COMPARISON OF BODY MASS INDEX AND WAIST CIRCUMFERENCE IN PREDICTING INCIDENT DIABETES

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Objective: The objective of the present investigation is to confirm that central obesity which is measured by waist circumference (WC) is more informative than general obesity determined by body mass index (BMI) in the prediction of diabetes mellitus (DM). **Material and Methods:** The study was conducted at Khyber Medical College, Peshawar during 2008 to 2009. A total of 475 adult male and female volunteers were the subject of present research and were categorised in terms of their BMI. The BMI was determined from weight and height; the subjects were grouped as normal, overweight and obese. WC was determined by measuring the waist between the lower rib and iliac crest. **Results:** The results show a consistence relation between BMI and WC with diabetes mellitus. The Chi-square test for 95% confidence interval showed 2-sided asymptomatic significance of diabetes mellitus with WC to be 0.016 and BMI 0.082. **Conclusion:** The results showed a higher trend of diabetes mellitus in males having WC greater then 40 inches (100 cm) and for female WC greater then 35 inches (87.5 cm) as compare to higher BMI.

Keywords: BMI, WC, DM

INTRODUCTION

Diabetes is a disease in which levels of blood glucose, also called blood sugar, are above normal. People with diabetes have problems converting food to energy. Normally, after a meal, the body breaks food down into glucose, which the blood carries to cells throughout the body. Cells use insulin, a hormone made in the pancreas, to help them convert blood glucose into energy. People develop diabetes because the pancreas does not make enough insulin or because the cells in the muscles, liver, and fat do not use insulin properly, or both. As a result, the amount of glucose in the blood increases while the cells are starved of energy.[1]

New recommendations for the classification and diagnosis of diabetes mellitus include the preferred use of the terms 'type 1' and 'type 2' instead of 'IDDM' and 'NIDDM' to designate the two major types of diabetes mellitus.[2] Screening for diabetes mellitus should begin at 45 years of age and should be repeated every three years in persons without risk factors, and should begin earlier and be repeated more often in those with risk factors. Risk factors include obesity, first-degree relatives with diabetes mellitus, hypertension, hypertriglyceridemia or previous evidence of impaired glucose homeostasis.[2] Over the years, high blood glucose, also called hyperglycaemia, damages nerves and blood vessels, which can lead to complications such as heart disease, stroke, kidney disease, blindness, nerve problems, gum infections, and amputation.[1]

The increase in the prevalence of type 2 diabetes is closely linked to the upsurge in obesity. About 90% of type 2 diabetes is attributable to excess weight. Furthermore, approximately 197 million people worldwide have impaired glucose tolerance, most commonly because of obesity and the associated metabolic syndrome. This number is expected to increase to 420 million by 2025.[3] In Pakistan, 6.9 million people are affected by diabetes with the International Diabetes Federation estimating that this number will grow to 11.5 million by 2025 unless measures are taken to control the disease. In 2007, 246 million people worldwide suffered from diabetes making the disease one of the most common non-communicable global diseases and the fourth leading cause of death in the world according to International Diabetes Federation (IDF) estimates.[4] The prevalence of diabetes mellitus in rural areas of NWFP is high and almost similar to that of Sindh and Baluchistan.[5]

Visceral fat at L_{2-3} and L_{4-5}, waist circumference, BMI and waist/height ratio (WHR) predicted the likelihood of developing diabetes ($p<0.05$).[6] Body mass index, waist circumference, and waist/hip ratio have been shown to be associated with type 2 diabetes. From the clinical perspective, central obesity (approximated by waist circumference or waist/hip ratio) is known to generate diabetogenic substances and should therefore be more informative than general obesity (body mass index). Although the clinical perspective focusing on central obesity is appealing, further research is needed to determine the usefulness of waist circumference or waist/hip ratio over body mass index.[7] BMI, WC and waist/hip ratio, are three obesity indicators and all having similar associations with incident diabetes**.** Although the clinical perspective focusing on central obesity is appealing, further research is needed to determine the

usefulness of waist circumference or waist/hip ratio over body mass index.[8]

