# A Study of Correlation of Body Mass Index, Waist to Hip Ratio and Lipid Profile in Type 2 Diabetes Mellitus Subjects

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***Abstract***
***Introduction:****Diabetes Mellitus (DM) is a major causative risk factor of increased cardiovascular (CVD) events. The studies clarifying the relationship between the anthropometric parameterslike body mass index (BMI) and waist to hip ratio (WHR), and the lipid profile values of type 2 DM patients are sparse.Measurement of alternate markers of dyslipidemia and CVD is important for preventing CVD end-points, especially in diabetic subjects*
***Aim:*** *To study correlation between BMI, WHR and lipid profile in recently diagnosed type 2 DM patients.*
***Materials and Methods:****This Cross-sectional study was carried out on 100 cases of recently (within 3 months) diagnosed type 2 DM, in department of Medicine, Rajindra Hospital/ Government Medical College, Patiala, over a period of 2 years. Pearson correlation coefficient was calculated to see the correlation between BMI, WHR and lipid profile. For all statistical analyses, a P value <0.05 was considered statistically significant.*
***Results:*** *Statistically significant positive correlations were seen between BMI and WHR in both males (r= 0.262, p=0.031) and females (r =0.555, p< 0.001).*
*Statistically significant positive correlations were found between WHR and total cholesterol (r=0.367, p=0.002), WHR and triglycerides (r=0.404, p= <0.001), WHR and LDL-Cholesterol (r=0.437, p= <0.001), and negative correlation was observed between WHR and HDL-Cholesterol in males (r=-0.683, p<0.001), while significant correlations were not seen between WHR and lipid parameters in females. Statistically significant correlations were not seen BMI and lipid profile in total population.*
***Conclusion:*** *In recently diagnosed type 2 DM, BMI does not correlate with lipid profile. WHR correlates with lipid profile in males but there is no such correlation seen in females. Overall, it is advisable that along with the measurement of anthropometric parameters like BMI and WHR, the lipid profile should also be monitored separately in patients with type 2 DM.*
***Keywords:****BMI, waist hip ratio, lipid profile, type 2 diabetes mellitus*

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## I. Introduction:

The prevalence of Diabetes Mellitus (DM) in adults, of which type 2 DM is more common, is predictedto increase in the next two decades especially in the developing countries.[1]With an increasing incidence worldwide, DM will likelybe a leading cause of morbidity and mortality in the future.[2]Anthropometric parameters likebody mass index (BMI),which measures generalised obesity, andwaist to hip ratio (WHR), which measures the central obesity, can serve as reliable indicators for predicting the incidence of CVD and type 2 DM.[3]BMI and WHRhave the advantages in daily clinical practice of being inexpensive and simple to measure tool with good reproducibility, especially in developing countries.[3][4][5] However, the studies showing the correlation between these anthropometric parameters and lipid profile in type 2 DM are sparse and reveal inconsistent findings.[6][7]

As the prevalence of DM is markedly rising, it will be a major causative risk factor of increased CVD events.Measurement of alternate markers of dyslipidemia and CVD in diabetic subjects is of paramount importance for preventing CVD end-points.

**Aim:** To study the correlations between BMI, WHR and lipid profile in recently diagnosed type 2 DM patients.

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## II. Materials and Methods :

This was a cross-sectional study which included 100 cases of recently (within 3 months) diagnosed type 2 Diabetes Mellitus,who satisfied the inclusion and exclusion criteria both from outpatient and/or inpatient department of Medicine, Rajindra Hospital/ Government Medical College, over a period of 2 years. The study was conducted in collaboration with department of Biochemistry Rajindra Hospital/ Government Medical College, Patiala.Informed consent was obtained from every participating patient and the study was approved by the institutional ethics committee.

### Inclusion Criteria:
The patients who were diagnosed with type 2 DM within 3 months, based on the ADA criteria[2] for diagnosis of DM were include in the study.

### Exclusion Criteria:
Known type 2 diabetics who were on treatment , patients using lipid lowering drugs or other drugs that could affect lipid levels, smokers, chronic alcoholics, patients with renal, hepatic disorders or hypothyroidism were excluded.
BMI was calculated as weight in kilograms divided by the square of height in metres.

