of continuous variables were done by unpaired t-test, categorical data were analyzed with Chi-square (X^2) test and Fisher's exact test and ANOVA tests were used as applicable. The significance of the results as determined in 95% confidence interval and a value of P < 0.05 were considered to be statistically significant. Spearman's rank correlation coefficient test, Pearson's correlation coefficient test and logistic regression analysis were used as appropriate.

RESULTS

There was no significant difference in mean age and sex in between the groups as the patients were homogenously distributed in between the groups. There was male predominance in both groups with no significant difference (Table I & Figure 1). In Table II, WHR were higher in male patients than female patients and the differences between them were statistically significant (p<0.05). There was no significant difference of distribution of patients in terms of different traditional risk factors for CAD in between two groups (Table III).

The mean body mass index and anthropometric status of the study patients were significantly higher in group II than group I (table IV). The ejection fraction of the patients and the mean difference between the two groups was not statistically significant (Table V). Patients with non critical CAD (14% vs 0%, *P* = 0.02) and single vessel disease (58% vs 24%, *P* = 0.005) were more frequent in Group I, on the contrary double vessel disease (24% vs 56%, *P* = 0.001) and triple vessel disease (4% vs 20%, *P* = 0.03) were more frequent in patients of Group II with significant difference (Table VI).

Table VII shows the sequence of mean WHR of study patients according to the number of vessels involvement. The mean WHR of subjects with normal angiographic findings was 0.85±0.029. The mean WHR of single, double and triple vessel disease were 0.91±0.135, 0.97±0.162 and 1.05±0.259 respectively and this differences were statistically significant (p=0.01).

Table VIII shows coronary artery disease (CAD) severity of the study patients.

Moderate to severe CAD was found 76% and 24% in group II and group I respectively.

The moderate to severe CAD patients are significantly higher in group II than group I (p<0.001). The difference of mean Gensini Score between the group I and group II was statistically significant (p<0.001).

The mean WHR was found 0.99±0.19 and 0.89±0.12 in moderate to severe and normal to mild CAD respectively. The difference of mean WHR between the moderate to severe and normal to mild CAD groups was statistically significant (Table IX).

The figure 2, depicts that there was a positive correlation between WHR and CAD severity in terms of vessel score (r=0.41). The figure 3, demonstrates that there was also

a positive correlation between WHR and CAD severity in terms of Gensini score (r=0.31). The table X depicts the multivariate logistic regression analysis of odds ratio (OR) for characteristics of the subjects likely to cause coronary artery disease severity. It was observed that waist circumference; increased BMI and increased WHR were found to be the significant predictors of severe CAD.

Table-I
Distribution age of the study population (n=100)

Age in years	Group I (n=50) Number	%	Group II (n=50) Number	%	p value
≤ 40	6	12.0	6	12.0	
41 -50	22	44.0	19	38.0	
51- 60	19	38.0	18	36.0	
> 60	3	6.0	7	14.0	
Mean± SD	49.6±7.4		52.3±8.7		0.009^{ns}
Range	28 – 65		35 - 75		

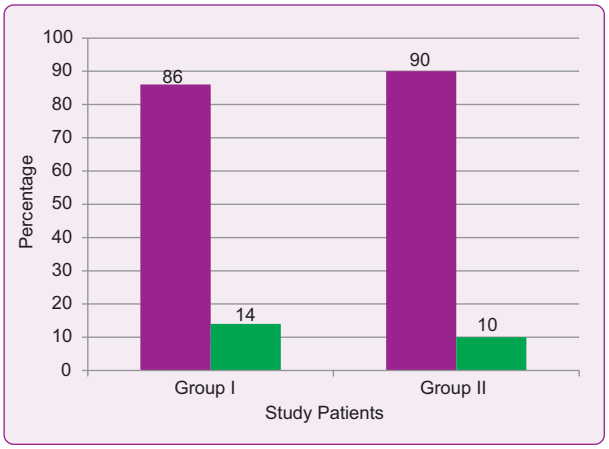

Fig.-1: *Distribution of gender in between the groups.*

Table-II
Gender wise distribution of WHR status of the study population (n=100)