MATERIALS AND METHOD

In the present study, data was collected through a questioner. The subjects included 500 adults with the age of 20 years and above both male and female were divided into 4 categories, based on the international recommendations for Asians[9] of their BMI as follows. BMI less than 18.5 kg/m^2 (lean), between 18.5 and 22.9 kg/m^2 (normal), between 23 and 24.4 kg/m^2 (overweight) and greater than 25 kg/m^2 (obese). Weight and height of the subjects were measured for calculating BMI. In addition, WC and Fasting Plasma Glucose (FPG) were also determined for each subject. The BMI was calculated from the data by the formula:

$$\text{BMI (Kg/m}^2\text{)} = \frac{\text{Weight}}{\text{Height}^2}$$

In the present study, waist circumference (WC) was determined by measuring the waist between the lower rib and iliac crest. Males with WC greater then 40 inches (100 cm) and for female WC greater then 35 inches (87.5 cm) are at risk of developing hazards of obesity.[10]

The Fasting Plasma Glucose (FPG) test is most reliable when done in the morning. The subjects were asked to fast for at least 8 hours. With a fasting glucose level of 100 to 125 mg/dL have a form of pre-diabetes called impaired fasting glucose (IFG). Having IFG means a person has an increased risk of developing type 2 diabetes but does not have it yet. A level of 126 mg/dL or above, confirmed by repeating the test on another day, means a person has diabetes.[1]

RESULTS

The results are tabulated in Tables 1–3. The results show that amongst 475 individuals both male and female, 20% were diabetic and amongst males 14% showed sign of diabetes. However, 26% females indicated higher incidence of diabetes. The trend of diabetes increases with increase in the BMI and WC.

Diabetes mellitus BMI Classes Cross-tabulation

		BMI Classes			Total
		Normal	Overweight	Obese	
Diabetes mellitus	No	52	130	205	402
	Yes	5	31	52	98
Total		57	161	257	475
Percentage		9%	19%	20%	20%

Diabetes mellitus waist circumference Cross-tabulation

		Normal waist	Abnormal waist	Total
Diabetes mellitus	No	106	271	377
	Yes	21	77	98
Total		127	348	475
Percentage		17%	22%	20%

Diabetes mellitus WC and BMI Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square for DM & WC	8.261(a)	2	0.016
Pearson Chi-Square for DM & BMI	5.011(a)	2	0.082

DISCUSSION

The results indicate a linear trend of relation between BMI and WC and diabetes mellitus. According to the results the prevalence of diabetes is more in female than in male subjects.[5] There has been much debate, whether BMI or WC is the best measure with respect to risk of metabolic disease. The analysis in the present study indicates that these measures were highly correlated, and therefore, the information derived from any one of these variables is shared to a large extent with the others.[6] According to Epidemiologic Review[8] the pooled relative risks for incident diabetes were adjusted for body mass index**,** waist circumference, and waist/hip ratio, respectively, demonstrating that these three obesity indicators (BMI, WC and WHR) have similar associations with incident diabetes. The Chi-square test for 95% confidence interval was used to measure the association among the different variables in the present study. It was performed for BMI and WC with respect to DM. The Chi-square for WC (p=0.016), which was less than 0.05 or better and that of BMI, is (p=0.082) which was greater than 0.05 and less significant. Results of this study show that WC is stronger indicator of the risk of diabetes than BMI.

The results indicate that persons having waist circumference more than desirable value have central obesity whereas, 22% of the subjects were found suffering from diabetes. Central obesity and positive family history were strongly associated with diabetes, as was prevalence of hypertension. The association with central obesity was greater for females than for males, and suggests important, modifiable risk factors related to lifestyle.[11]

CONCLUSIONS

It is a well recognised fact that overall obesity causes insulin resistance and because various adipose tissue depots may have unique characteristics related to differential expression of enzymes involved in triglyceride synthesis, lipolysis, adipocytokines synthesis, as well as other functions, so these differences may help in understanding the unique contributions of various adipose tissue depots to disorders of glucose and lipid metabolism. Central obesity, which develops much earlier in Asian population, is therefore stronger predictor of diabetes mellitus.

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