Waist circumference was measured at the midpoint between the lower margin of the last palpable rib in the mid axillary line and the top of the iliac crest and the hip circumference was measured around the widest portion of the buttocks. The ratio of the waist circumference and hip circumference was calculated to calculate WHR.[8]The threshold cut-off values adopted for anthropometric parameters were BMI $\geq 25$ kg/m$^{2}$[9][10],WHR $\geq 0.90$ for males and $\geq 0.85$ for females [8][11]

Venous blood samples were collected after an overnight fasting in the patients for measuring FBS and lipid profile.The cut-off values for dyslipidemiaaccording to National Cholesterol Education Program Adult Treatment Panel III criteria [12] were total cholesterol (TC)$\geq$ 200mg/dl,low density lipoprotein (LDL-C)$\geq$ 100mg/dl, triglycerides (TG)$\geq$ 150mg/dl, high density lipoprotein (HDL-C)$<$ 40mg/dl.[12][13]

**Statistical analysis and technique:**Statistical analysis was carried out using SPSS 16 version. Pearson correlation coefficient (r) was calculated to see the correlation between BMI, WHR and lipid profile. For all statistical analyses, a P value $<0.05$ was considered statistically significant.

## III. Results :

The mean age of the present population of recently diagnosed type 2 diabetics under study was $49.77 \pm 6.62$ years.The mean BMI of the total group under study in the present study was $24.99 \pm 3.27$.In this study the mean WHR for males was $0.91 \pm 0.07$ and for females was $0.87 \pm 0.04$.Dyslipidemia was observed in 84% of the total population under study.The most commonly elevated lipid parameter found was LDL-C (69%) followed by hypertriglyceridemia (66%), which was followed by low HDL-C (43%) followed by Hypercholesterolemia (31%)

**Table 1.** Correlations between BMI and WHR in male and female diabetics.

|  | MALES (n=68) | FEMALES (n=32) |
|---|---|---|
| r | 0.262 | 0.555 |
| p value | 0.031 | <0.001 |
| significance | S | HS |

r - Pearson correlation. Pearson correlation is significant at p < 0.05.

When Pearson correlation values were calculated ,statistically significant weak positive correlation was seen between BMI and WHR (r= 0.262, p=0.031) in males. Statistically significant positive correlation was seen between BMI and WHR (r =0.555, p< 0.001) in females. (Table 1)

**Table 2.**Correlations between WHR and Lipid profile in diabetic males

|  | TC | HDL | TG | LDL |
|---|---|---|---|---|
| r | 0.367 | -0.683 | 0.404 | 0.437 |
| p value | 0.002 | <0.001 | <0.001 | <0.001 |
| significance | S | HS | HS | HS |

