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Association of anthropometric measurements with angiographic findings among diabetic patients with coronary artery disease

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Abstract

Introduction: Obesity is one of the modifiable risk factors of diabetes mellitus (DM) and its complications viz. coronary artery disease (CAD). Scientific evidence indicates a stronger association of angiographic severity with obesity. This study aimed to compare the association of different anthropometric measurements with angiographic severity among diabetic patients with CAD and evaluate its usefulness.

Methods: A cross-sectional study was conducted among 78 consecutive diabetic patients who underwent coronary angiography for suspected or known CAD of both sex aged between 35 and 65 years, with significant angiographic findings of >50% diameter stenosis. Grouping was done based on body mass index (BMI): Group I – 18 to 24.9 kg/m^2 and group II – ≥ 25 kg/m^2. WC (waist circumference) > 90 cm in males and > 80 cm in females was considered as abnormal (central obesity). The anthropometric measurements included height, weight, BMI, WC, and visceral adiposity index . The Gensini scoring system was used for the assessment of the severity of CAD.

Results: Among the 78 patients 57 (73%) and 21(27%) were males and females, respectively. Forty-three percent of the patients had (n=33) high BMI ≥ 25 kg/m^2 but 69.2% had abnormal WC. Gensini score was 34.9 SE 4.5640 and 36.09 SE 5.77 among group I and group II, respectively. We found a statistically significant association of WC with the number of vessels involved (P = 0.019).

Conclusion: There was a significant positive association of WC with the number of vessels involved among diabetic patients with CAD.

Keywords: body mass index; coronary artery disease; Gensini score; waist circumference

Introduction

Diabetes mellitus (DM) has become one of the major global health burdens especially, in developing countries. In 2013, 382 million people had diabetes; and this is expected to rise to 592 million by 2035[1]. Obesity is a morbid state, causing dysfunctional adiposity, affecting many organs, and plays a vicious role in metabolic diseases such as DM and cardiovascular disease.[2,3] Body mass index (BMI), waist circumference (WC), and waist-hip ratio (WHR) are the various tools used to assess obesity, out of which BMI is used for classifying overweight and obesity. WHR is used commonly to assess central obesity. The WC is found to have a better correlation with abdominal fat localization[4] and is the main predictor of cardiovascular and metabolic risk in obese girls.[5] As per prospective epidemiological studies, central obesity assessed by WC and WHR is more significant to coronary artery disease (CAD) risk.[6] The visceral adiposity index (VAI), which includes anthropometric measures like WC, BMI, high-density lipoprotein-cholesterol (HDL-C), and serum triglycerides (TG) levels, was revealed to be

a better surrogate index than single anthropometric indices in predicting metabolic disorders related to insulin resistance.[7]

CAD is one of the most pivotal microvascular complications of DM. The Gensini score system is a technique developed by Gensini *et al*.,[8] for assessing the severity of CAD. The South Asians have a lower BMI with visceral adiposity and are more prone to CAD,[9] so, we aimed to explore the association of anthropometric measurements with angiographic severity among diabetic patients with CAD.

Methodology

Selection of patients

This is a cross-sectional study conducted among 78 consecutive diabetic patients who underwent coronary angiography for known or suspected coronary atherosclerosis of both sexes aged between 35 and 65 years with significant angiographic findings of >50% diameter stenosis at the cardiac department of a tertiary care hospital with their prior informed consent. The sample size was calculated at a 5% level of significance and 27.86 standard deviations based on the study by Nabati et al.,[10] with a 7% margin of error.

Clinically stable patients without any major concomitant non-cardiovascular disease were included in the study on assessment at the tertiary care hospital.

Exclusion criteria: patients with insignificant angiographic findings diameter stenosis of < 50% in vessels, aged > 65 years, chronic decompensated hepatic disorder, and chronic renal disorder beyond stage 3 are excluded from the study.

Institutional ethical committee clearance was obtained before the initiation of the study (IEC No.YEC-1/2019/106). The written informed consent was obtained from all the study subjects. Information pertaining to socio-demographic characteristics and anthropometric measurements was collected by personal interviews.

Coronary angiography

Gensini scoring system,[8] was used to score angiographic findings as follows: one point for ≤25% narrowing, two points for 26 to 50% narrowing, four points for 51 to 75% narrowing, eight points for 76 to 90% narrowing, 16 points for 91 to 99% narrowing, and 32 points for total occlusion. This primary score was later multiplied by a factor that is assigned according to the geographical position of the lesion in the coronary arterial tree. Score 1–32 is considered as mild and 33–58 and >59 considered as moderate and severe, respectively.

