

COMPARISON OF CENTRAL OBESITY WITH OVERALL OBESITY IN PREDICTING THE RISK OF TYPE 2 DIABETES MELLITUS

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ABSTRACT

INTRODUCTION

Many studies have shown the association of waist circumference, waist hip ratio and body mass index with type 2 diabetes mellitus. Waist circumference and waist hip ratio have been used as measures of central obesity and body mass index has been used as a measure of general obesity. Objective of this study is to find out which type of obesity is better for prediction of risk of type 2 diabetes mellitus.

MATERIAL AND METHODS

Total 100 participants with confirmed diagnosis of type 2 DM with age group 35-80 years were selected for the study. Anthropometric measurements like height, weight, waist circumference (WC) and hip circumference were measured and body mass index (BMI) and waist hip ratio (WHR) were calculated. Area under receiver operating characteristic (ROC) curve was used for correlating the parameters with type 2 diabetes mellitus in both male and female patients.

RESULTS

Area under ROC curve, a measure of performance of the indices in predicting diabetes in total subjects, was found to be highest for waist hip ratio (0.840) followed by waist circumference (0.688) and BMI (0.608). Similarly, area under ROC curve was found maximum for waist hip ratio followed by waist circumference and body mass index in case of male and female patients.

CONCLUSION

The present study concludes that anthropometric indicators of central obesity (WHR and WC) are more predictive for type 2 DM than anthropometric indicator of general obesity (BMI).

KEY WORDS Type 2 diabetes mellitus, body mass index, waist circumference, waist hip ratio

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INTRODUCTION

Diabetes is a group of metabolic diseases characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both.¹ Type 1 DM results from autoimmune beta cell destruction which leads to deficiency of insulin. Type 2 DM is a heterogeneous group of disorders characterized by variable degrees of insulin resistance, impaired insulin secretion, and increased glucose production.²

There is dramatic increase of diabetes worldwide as a consequence of changes in lifestyle, including physical inactivity and unhealthy diet.³ Several studies indicate that weight gain and obesity are associated with increased risk of diabetes and that the onset of diabetes can be prevented by weight reduction and change in life style.^{4,7} Body mass index, waist circumference, and waist hip ratio have been shown to be associated with type 2 diabetes. Among these anthropometric measurements, waist circumference and waist hip ratio have been used as the measures of central obesity (where visceral adipose tissue is stored), and body mass index (kg/m²) has been used as a measure of general obesity.⁸ From the clinical point of view, central obesity is known to generate diabetogenic substances and should, therefore, be more informative in predicting type 2 diabetes mellitus than general obesity.⁹ Although many aspects of clinical view supporting the central obesity is convincing, further research is needed to determine the usefulness of waist circumference or waist/hip ratio over body mass index. Therefore, we designed this study to find out the best parameter among body mass index, waist circumference and waist hip ratio to predict the risk of type 2 diabetes mellitus.

MATERIAL AND METHODS

The present study was conducted at College of Medical Sciences Teaching Hospital, Bharatpur, Chitwan. The duration of the study was nine months i.e., from January 2014 to September 2014. We included 100 patients with confirmed diagnosis of type 2 DM. Subjects with age group 35 to 80 years were selected for the study. The samples were selected from the patients visiting the OPD with confirmed diagnosis of Type 2 Diabetes Mellitus.

Diagnosis of DM was made according to the following criteria¹⁰ (set by the WHO):

1. Symptoms of diabetes plus random blood glucose concentration ≥ 200 mg/dL, or
2. Fasting blood glucose ≥ 126 mg/dL, or
3. Glycated hemoglobin (HbA1C) $> 6.5\%$, or
4. Two hour blood glucose ≥ 200 mg/dL during an oral glucose tolerance test

Exclusion criteria

- Patient with serious illness
- Other specific types of diabetes mellitus
- Other causes of abdominal distension
- Pregnancy

- Study participants who are not willing to participate in the study.

Procedure

Subject with known case of diabetes mellitus type 2 were chosen as the case and their laboratory reports were obtained for confirmation. After that detailed history of study participants were taken and finally following anthropometric measurements were done.

- Weight in kg
- Height in cm
- Waist circumference in cm
- Hip circumference in cm

Weight was measured using portable weighing machine. Height was measured using calibrated stadiometer. Height of the subject was measured without shoes in cm and then converted to meter and weight was taken in kilograms.