r - Pearson correlation. Pearson correlation is significant at p < 0.05.
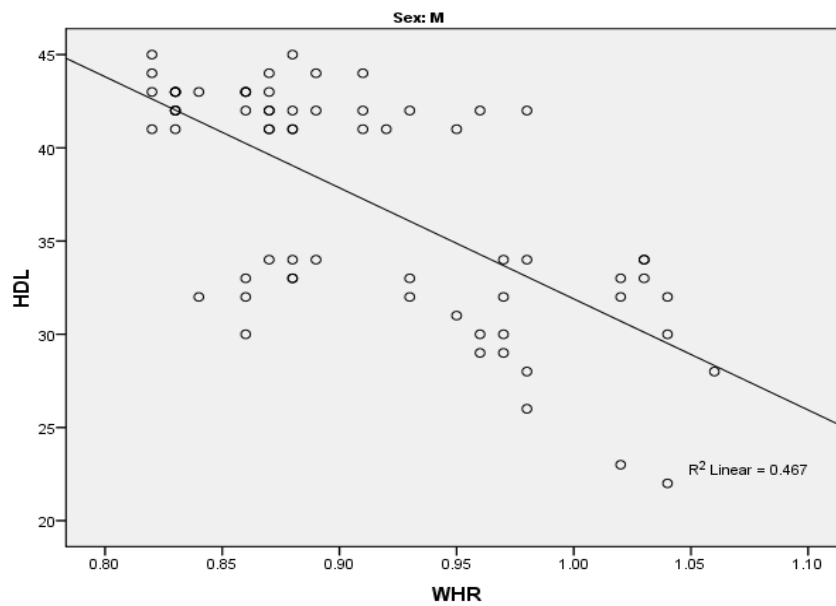
In case of males, statistically significant positive correlations were found between WHR and TC (r=0.367, p=0.002), WHR and TG (r=0.404,p <0.001), WHR and LDL-C (r=0.437,p<0.001) andstatistically significant negative correlation was obtained between WHR and HDL-C (r=-0.683, p<0.001).(Table 2)
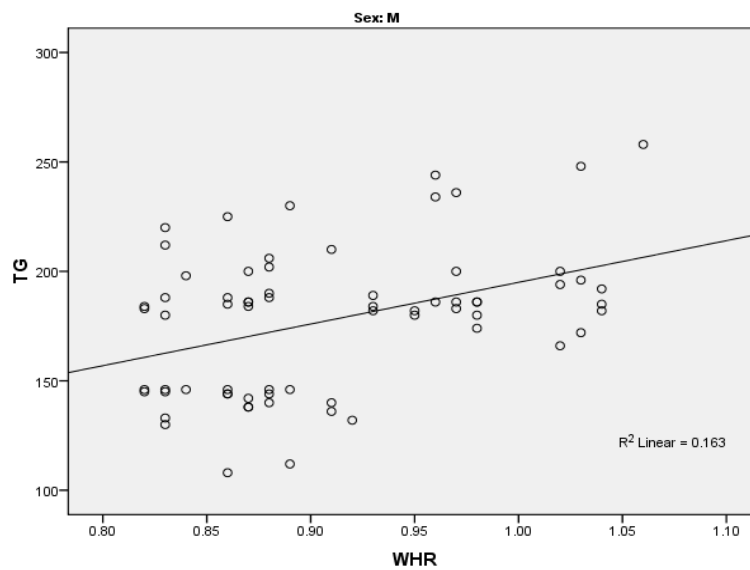Scatter plot 1.Relationship between WHR and TC in males.
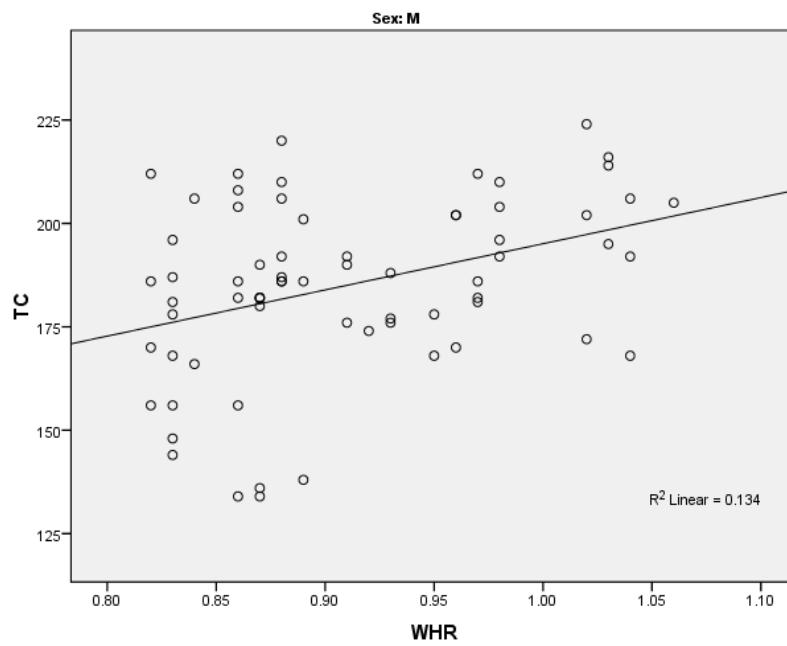
Statistically significant positive correlation was observed between WHR and TC in diabetic males($r= 0.367$, $p= 0.002$).

