

**Original article**

# COMPARISON OF ANTHROPOMETRIC INDICATOR OF GENERAL OBESITY (BMI) TO ANTHROPOMETRIC INDICATORS OF CENTRAL OBESITY (WC, WHR) IN RELATION TO DIABETES MELLITUS IN MALE POPULATION

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## ABSTRACT

**Objective:** -To evaluate and compare predictor for Diabetes mellitus among anthropometric indicators of obesity (Body Mass Index, Waist circumference and Waist to Hip Ratio).

**Method:** - The present study was conducted among policemen of the Bhavnagar city, total 260 policemen of  $\geq 30$  years of age included in the study (Response rate 83 %). The fasting and 2 hour postprandial blood glucose test was done for diagnosis of the diabetes and According to American Diabetes Association (2004) criteria subjects was diagnosed as a diabetic, prediabetic (Impaired Fasting Glucose and Impaired Glucose Tolerance) and normoglycemic. BMI, waist circumference and Waist to hip ratio of every subject was measured. Receiver operator characteristic curve was constructed to determine the optimal value of each parameter to diagnose the diabetes and compare the all three anthropometric indicator for predicting the diabetes.

**Result:** Higher area under curve was found with WHR, than WC and lowest with BMI. It was 0.764, 0.751, and 0.611 for WHR, WC and BMI respectively. Optimum cut off points for predicting diabetes are 0.948, 98 cm and 25 for WHR, WC and BMI respectively. Higher Youden index found for WHR and WC than BMI.

**Conclusion:** our study shows that the anthropometric indicators of central obesity (WHR and WC) are better predictive of diabetes mellitus than Anthropometric indicator of general obesity (BMI).

**Key Words:** Obesity indicators, ROC curve, Diabetes mellitus

## INTRODUCTION

Socioeconomic development, technological advancements, changes in lifestyle, changes in behavioural pattern and demographic profile transition (aging population) lead to major health transition, causes rapidly raising the burden of the non communicable diseases and its burden overweight the communicable diseases.

India has also experienced this health transition cause increase the burden of diabetes and other Non-communicable diseases.<sup>1-4</sup>

According to 5<sup>th</sup> edition of IDF Diabetes Atlas, India is second to china in world for the number of people suffering from diabetes. Number of people with diabetes in India is estimated around 61.3 million in 2011 and this number is

expected to rise to 101.2 million by 2030, unless urgent preventive steps are taken.<sup>5</sup>

It has been recognized that south Asian has certain unique clinical and biochemical characteristics that are collectively referred to as the-Asian Indian phenotype. In them despite relatively lower prevalence rates of general obesity as defined by Body mass index, they tend to have larger waist measurement and waist to hip ratios. This phenotype makes Asian Indians more prone to diabetes and premature coronary artery disease.<sup>6</sup>

The major contributor of the diabetes epidemic is the more common form of diabetes namely type 2 diabetes, which accounts for more than 90% of all diabetic cases.<sup>7</sup> Obesity is a substantial risk factor for type 2 diabetes and its complications. More than 80% of cases of Type 2 DM can be attributed to obesity.<sup>8-12</sup>

Distribution of fat is at least as important as the amount of fat in the body.<sup>16</sup> Obesity particularly central obesity is associated with the Type 2 DM, both the duration and degree of obesity.<sup>13</sup>

The usual measure of central obesity is the WHR or WC. Since the excess fat is usually concentrated in the hip in women and the waist in men, the optimum value for the WHR is lower in women (<0.85) than in men (<0.95).<sup>12</sup>

Recently waist circumference has been found to be an even better indicator of central obesity than WHR, the recommended waist circumference for Asian Indians is <80 cm in women and <90 cm in men.<sup>14</sup>

We compared the predictive performance of baseline WC, WHR and BMI in predicting diabetes mellitus and estimated the related optimal cut-off points, respectively.

## MATERIAL AND METHODS

A Community based Cross sectional study was conducted among police personnel working in Bhavnagar city. This study conducted in a year 2011 after obtaining the permission from the ethics committee of Govt. Medical College, Bhavnagar. All police personnel of Bhavnagar city of  $\geq 30$  yrs of age were enrolled for the study. Total 252 out of 294 male study subjects were included in the study (Response rate 82.8%).

**Inclusion Criteria:-** Police personnel working in Bhavnagar city with  $\geq 30$  years of age are in-

cluded in the study; and known cases of diabetes ( $\geq 30$  years of age) are also included in the study.

**Exclusion Criteria:-** Patient with serious illness; Study participant on drug causing hyperglycemia; and Study participants who are not willing to participate in the study.

The pre-tested and structured questionnaire was used for the data collection. On the Previous day, the data collection place was visited and study subjects were instructed about overnight strict fasting (minimum 8 hours). Then on next day morning, data collection was done. First the purpose and procedure of this study explained to the study subject. After obtaining the written consent, general and demographic information, data regarding risk factors of the diabetes were collected by personal interview. After that, anthropometric measurements were done.

Anthropometric measurements were taken with subjects in light clothing and without shoes. Height and weight were measured using calibrated stadiometer and portable weighing machine respectively. The height and weight were recorded to the nearest centimeters and kilograms respectively. BMI was calculated by dividing weight (kg) by square of height (m<sup>2</sup>). Waist and hip circumference were measured with a non stretchable plastic tape. Waist circumference was measured as the minimum horizontal girth between costal margins and iliac crests at the end of normal expiration. The waist circumference was recorded nearest to centimeter. Hip circumference was measured as the maximum circumference of the buttocks over the greater trochanters. The hip and waist circumference was recorded nearest to centimeter. Waist to Hip ratio (WHR) was calculated as Waist circumference (cm) divided by Hip circumference (cm).