Anthropometric measurements

BMI was calculated as weight in kg divided by the height in m^2 and categorization of the participants were done as per World Health Organization (WHO) criteria.[11] WC >90 cm in males and >80 cm in females was considered as abnormal (central/truncal obesity).[12] VAI was calculated as:

$$\frac{WC}{39.68+(1.88\times BMI)}\times\frac{TG}{1.03}\times\frac{1.31}{HDL}\text{ in males and}$$

$$\frac{WC}{36.58+(1.89\times BMI)}\times\frac{TG}{0.81}\times\frac{1.52}{HDL}\text{in females.}^{13}$$

Study groups

- Group I included patients with normal BMI of 18–24.9 kg/m^2.
- Group II included overweight and obese patients with BMI ≥ 25 kg/m^2.

Biochemical investigations

Fasting blood samples were taken under aseptic condition for fasting blood glucose, lipid profile, and glycated hemoglobin (HbA1c) estimations performed by standard, automated methods.

Statistical analysis

The data were analyzed with Statistical Package for the Social Science, version 22 (SPSS Inc., Chicago, IL). Results are presented as mean and standard deviation for continuous variables. An independent student t-test was used to compare between groups. Mann-Whitey test and Spearman correlation was used to compare nonparametric parameters. Categorical variables were compared using

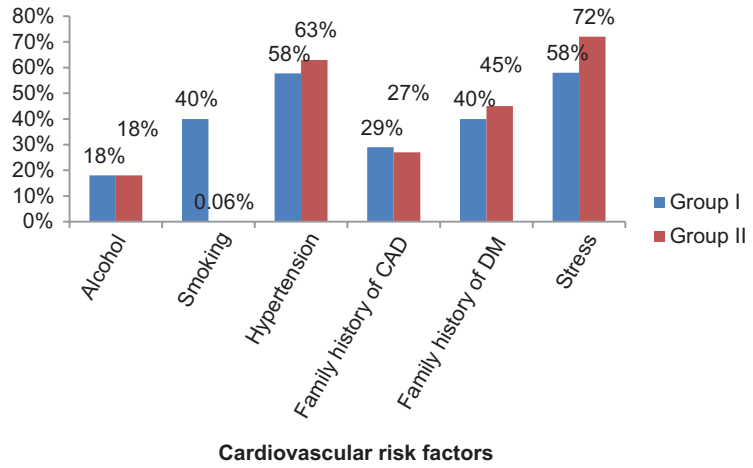

Figure 1 Prevalence of cardiovascular risk factors among study groups based on body mass index.

the chi-square test. $P < 0.05$ was considered as significant.

Results

Of the 78 diabetic patients included in the study, 57 (73%) were males, and 21(27%) were females. Table 1 shows the demographic and baseline characteristics of groups I and II patients categorized on their BMI. Among, the total population 57% (n=45) had normal BMI (18–24.9 kg/m^2) whereas remaining 43% (n=33) had ≥ 25 kg/m^2. Figure 1 shows the prevalence of cardiovascular risk factors. Stress was found to be higher among both groups. Statistical analysis did not show any significance with cardiovascular risk factors between the two groups. Table 2 shows the association of angiographic severity with WC. There was a significant association of the number of vessels with WC with a P =0.019. Table 3 shows no significant association of angiographic findings with BMI.

Table 1 Baseline characteristics of study participants in groups I and II.

Parameters	Group I, N(%) 45(57.6)	Group II, N(%) 33(42.3)	P-value
Age (years)	54.46 ± 7.536	53.394 ± 8.2	0.56
Gender (M/F)	37/8	20/13	0.034*
SBP (mmHg)	125.56 ± 11.97	127.27 ± 9.1	0.5
DBP (mmHg)	80.22 ± 6.57	80.9 ± 5.2	0.62
Height (m^2)	1.64 ± 0.069	1.6 ± 0.08	0.02*
Weight (kg)	59.37 ± 7.9	72.15 ± 9.9	0.000*
BMI	21.92 ± 1.94	28 ± 2.46	0.000*
WC (cm)	88.63 ± 7.41	99.52 ± 8.64	0.000*
VAI	4.27 ± 2.53	4.98 ± 3.76	0.35
Diabetic duration†	5.37 SE 1.024	6.65 SE 1.179	0.238
FBS† (mg/dL)	154.6 SE 9.2	171.6 SE 11.3	0.15
HbA1C (%)	9.2 ± 2.4	9.98 ± 2.73	0.213
TC (mg/dL)	186.27 ± 42.4	175.66 ± 51	0.329
LDL (mg/dL)	115.67 ± 42.9	103.63 ± 43.05	0.26
TG† (mg/dL)	183.28 SE 15.66	185.5 SE 17.1	0.69
HDL (mg/dL)	34.6 ± 9.8	32.9 ± 10.3	0.513
TC/HDL	5.9 ± 2.4	5.5 ± 1.83	0.49

*P < 0.05 was considered significant. Results are expressed as mean ± SD.
†Expressed as median and standard error.
SBP, systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index; WC, waist circumference, VAI, visceral adiposity index; FBG, fasting blood glucose; HbA1c, glycated hemoglobin; TC, total cholesterol; LDL, lowdensity lipoprotein; TG, triglyceride; HDL: highdensity lipoprotein.

