

# Waist circumference and waist hip ratio as predictor of incident diabetes in young adults: A cross-sectional study

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## Abstract

**Background:** Clinical evidence suggests that the association of diabetes with central obesity is stronger than the association with general fat. A lot has to be done to prevent or at least postpone its onset. Hence finding bio-markers is important to warn people and create awareness. We aimed to make a comparison between blood sugar level and waist hip ratio in young healthy males and females. We included waist/hip ratio because it was the most common obesity-related predictor of diabetes after body mass index. **Material and Methods:** The present study was conducted in healthy medical students of first professional M.B.B.S. (n = 100) with 50 males and 50 females of 18 to 27 years age groups at tertiary care Institute of Medical Science, India. Waist Circumference (WC) and Hip Circumference (HC) of each subject were recorded and Waist - Hip Ratio (WHR) was calculated. A fasting and 2 hour post-prandial venous blood samples were drawn from each subject for blood sugar assay. **Results:** According to WHR criteria, post prandial blood sugar level was significantly raised in males 'at risk level' (WHR  $\geq$  0.90) as compared to males 'below risk level' (WHR  $\leq$  0.90) Waist Hip Ratio was positively correlated with fasting blood sugar (r = 0.119) and post-prandial blood sugar level (r = 0.016). None of these correlations were statistically significant (p > 0.05). **Conclusion:** Majority of our type 2 diabetic patients having waist circumference and waist hip ratio, above cutoff values for Asians. The present study demonstrated strong associations of waist/hip ratio with incident diabetes. But we need to do more studies with higher sample size to corroborate these findings.

**Key Words:** Diabetes, Venous Blood Sample, Waist Circumference, Waist/hip ratio

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## INTRODUCTION

Type 2 diabetes mellitus belongs to a group of diseases labeled as lifestyle diseases" and is on the rise in Asians especially Indians. Besides morbidity due to its complications, Type 2 diabetes Mellitus carries a high risk

of Myocardial infarction, Stroke and premature death. Thus every effort must be made to prevent or postpone this disease by spreading awareness, risk stratification, early diagnosis, and regular treatment. Waist circumference and waist-hip ratio are markers of Abdominal Obesity. Obesity has become a major worldwide epidemic affecting more than 300 million people. It is an important risk factor for diabetes mellitus type 2, a chronic disorder of carbohydrate, fat, and protein metabolism. From the clinical perspective, visceral adipose tissue is known to generate diabetogenic substances and, as such, may be more informative than total fat for diagnostic evaluation.<sup>1</sup> The standard epidemiologic translation of these important clinical facts uses anthropometric measures. Waist circumference and waist/hip ratio have been used as measures of central obesity (where visceral adipose tissue is stored), and body mass index (kg/m<sup>2</sup>) has been used as

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a measure of general obesity.<sup>2</sup> Clinical evidence suggests that the association of diabetes with central obesity is stronger than the association with general fat. Studies using computed tomography and magnetic resonance imaging have provided further evidence to support that central obesity, visceral adipose tissue, and upper-body nonvisceral fat are the major contributors to the metabolic complications.<sup>2,3</sup> Central obesity has been associated with decreased glucose tolerance, alterations in glucose insulin homeostasis, reduced metabolic clearance of insulin, and decreased insulin-stimulated glucose disposal.<sup>4,5</sup> Asians with normal BMI may have more than normal abdominal obesity. Thus the choice of waist circumference and waist-hip ratio, in present study. In 2003 WHO laid down guidelines for screening of type 2 diabetes mellitus, risk factors which included Waist-hip ratio and waist circumference, as important risk predictors of type 2 Diabetes Mellitus. Family history of diabetes is given a lot of importance in India, and patients rely on it to predict Diabetes. Individually it is a risk factor, though not the only one and absence of Family history does not guarantee freedom from developing diabetes.<sup>6-8</sup> We aimed to make a comparison between blood sugar level and waist hip ratio in young healthy males and females. We included waist/hip ratio because it was the most common obesity-related predictor of diabetes after body mass index.

**MATERIAL AND METHODS**

The present study was conducted in healthy medical students of first professional M.B.B.S. (n = 100) with 50 males and 50 females of 18 to 27 years age groups at tertiary care Institute of Medical Science, India. Waist Circumference (WC) and Hip Circumference (HC) of each subject were recorded and Waist - Hip Ratio (WHR) was calculated. A fasting and 2 hour post-prandial venous blood samples were drawn from each subject for blood

sugar assay. The subjects were divided into following groups:

According to WHR

Males with WHR < 0.90: “Below risk level” males

Males with WHR ≥ 0.90: “At risk level” males

Females with WHR < 0.85: “Below risk level” females

Females with WHR ≥ 0.85: “At risk level” females

Blood sugar levels were done by Biochemical Autoanalyser at the pathology lab using Enzymatic – colorimetric – Trinder – End Point method (Glucose oxidase and glucose peroxidase method). Normal reference value taken as 75 -100 mg/dl (4.2 - 5.6 mmol/L).

**Statistical analysis:** The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2007) and then exported to data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). For all tests, confidence level and level of significance were set at 95% and 5% respectively.

**RESULTS**

In males “below risk level” (WHR < 0.9), post prandial blood sugar level ranged from 88 to 119 mg/dl with mean and SD of 101.11±9.14 and in males at risk level (WC ≥ 0.9), post prandial blood sugar ranged from 96 to 184 mg/dl with mean and SD of 114.54±22.47. Post-prandial blood sugar level was increased in males “at risk level” as compared to males “below risk level” and the difference was statistically significant (p < 0.05). Fasting blood sugar level was also increased in males “at risk level” as compared to males “below risk level” but the difference was not statistically significant (p > 0.05). In females, the variation in values of fasting and postprandial blood sugar was not statistically significant (p > 0.05). Waist Hip Ratio was positively correlated with fasting blood sugar (r = 0.119) and post-prandial blood sugar level (r = 0.016). None of these correlations were statistically significant (p > 0.05).