Waist and hip circumferences were measured as per the WHO guidelines.¹¹

- Waist and hip circumference were measured with a non-stretchable tape. Measurement was taken at standing position and bulky clothing was avoided.
- Waist circumference was measured at the approximate midpoint between the lower margins of last palpebral rib and the top of iliac crest in the mid axillary line at the end of normal expiration.
- Hip circumference measurement was taken around the widest point of buttocks.
- Both measurements were taken with a stretch resistant tape wrapping snugly around the subject keeping the tape level parallel to the floor at the point of measurement.

With the above obtained data following parameters were calculated:

1. Body mass index

$$BMI = \frac{\text{Weight (kg)}}{(\text{Height in meter})^2}$$

2. Waist hip ratio

$$WHR = \frac{\text{Waist circumference}}{\text{Hip circumference}}$$

Statistical analysis

Statistical analysis was done using SPSS 20.0 version (Statistical Package for Social Science for Windows Version) and Microsoft Office Excel 2010. Area under receiver operating characteristic (ROC) curves was used as a measure of performance of indices in both male and female patients.

RESULTS

Total number of diabetic patients in the study was 100. Out of them 53 were male and 47 were female. The mean age of the male participant was 56.40 ± 11.086 years and female was 56.06 ± 11.805 years. The mean BMI (kg/m²) of male

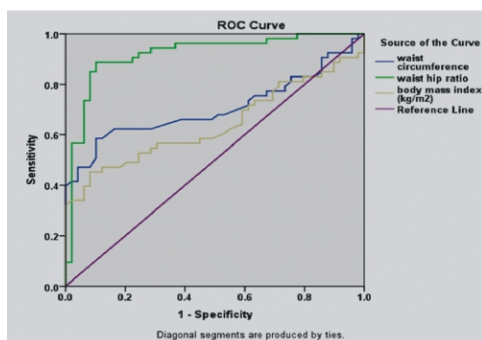
participants was 24.35 ± 3.135 and female participants were 25.20 ± 4.063 . Likewise, the mean waist circumference (in cm) of male and female participants was 91.90 ± 7.381 and 87.86 ± 8.712 respectively. Similarly, mean waist hip ratio of male and female participants was found to be 0.994 ± 0.031 and 0.922 ± 0.046 respectively (table-1).

Table 1. Mean age, BMI, WC and waist hip ratio of study participants

	Diabetic participants	Mean \pm SD	Number
Age of the subjects (In years)	Male	56.40 ± 11.086	53
	Female	56.06 ± 11.805	47
	Total	56.24 ± 11.373	100
Body mass index (In kg/m^2)	Male	24.35 ± 3.135	53
	Female	25.20 ± 4.063	47
	Total	24.75 ± 3.607	100
Waist circumference (In cms)	Male	91.90 ± 7.381	53
	Female	87.86 ± 8.712	47
	Total	90.00 ± 8.246	100
Waist hip ratio	Male	0.994 ± 0.031	53
	Female	0.922 ± 0.046	47
	Total	0.960 ± 0.053	100

Comparison of BMI, WC, and WHR in male subjects

In male participants, area under the curves for WC, WHR and BMI are 0.705, 0.918, and 0.640 respectively. So, the area under ROC curve, a measure of the performance of the indices in predicting diabetes in female subjects, was found to be highest for waist hip ratio followed by waist circumference and BMI (Fig-1).

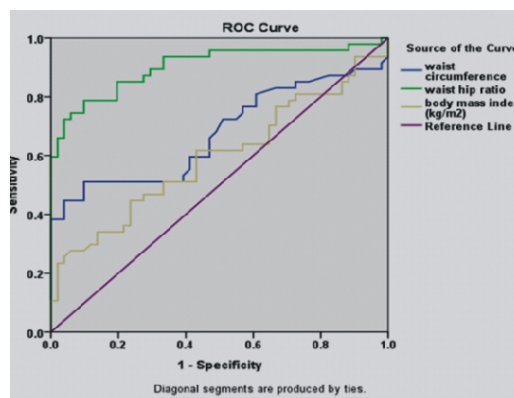


Area Under the curve for WC = 0.705; Area Under the curve for WHR = 0.918; Area Under the curve for BMI = 0.640

Figure 1. Comparison of the ROC curves of WC, WHR and BMI in male subjects

Comparison of BMI, WC, and WHR in female subjects

In case of female participants, area under the curves for WC, WHR and BMI are 0.675, 0.902 and 0.594 respectively. So, the area under ROC curve, a measure of the performance of the indices in predicting diabetes in female subjects, was found to be highest for waist hip ratio followed by waist circumference and BMI (Fig-2).

