Original Article

A Correlation study of Fasting blood glucose with body mass index and waist circumference in adult population.

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Abstract: *The incidence of diabetes mellitus (DM) is increasing rapidly worldwide, threatening to reduce life expectancy around the globe. Over a period of time great emphasis has been made to prevent diabetes and its complications. The objective of the study was to assess the correlation of fasting blood sugar with waist circumference and body mass index in adult population. 84 patients were examined for body mass index (BMI), waist circumference(WC), and fasting blood sugar (FBS). The study showed a positive statistically significant correlation between fasting blood sugar and BMI ($p<0.05$) (R 0.275) and Waist circumference ($p<0.001$) (R 0.421). High BMI, Waist circumference, can be taken as predictors of type 2 diabetes.*

Key words: *T2DM, Waist circumference (WC), Body mass Index (BMI), FBS.*

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Introduction

Worldwide the prevalence of type-2 diabetes mellitus (T2DM) has been rising, and about 90 % of the diabetic population are T2DM.[1] An estimated 10 million people in Bangladesh have diabetes.[2] A study reveals a more shocking fact, almost one in ten adults in Bangladesh was found to have diabetes.[3]

Bangladesh, a developing country with fast economic growth, has been experiencing rapid urbanization for the past several decades. This development and urbanization raise the concern that the chronic disease burden may show an increasing trend in future, especially due to altering food habit including increased access to and popularity of processed food, irregular meal times, less physical activity, obesity etc.[4] Three big reasons to diabetes among Bangladeshi people are carbohydrate-dependent food pattern, sedentary lifestyle and huge gap between the number of diabetic patients and doctors.[5] According to the WHO-Diabetes country profile of Bangladesh in 2016, the physical inactivity was prevailing among 25.1% of population.[6] According to the latest WHO data published in 2017 Diabetes Mellitus deaths in Bangladesh reached 40,142 or 5.09% of total deaths.[7]

The International Diabetes Federation estimated 7.1 million people with diabetes in Bangladesh. This number is estimated to double by 2025. During 90s, the country has a relatively low diabetes affected population. According to the International Diabetes Federation, the prevalence will be 13% by 2030. Bangladesh was ranked as the 8th highest diabetic populous country in the time period of 2010-2011. About 129,000 deaths were attributed to diabetes in Bangladesh in 2015,

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as reported by leading research organization ICDDRB.[8]

Diabetes has been associated with several risk factors. One of the most important risk factors is obesity.[9,10] High BMI has been associated with great morbidity and mortality worldwide.[1,11] The obesity is hazardous health problems. The mortality increases with increase prevalence of obesity.[12] The overweight and Obesity have significant association with adults diabetes mellitus (DM) and hypercholesterolemia.[13]

Lipid metabolism is also adversely affected in obesity. The prevalence of these risk factors substantially increases with increasing BMI. Overweight and obesity are also known to be independent risk factor for DM in adults.[14]

Glucose synthesizes fatty acid that constitute body fat content. An increase in blood glucose level will result in increase in BMI causing increased lipid biosynthesis and hence body weight.[15] Insulin which is secreted from beta cells of islets of langerhans from pancreases act through specific cell receptor of insulin sensitive cells which results in enhanced glucose uptake into the cell.[16] Insulin being an anabolic hormone results in energy conservation and thereby signaling the body to produce fat. As BMI increases, insulin resistance also increases which results in increased blood glucose level in body. Since body weight is associated with BMI, it may be expected that BMI should correlate with blood glucose levels.[17]

BMI which relates weight to height. It is the most widely used parameter for evaluation of obesity, but it has several limitations. First, lean mass and fat mass could not be differentiated for a given BMI across age, sex and race.[18] Second, fat distribution could not be distinguished by BMI.[19,20] As a measure of identification of body fat composition as well as regional body fat distribution is not reliable because it is a marker of general obesity rather than central obesity, whilst it has been generally accepted that visceral adiposity plays more important role in developing insulin resistance and diabetes rather than overall adiposity.[21,22] Visceral fats are linked with lipolytic activity and reduce insulin activity through increasing fatty acids.[23,24] Therefore, waist circumference (WC) was developed as an abdominal adiposity measure which considers fat distribution. Among other anthropometric parameter, WC are the better measure of visceral and abdominal fat distribution and accepted as the best anthropometric indicator of abdominal adiposity and metabolic risk.[12,16] Although in most populations WC is a stronger predictor for diabetes compared with BMI[22,25] no significant differences were observed between WC and BMI in Japanese and Iranians to predict disease risk.[26,27] Central obesity is a common factor among Bangladeshi people.[8] Moreover, BMI is a difficult term for the common man to understand. Calculation of BMI is also difficult for a common man. On the other hand everyone knows their pant or pajama size that's why WC which gives a perfect representation of the abdominal obesity and it is an easily understandable term, and also can be a better predictor of diabetes. The aim of the present study was to investigate the relationship of BMI and FBS and WC and FBS level in adult population.