Study Group	WHR Male Mean±SD	WHR Female Mean±SD	p value
Group I (n=50, M-43, F-7)	0.85±0.023	0.81±0.045	0.01^{S}
Group II (n=50, M-45, F-5)	1.06±0.194	0.92±0.039	0.04^{S}
Total (n=100, M-88, F-12)	0.95±0.174	0.86±0.067	0.03^{S}

Table-III
Distribution of risk factors of the study population (n=100)

Risk Factors	Group I (n=50) Number	%	Group II (n=50) Number	%	p value
Hypertension	21	42.0	28	56.0	0.16^{ns}
Diabetes Mellitus	19	38.0	25	50.0	0.22^{ns}
Dyslipidaemia	21	42.0	27	54.0	0.23^{ns}
Smoking	22	44.0	26	52.0	0.42^{ns}
Family H/O CAD	11	22.0	15	30.0	0.36^{ns}

Table-IV
Distribution of anthropometric parameters of study population(n=100)

Characteristics	Group I (n=50) Mean ± SD	Group II (n=50) Mean ± SD	p value
Body Mass Index (kg/m2)	21.78±3.55	26.90±3.24	0.001s
Waist circumference (cm)	77.70±6.03	98.84±5.53	0.001s
Waist-Hip ratio	0.84±0.03	1.04±0.19	0.001s

Table-V
Distribution of ejection fraction of study population (n=100).

Ejection fraction (%)	Group I Number	%	Group II Number	%	p value
Moderate LV dysfunction (35-44)	0	0.0	2	4.0	
Mild LV dysfunction (45-54)	13	26.0	18	36.0	
Normal LV function (≥55)	37	74	30	60.0	
Mean ± SD	57.5±5.3		55.1±4.8		0.12ns
Range	48-68		36-68		

Table-VI
Distribution of the study population according to vessel score (n=100).

Vessel score	Group I Number	%	Group II Number	%	p value
Score – 0	7	14.0	0	0.0	0.022s
Score – 1	29	58.0	12	24.0	0.005s
Score – 2	12	24.0	28	56.0	0.001s
Score – 3	2	4.0	10	20.0	0.031s

Table-VII
Association between WHR and number of vessels involvement (n=100).

Number of vessel involved	Waist-hip Ratio (WHR) Mean	±SD	p value
None (n=7)	0.85	0.029	?
Single (n=41)	0.91	0.135	?
Double (n=40)	0.97	0.162	0.01s
Triple (n=12)	1-05	0-259	

Table-VIII
Distribution of study population according to CAD severity between the groups by Gensini score (n=100).

CAD severity by Gensini Score	Group I Number	%	Group II Number	%	p value
Moderate to severe (≥36 points)	12	24.0	38	76-0	0.001s
Normal to mild (≥36 points)	38	76.0	12	24.0	0.001s
Mean ±SD	21.96±19.72		44.18±28.91		<0.001s

Table-IX
Mean status of WHR of the study patients according to significant coronary artery disease defined by Gensini Score (n=100)

WHR	Moderate to severe CAD (n=50) (GS ≥36)	Normal to mild CAD (n=50) (GS<36)	p value
Mean±SD	0.99±0.19	0.89±0.12	0.004s

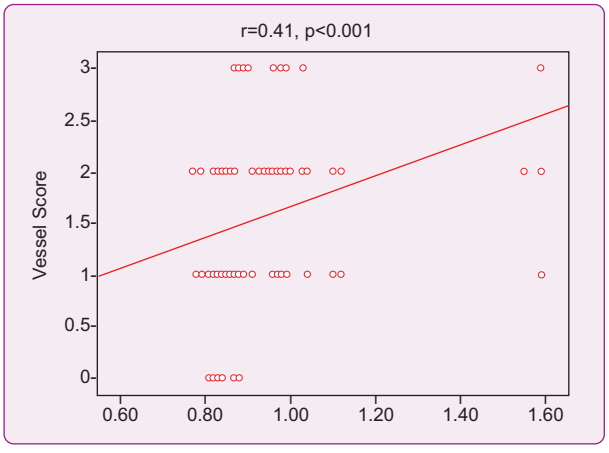

Fig.-2: *Correlation between WHR and vessel score.*

Table X
Multivariate regression of determinants of significant CAD (Gensini Score).