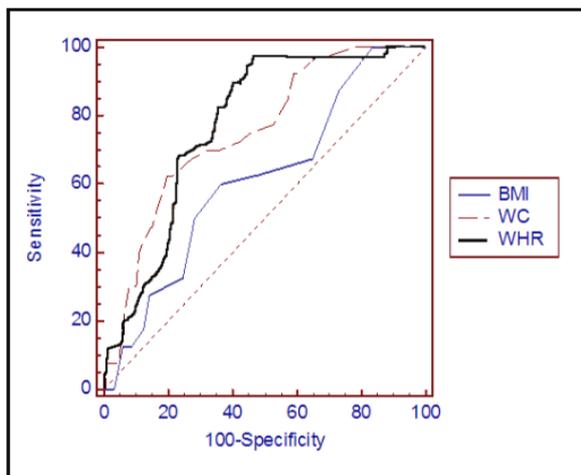
Subjects reporting a history of DM and currently taking insulin or oral medications for diabetes were considered to have DM. Diagnosis of the diabetes was done by blood sugar examination by "Gluco Dr" portable glucometer with aseptic precaution. On previous day study subjects (participants) were instructed for 8 hour fasting and on next day morning fasting blood sugar and 2 hour postprandial blood glucose test was done and according to American Diabetes Association (ADA) 2004 criteria subjects were classified as diabetics, pre diabetics (impaired fasting sugar or impaired glucose tolerance) and normoglycemics.

**Statistical analysis:** - Data entry was done in Excel 2007 sheet and Statistical analysis was done by Med Calc version 11.6.1.0 (trial version) statistical software. The Youden index (J), a function of sensitivity and specificity, is a commonly used measure of overall predictive or diagnostic effectiveness, its range from 0 to 1. Youden index nearer to 1 has higher predictive or diagnostic effectiveness.

## RESULT

Out of 252 study subjects, 39 had diabetes mellitus. So prevalence rate of diabetes is 15.47%.

Figure 1 shows the ROC curve of anthropometric indicators of obesity namely BMI, WC and WHR in diagnosis of diabetes, highest area under the curve was found for WHR than WC and lowest for the BMI, its indicate that the Central obesity indicators like WC and WHR are more predictive than general obesity indicators like BMI.



Area Under the curve for BMI = 0.611  
Area Under the curve for WC = 0.751  
Area Under the curve for WHR= 0.764

**Figure:-1** Comparison of the Receivers Operator Characteristic (ROC) curves of BMI, WC, and WHR

Table-1 show the results obtained from the ROC curve analysis for BMI, WC and WHR. It shows the "optimal" cut-off points where sensitivity, specificity, and positive likelihood ratios were maximized. Optimum cutoff point of indicators of obesity to diagnose the diabetes was estimated and the optimum cutoff point for BMI, WC and WHR were >25, >98 cm and >0.94 respectively.

**Table: - 1 optimum cut off point of various obesity indicators**

Associated values for the optimum BMI, WC and WHR cut-off points:	Optimum cut off point		
	BMI >25	WC >98	WHR >0.948
Sensitivity	58.97	64.10	97.44
Specificity	64.15	79.72	51.42
LR+	1.65	3.16	2.01
LR-	0.64	0.45	0.050
Youden index	0.2313	0.4382	0.4885
Area under the curve	0.611	0.751	0.764

Table 1 show that Waist to Hip ratio has higher Youden index than Waist circumference and Body mass index has lowest Youden index.

Table-1 shows that WHR, WC, and BMI of the male subjects covered 76.4%, 75.1%, and 61.1% areas under ROC curve respectively. The risk of developing type 2 DM for male subjects maximized with WC > 98 cms, WHR > 0.948 and BMI >25 kg/m<sup>2</sup>.

## DISCUSSION

The concept of central obesity was first introduced by Vague in the 1940s and a few years later in 1956 he pointed out for the first time that central obesity was more important than peripheral obesity in relation to diabetes, gout, atherosclerosis, and uric calculus diseases.<sup>15,16</sup> Since the 1990s, interest in WC has increased in light of the findings that WC was more closely correlated with the abdominal visceral fat than either WHR or BMI.<sup>17,18</sup> Body mass index has limitations because it does not distinguish overweight due to excess fat mass from excess muscle mass.<sup>19</sup> In recent years, the association of these obesity indicators with diabetes has been studied in different ethnic groups. Results from most of the retrospective and cross-sectional studies have shown a stronger association of diabetes with central obesity (WC or WHR or WSR, or all) than with general obesity (BMI) as indicated by slightly larger areas under the ROC curves.<sup>20-22</sup>

## CONCLUSION

Our study confirms that the better predictor of diabetes is Waist to Hip ratio compared to Waist circumference and body mass index. Both WHR and WC has nearly similar AUC under ROC, also have nearly similar Youden index, it indicate that Anthropometric indicators of central obesity (WHR and WC) is more predictive for

diabetes mellitus than anthropometric indicator of general obesity (BMI).

Our findings suggest that current recommended WC cut-points should be modified to around 98 in men to optimize the discrimination of diabetes in these populations. While WHR at > 0.95 is the optimum cut off point for predicting the diabetes as per WHO guideline, same results were found in our study also.

### Limitation

Our study population was the one of the occupational group "the police personnel", because the female police population was very small in number, we did not included them in our study.

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