**Table 1:** Blood sugar level (mg/dl) according to waist hip ratio

	Males		Females	
	“Below risk level” n=14	“At risklevel” n=16	“Below risk level” n=14	“At risklevel” n=16
<b>Fasting Sugar</b>	88.60±6.90	92.95±6.28	89.05±5.20	88.01±3.65
<b>PPS Sugar</b>	101.11±9.14	114.54±22.47	106.97±10.13	106.06±9.35

**Table 2:** Correlation coefficients analysis

Variable	WHR
Fasting Sugar	0.119
PPS Sugar	0.016

**DISCUSSION**

In present study of type 2 diabetes patients, waist circumference, and waist-hip ratio was above cut off in majority, both males and females, thus emerging as an

important marker. This parameter of abdominal obesity has been widely studied all over the world. In the USA, as early as 1992 and 1997 studies established a link between waist circumference and type 2 diabetes.<sup>1,2</sup> In the Carribean Islands, people of African origin, like Nigerians,

Jamaicans and African-Americans were studied, by Okosun IS, *et al.* and were found to have a high risk of hypertension and high fasting blood sugar. Mexican population was studied by Berber A, *et al.* reporting a high cut off of BMI of 25.2 to 26.6, and 90cms and 85 cms as cutoff waist circumference for prediction of type 2 diabetes mellitus.<sup>8</sup> In 2003 WHO laid down guidelines for screening for diabetes mellitus in which most important measurements were Waist circumference and Waist hip ratio, and the correct method of measurement Snehalata C, *et al.* in a study from India defined waist and hip circumference cutoff values for Asian Indian Adults and also the correct way to measure the same.<sup>9,10</sup> Another Indian study by Misra A, *et al.* not only gave cutoffs but also action levels : action level 1 for Asian Indians : WC >78cms for men and >72cms for women should be advised to avoid weight gain and maintain increased physical activity.<sup>11</sup> Post-prandial blood sugar level was increased in males “at risk level” according to waist hip ratio (WHR  $\geq$  0.9), as compared to males “below risk level” (WHR < 0.9), and the difference found was statistically significant ( $p < 0.05$ ). McKeigue *et al.*<sup>12</sup> (1991) and Mohan *et al.*<sup>13</sup> (2003) similarly found increase in glucose intolerance with increase in WHR. Gharakhanlou *et al.*<sup>14</sup> (2012) found that in men, WHR was a significant predictor for glucose. Though, Ghosh *et al.* (2004)<sup>15</sup> reported that centrally obese subjects had a significantly higher FPG ( $P < 0.001$ ) compared with centrally non-obese subjects. Ko *et al.*<sup>16</sup> (1999) concluded that higher levels of WHR is associated with risk of diabetes. Palacios *et al.*<sup>17</sup> (2011) found that WHR had the highest prevalence odds ratio for overall cardiometabolic risk and glycosylated hemoglobin. In study by Joshi *et al.*<sup>18</sup> (2019), the range of WHR in both male and female diabetic participants (100) was higher than non-diabetic participants (100) and the result was statistically significant in both the cases. Kharal *et al.*<sup>19</sup> (2013) stated that mean waist hip ratio was 0.87 and increase in Waist hip ratio correlated significantly with increase in random blood sugar level both in males ( $p = 0.008$ ) and females ( $p = 0.007$ ). Gu *et al.*<sup>20</sup> (2011) stated the associations of anthropometries with each metabolic factor (in metabolic syndrome) to be significant and equal for BMI, WC, WHR and WHtR. Vazquez *et al.* (2007) concluded waist/hip ratio was the most common obesity-related predictor of diabetes. Shah A *et al.*<sup>21</sup> (2009) showed that in female, age (82.9%) is the strongest predictor followed by WHR (78.1%), WC (70.2%) and least for BMI (55.0%) whereas for male WC (87.0%) is the strongest followed by WHR (81.6%), BMI (68.5%) and least: for age (6.4.6%) using Receiver Operating Characteristic (ROC) curves. Perez-pavida *et al.*<sup>22</sup> (2019) opined that one in four subjects had post-prandial hyperglycaemia despite normal fasting glycaemia. Similar to our result, they found

that anthropometric indices of central fat distribution were strongly and independently associated with an increased risk of post-prandial hyperglycaemia. Misra *et al.* also reported that post-prandial blood sugar level was raised in subjects with high WHR. But contrary to this, Hardiman *et al.* observed that there was no association between blood glucose level and WHR and Ghosh *et al.*<sup>15</sup> (2004) found WHR to be associated with fasting plasma glucose level which was again different from our result. The difference in the results may be due to their larger and wide spectrum groups of all ages. Abdul Ghani MS *et al.* (2009)<sup>23</sup> proved that measurement of the postload plasma glucose concentration has additive value to models based only on fasting measurements in predicting the future risk for type 2 diabetes. Jiang J *et al.*<sup>24</sup> opined that post prandial blood sugar is more informative for screening of coronary heart disease and in our study also, we are finding post prandial hyperglycemia to be more significant.

## CONCLUSION

Present study did show, majority of our type 2 diabetic patients having waist circumference and waist hip ratio, above cutoff values for Asians. The present study demonstrated strong associations of waist/hip ratio with incident diabetes. But we need to do more studies with higher sample size to corroborate these findings.

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