Variables	Regression coefficient (B)	OR	95% CI	p value
Waist Circumference	0.398	1.37	1.045 - 8.290	0.04s
Increased BMI	0.504	1.52	1.021 - 7.912	0.02s
Increased WHR	0.812	3-45	1.229 - 12.979	0.01s

Discussion

This study intended to evaluate the association between WHR and the severity of coronary artery disease in patients with Non ST-segment elevation myocardial infarction (NSTEMI). Mean body mass index and anthropometric status were observed between two groups. Both BMI and Waist-hip ratio were significantly (p<0.001) higher in group II than group I.The results were compatible with the study done by Rofiquzzaman et. al[23].

Among group II, highest percentage was of 2 vessel score (56%) followed by 1 vessel score 24%, 2 vessel score (20%) and none in 0 vessel score. On the contrary among group I, highest percentage was of 1 vessel score (58%) followed by 24% in 2 vessel score, 14% patients had 0 vessel score and 4% of 2 vessel score. 0 vessel involvement was found statistical association in both group (p=0.02). 1 vessel score significantly higher in group I (p=0.005) than group II. 2 vessel involvement was significantly higher in group II than group I (p=0.001). Three vessel involvement was observed more in group II than group I and was statistically significant (p=0.03).This result was comparable with the study of Rofiquzzaman[23].

The mean WHR of subjects with normal angiographic findings was 0.85±0.029. The mean WHR of single, double and triple vessel disease were 0.91±0.135, 0.97±0.162 and 1.05±0.259 respectively. The WHR increased in proportion with the number of vessel involved from no vessel involvement to triple vessel involvement and the differences were statistically significant (p=0.01). Ahmad et al., found that the WHR was abnormally increased in 65% of patients with CAD, whereas only 34% were normal WHR were diagnosed to have CAD[5].

Moderate to severe CAD was found 76% and 24% in group II and group I respectively.

The moderate to severe CAD patients are significantly higher in group II than group I (p<0.001). It was also found that the relative risk of CAD was approximately twice in the group with increased WHR than among

normal WHR (RR= 3.16, CI=1.888 – 5.312, p<0.001). Ahmad et al., found that the relative risk of CAD was approximately twice in the group with increased WHR than among normal WHR which supported the finding of the present study[5].

The mean Gensini Score was found 21.96±19.72 and 44.18±28.91 in group I and group II respectively. The difference of mean Gensini Score between the group I and group II was statistically significant (p<0.001). Bakhoum, et al. found that the mean Genseni's score was 85.1±38.5 vs 60.4 ± 43.6 in patints with or without abdominal obesity in terms of WC respectively that indicated that Genseni's score was higher in abdominal obese than normal population[24].

The mean WHR was found 0.99±0.19 and 0.89±0.12 in moderate to severe and normal to mild CAD respectively. The difference of mean WHR between the moderate to severe and normal to mild CAD groups was statistically significant (p=0.004). Similar finding was evaluated by Parsa et al., who found mean±SD of their WHR in relation to CAD severity in terms of duke score from 0.951±0.07 to 0.987 ±0.05 and was statistically significant (p=0.03)[25].

There was a positive correlation between WHR and coronary artery disease severity in terms of vessel score (r=0.41). It was observed that the Spearman's rank correlation was statistically significant (p<0.001). There was also a positive correlation between WHR and coronary artery disease severity in terms of Gensini score (r=0.31). It was observed that the Pearson's correlation was statistically significant (p=0.001). It was supported by the study of Ahmadet al., and Parsaet al[24, 25].

Multivariate logistic regression analysis of odds ratio (OR) for characteristics of the subjects likely to cause coronary artery disease severity. The variables revealed to be significantly associated with severe CAD by multivariate analysis were entered into the model directly. It was observed that waist circumference, increased BMI and increased WHR were found to be the significant predictors of severe CAD with ORs being 1.37, 1.52 and 3.45 respectively. This result was compatible with the study of Parsa et al[25].

Conclusions:

The present study concluded that increased WHR was significantly associated with the angiographic severity of coronary artery disease in patients with Non ST-segment elevation myocardial infarction. Significant positive correlation was observed between the vessel score and WHR. Similarly WHR levels were found to be higher in patients with high degree of angiographic stenosis in terms of Genseni's score. So, abdominal obesity, as evidenced by increased WHR, may be considered as a predictor of the severity of CAD in patients with acute Non ST-segment elevation myocardial infarction.

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