Discussion

In the present study, we found a significant association in the number of vessels involved with WC. However, we found no association between anthropometric parameters such as BMI and VAI with the severity of CAD. Nearly 75% of the population had abnormal WC with double or triple vessel disease. This had clinical implications since the literature mentions diffuse disease among diabetic patients.[14] Current lifestyle changes have led to an increase in the prevalence of obesity and obesity-associated with morbidity and mortality, including CAD. The quench for early diagnosis of obesity and its complication encouraged researchers to find the most accurate indexes of obesity.[5] Anthropometric indices BMI, WC, WHR, and waist-height ratio have

Table 2 Association between angiographic findings and waist circumference.

	WC		Total	P value
	Normal, N(%) 25(32.05%)	Abnormal, N(%) 53(67.9%)		
Number of vessels involved				
Single	3 (3.8%)	22 (28.2%)	25 (32.1%)	
Double	11 (14.1%)	18 (23.1%)	29 (37.2%)	0.019*
Triple	11 (14.1%)	13 (16.7%)	24 (30.8%)	
Gensini score				
Mild	10 (12.8%)	30 (38.5%)	40 (51.3%)	
Moderate	11 (14.1%)	17 (21.8%)	28 (35.9%)	0.390
Severe	4 (5.1%)	6 (7.7%)	10 (12.8%)	

*P < 0.05 was considered significant. WC, waist circumference

been shown to have significant correlations with lipid parameters in young Indian females, which is one of the contributing factors for coronary artery disease.[15]

A higher percentage (57.6%) of patients had normal BMI than those with high BMI (42.3%) in the present study (Table 1). Despite a relatively lower rate of obesity as defined by BMI cut points, South Asians have larger waist measurements and WHR, indicating a greater degree of central body obesity. This is associated with a characteristic metabolic profile with higher insulin levels, a greater degree of insulin resistance, and a higher prevalence of diabetes.[9] Different anthropometric cut-off values for various ethnic groups and populations always make comparisons difficult and limit generalizability.[12]

As we did not find any statistically significant comparison between the two groups, we checked for an association of angiographic findings between groups based on WC (Table 2) and BMI (Table 3). We found a significant association between WC group and the number of vessels involved with a $p = 0.019$. Even though most of our study population (57.6%) were falling to a healthy group based on BMI, 69.2% of the population had abnormal WC. WHR or WC may predict cardiovascular risk better than BMI.[5] We did not find any significant association with the Gensini score. This finding is consistent with the findings of previous studies.[16,17] This may be because the Gensini scoring is done based on the geographical importance of vessel multiplied by degree of occlusion scores. Moreover, our population only included the diabetic population who are more prone to develop diffuse coronary artery disease.

Rubinshtein et al.[18] stated an inverse relationship between severity of CAD and BMI among 928 patients with CAD. A study conducted by Rashiti et al.[21] on 82 patients with suspected or known CAD, did not show any significant correlation between BMI and CAD. But the result showed a significant correlation between WHR and CAD ($p = 0.0001$).[19] On comparing WC and WHR as a marker of risk factors, the latter was found to be superior, according to most of the cross-sectional studies.[20] In the global obesity epidemic report on 1997, the WHO recommended the assessment of both BMI and WC for the determination of CVD risk and subsequent treatment strategies.[21] In a prospective study conducted by Alan et al.,[22] they found that 84cm in men and 71cm in women may be useful in identifying those at increased risk of developing CHD.[22] According to Niraj et al.,[23] as obese patients are referred at an earlier age for coronary angiography, they are found to have less severe CAD. This may impart further integrity to the occurrence of an apparent obesity paradox. Nevertheless, after adjustment for comorbidities, obesity intrinsically is not an independent predictor of CAD severity.

Conclusion

A significant positive association exists between WC and the number of vessels involved in diabetic patients with CAD. WC an index of abdominal/central adiposity can serve as a more useful anthropometric index for the assessment of cardiometabolic risk than BMI which is a standard tool to assess body obesity, a known risk factor for DM and CAD.

Limitation

Our study is a cross-sectional study, which limits the causal relationship between anthropometric measurements and angiographic findings. There

are several factors which influence BMI and other anthropometric levels, which play a role in controlling diabetes and in the primary prevention of CAD. Because of the relatively small sample size, comparisons were limited to two BMI groups: Group I – normal weight and group II – overweight and obese. WHR which might have served as a better index than WC was not used in the study.

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