Material And Methods

The study was conducted at Sylhet Women's Medical college Hospital from March 2019 to May 2019. Patients attending the medical outpatient department were invited to participate in the study. Informed written consent was obtained from all the subjects. Total 84 subjects were enrolled in the study. Weight was recorded to nearest 0.5 kg and height was recorded to nearest 0.5 cm. Height was measured in the standing position without shoes by using a tape meter, shoulder was in a normal position. BMI was calculated as weight (kg) divided by height squared (meter) and used as the WHO criteria for Asian people for the diagnosis of overweight and obesity. Those with a BMI of 17.5- 22.9 kg/m2 were classified as normal weight, while 23.0-27.9 Kg/m2 were classified as overweight and those with a BMI $\geq$ 27 Kg/m2 were defined as obese. The waist circumference was measured by using a

measuring tape at the level which was midway between the lowest rib margin and the iliac crest. According to WHO criteria for Asian people those WC with > 90 cm in male and >80 were classified as obese and those WC were less than 90 cm in male and less than 80cm in female were classified as non-obese.[28]

Fasting blood sugar was taken after an 8 hour of fast. Under aseptic precautions, 5 ml of fasting venous sample was collected for FBS, Fasting blood sugar were analyzed on Vitros 250 dry chemistry fully auto analyzer. Fasting sugar level above 7mmol/l was confirmed as a diabetic. All data were analyses by SPSS 22. The Pearson correlation coefficient test was used to explore the relationship between the data. Chi square test was used to find out the relationship. Statistical significance was considered at p value <0.05.

Inclusion criteria

Subjects of either gender between 20-65 years and not taking any anti-diabetic drugs.

Exclusion criteria

Patients with chronic liver diseases, renal disease, cardiac disease, respiratory disease, or any other acute or chronic diseases as well as patients suffering from AIDS, thyroid disorder, psychiatric illness or on insulin therapy were also excluded. Pregnant women are also not included in the study. Detailed history, general physical examination and systemic examination were performed for all the participants.

Results

Total 84 patients were included in this study. Normal BMI was found in 20(71.4%) patient, they were non diabetic and 8(28.6%) were diabetic.11 (23.9%) patients were overweight and non diabetic and 35(76.1%) of overweight patients were diabetic . Only 10 (11.9%) patients were obese having BMI 23.0-27.9 Kg/m2 and 5 (50.0%) of them are non diabetic patients and 5 (50.0%) were diabetic . (Table 1).

Table 2 shows: FBS according to WC. In this analysis obese presented higher fasting blood sugar level than non-obese. There was significant correlation between WC and FBS. ($P < 0.001$)

The study also established a correlation between FBS and BMI and between FBS and WC (Table 3).

Figure 1: Shows significant correlation between body mass index and fasting blood sugar.

Figure 2: shows significant better correlation between waist circumference and fasting blood sugar.

Table -1: Association of the body mass index with fasting blood sugar

FBS	BMI			Pearson Chi-Square	P-value
	Normal weight	Over weight	Obese		
Normal	20 (71.4%)	11 (23.9%)	5 (50.0%)		
Diabetic	8 (28.6%)	35 (76.1%)	5 (50.0%)	16.283	<0.001
Total	28 (33.3%)	46 (54.8%)	10 (11.9%)		

Table- 2: shows the Association of the waist circumference with fasting blood sugar

FBS	Waist circumferance		Pearson Chi-Square	P-value
	Non Obese	Obese		
Normal	25 (65.8%)	11 (23.9%)	14.901	<0.001
Diabetic	13 (34.2%)	35 (76.1%)		
Total	38 (45.2%)	46 (54.8%)		

Table -3 Correlation of FBS with BMI and WC

	Pearson Correlation	p- value
FBS & BMI	0.275	< 0.05

FBS & WC	0.421	< 0.001

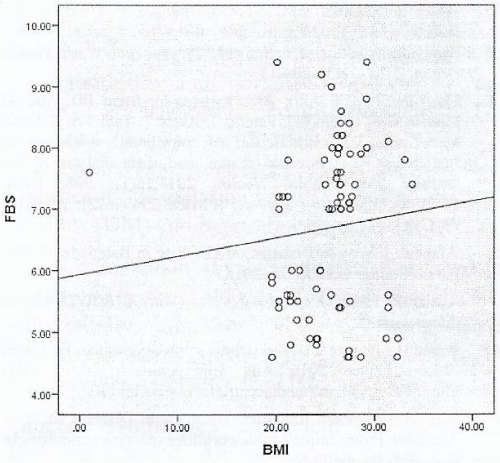

Figure 1: Correlation of fasting blood sugar (FBS) in mmol/L and body mass Index (BMI) in Kg/m^2