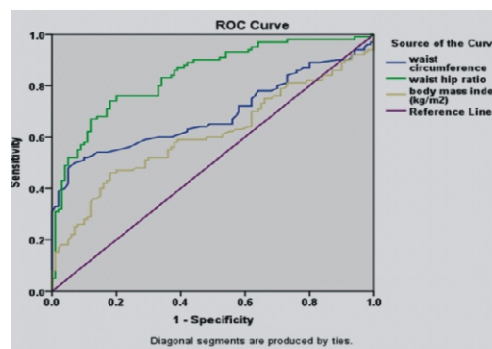


Area Under the curve for WC = 0.675; Area Under the curve for WHR = 0.902; Area Under the curve for BMI = 0.594

Figure 2. Comparison of the ROC curves of WC, WHR and BMI in female subjects

Comparison of BMI, WC, and WHR in total subjects

In case of total participants, area under the curves for WC, WHR and BMI are 0.688, 0.840 and 0.608 respectively. So, the area under ROC curve, a measure of the performance of the indices in predicting diabetes in total participants, was found to be highest for waist hip ratio followed by waist circumference and BMI (Fig-3).



Area Under the curve for WC = 0.688; Area Under the curve for WHR = 0.840; Area Under the curve for BMI = 0.608

Figure 3. Comparison of the ROC curves of WC, WHR and BMI in total subjects

DISCUSSION

Increase in obesity is one of the serious health problems in the present world as it is intimately related with the rate of development of diabetes mellitus and cardiovascular diseases resulting in a dramatic increase in morbidity and mortality. In recent years, BMI, WHR and waist circumference are changed significantly with the elevation of living standard and sedentary lifestyle, and the mean BMI in adults is increasing in both developed and developing countries.¹²

It is already an established fact that, increase in body mass index, waist circumference and waist hip ratio increases the risk for type 2 diabetes mellitus. In this study, we compared waist circumference, waist hip ratio and body mass index to find out the better parameter for prediction of type 2 diabetes mellitus. In this cross sectional study we found that both generalized obesity (measured by BMI), and central obesity (measured by waist circumference and waist hip ratio) predict type 2 diabetes mellitus. The comparison of ROC curve for BMI, WC and WHR in case of male, female and total patients showed that AUC is highest for waist hip ratio followed by waist circumference and BMI. This shows that among male and female patients waist hip ratio and waist circumferences are the better predictors of type 2 diabetes mellitus than body mass index. This also concludes that central obesity is better predictor of type 2 diabetes mellitus than generalized obesity.

Many cohort study, conducted previously to compare different anthropometric measurements with regard to diabetes risk prediction suggest that anthropometric measurements that describe central obesity (waist circumference and waist hip ratio) may be superior to measurements of general adiposity (BMI).¹³⁻¹⁵ Similarly, many other studies compared waist circumference and body mass index and found waist circumference to be better correlated with the risk of type 2 diabetes mellitus.¹⁶⁻¹⁸ In a similar study by Wang et al,¹⁹ comparing the WHR and BMI the results showed that AUC for WHR was greater than BMI indicating WHR more convincing for prediction of type 2 DM.

The present study suggests that waist hip ratio and waist circumference are the better indicators for predicting diabetes than body mass index. This is also consistent with findings from many other studies. Many prospective studies have also shown that abdominal obesity is a major risk factor for the development of type 2 diabetes.²⁰

There has been much debate about the best parameter among BMI, WC and waist hip ratio to predict the risk of metabolic diseases like diabetes mellitus. Although many studies have used body mass index as an indicator of obesity, our results from ROC curve showed that WHR and WC are the better indicators of risk of diabetes than BMI. The possible pathophysiological explanation is that large amounts of visceral fat cause insulin resistance because lipolysis of

visceral adipose tissues releases free fatty acids²¹ and excess intra-abdominal adiposity may have the potential to influence metabolism through alterations in the secretion of adipokines.²²

CONCLUSION

This study concludes that waist hip ratio and waist circumference are the better predictors of type 2 DM compared to body mass index in both male and female patients. WHR and WC have higher area under ROC curve in case of both male and female diabetic patients. It indicates that anthropometric indicators of central obesity (WHR and WC) are more predictive for type 2 DM than anthropometric indicator of overall obesity (BMI). But all the three parameters are useful in prediction of risk of type 2 diabetes and further large population based studies are required.

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