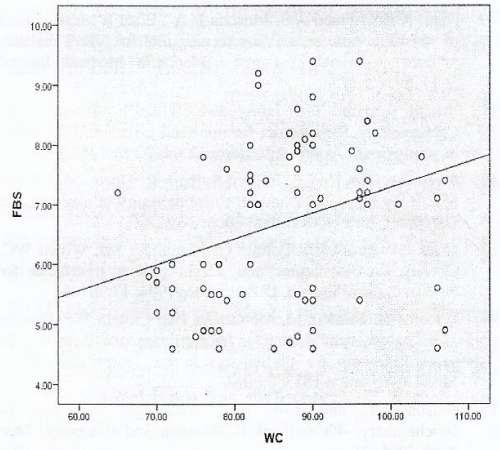

Figure 2: Correlation of fasting blood sugar (FBS) and waist circumference (WC) in cm

Discussion

Diabetes is becoming a major health problem in Bangladesh. Therefore there is an urgent need to generate easy, understandable and effective ways for prevention of diabetes among Bangladeshi. BMI has been established as a predictor of diabetes risks among Bangladeshi[8], but it is difficult for a common man to calculate his or her BMI themselves. So there is a need for an effective and easily understandable parameter as a predictor for diabetes risk.[29] Therefore the study tries to establish WC as one such predictor for diabetes risk. The study shows a statistically significant difference ($P < 0.001$) between WC and FBS. The study also shows that WC is above normal level is associated diabetes risk.

We also found a good correlation between FBS and BMI, suggesting that increase in BMI is associated with an abnormal FBS. Our findings are similar to other studies who showed a definite relation of BMI and diabetes mellitus.[6,12] Vivek et al found that a positive and significant correlation between BMI and FBS.[30] One study showed that over weight and central obesity were significantly associate with diabetes.[31] A study conducted in a diabetic clinic at a university hospital showed a statistically significant higher BMI diabetic patients compared to non diabetics.[32] Rathore AJ et al found that BMI is positively correlated with weight, FBS and cholesterol.[33] These findings are similar to related studies who found same significant correlation.[9,34]

The important finding of our study is that we found correlation between WC and FBS, and also between BMI and FBS. A meta-analysis of the Asian cohorts suggested that BMI and WC were similarly related to incident of diabetes.[35] Yoon *et al.* indicated that BMI and WC have similar predictive power for insulin resistance and diabetes among Korean adults.[36] Many other study shows similar result .[29,37] One study showed good correlation between FBS and BMI with R value of 0.539 and better correlation between WC and FBS (R 0.813) than between BMI and FBS(R 0.539).[29]

Most patients do not understand the importance of body mass index or BMI which involves two parameters-weight and height. However waist circumference is an easily understandable term,

can be measured by patient themselves, and they can regularly monitor it. A person may not know their BMI but they know their pant (trouser/ payzama) size, which more or less correlates with the waist circumference.[4] People can be motivated to keep a track of their pant size, and whenever it exceed more than normal level they take it as an alarm and modify their lifestyles and get their blood sugar tested.

We feel that assigning risk for diabetes based on pant size (waist circumference) can make the layman understand the effect of obesity, and they can very well monitor their waist circumference. This can be more beneficial than BMI cut off as a risk factor. Interestingly the study also shows that BMI and WC are very well correlated with FBS, WC is better than BMI as a predictor of diabetes. This can also be helpful for health education provider who can make the layman understand to track their WC rather than track their BMI. Importantly abdominal obesity is more associated with insulin resistance than overall obesity, and WC is the most affected parameter by abdominal obesity. Further study is recommended with large sample size for establishment of better correlation between WC and FBS.

Conclusion

The study establishes that any waist circumference above normal is associated with diabetes risk. We finally conclude that though BMI was considered as a more accurate predictor of diabetes risk, the layman finds it difficult to understand and measure BMI. But pant or trouser size which often correlates with WC is known to all, and therefore it can be a better predictor for diabetes risk among the masses. Moreover people can be easily motivated to keep a track of their pant size, and thus WC can be a better parameter than BMI as a predictor for diabetes risks.

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