Scatter plot 2. Relationship between WHR and HDL in males.



Statistically significant negative correlation was seen between WHR and HDL in diabetic males($r= -0.683$, $p< 0.001$).

Scatter plot 3.Relationship between WHR and TG in males.



Statistically significant positive correlation was observed between WHR and TG in diabetic males(r= 0.404, p< 0.001).

Scatter plot 4. Relationship between WHR and LDL in males.
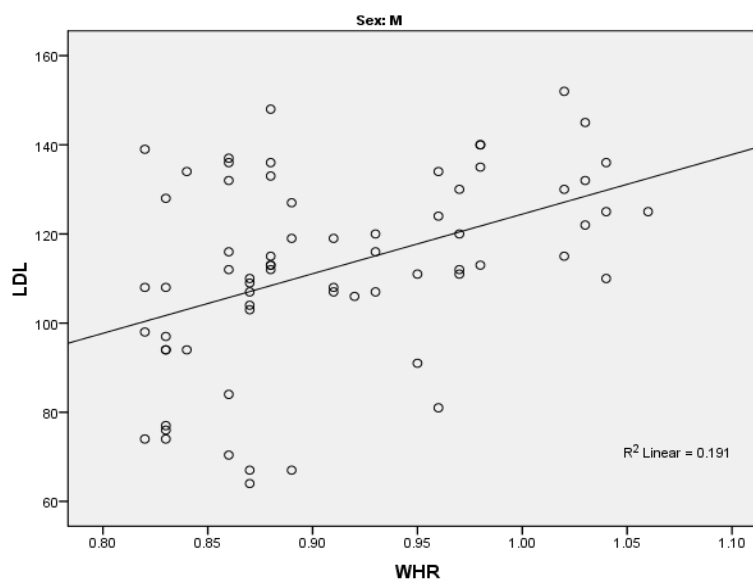


Statistically significant positive correlation was observed between WHR and LDL in diabetic males(r= 0.437, p< 0.001).

Statistically significant correlations were not seen between WHR and TC(r=-0.019, p=0.918), WHR and HDL-C(0.217, p=0.232), WHR and TG(r=-0.273,p=0.131) or WHR and LDL-C(r=-0.021,p=0.909) in females in the present study. Also, statistically significant correlations were not seen between BMI and TC (r= 0.0183,p = 0.856) ,BMI and HDL-C (r=0.035,p= 0.728), BMI and TG (r=-0.074, p= 0.464) or BMI and LDL-C(r=0.021,p=0.832) in the total population.

## IV. Discussion

In the present study, it was observed that dyslipidemia is quite prevalent in recently diagnosed type 2 diabetics andthe most commonly elevated lipid parameter found was elevated LDL-C followed by hypertriglyceridemia,which was similar to the pattern seen in the studies conducted by Bolre et al[14] and Pokharel et al[15]. The present study shows that WHR correlates significantly with lipid profile in type 2 diabetic males ,while there is no such correlation in diabetic females. There is no significant correlation between BMI

and lipid profile inrecently diagnosed type 2 diabetics. Astudy conducted by Sandhu et al[16]showed significant positive correlations between WHR and TC , TG, LDL-C in type 2 diabetic males, while the same study showed negative correlation between WHR and LDL-C in female diabetics in fouth and fifth decades.No correlation withthe other lipid parameters was seen in females.In another study conducted by Biadgo et al[17], positive correlations were seen between WHR and TC, LDL-C andtriacylglycerol in type 2 diabetics.A study conducted by Kanwar et al[18],showed positive correlation between WHR and serum triglyceride, and negative correlation between WHR and HDL-C in diabetic males, while no significant correlations were obtained in female diabetics.S Choi[19] conducted a study in type 2 diabeticsin whichWHR was found to be positively associated with LDL-C and TC levels in diabetic men whileBMI was not associated with lipid parameters.In the study conducted by Himabindu et al[20] significant negative correlation was seenbetweenWHR and HDL-C in type 2 diabetics while significant correlations were not observed between anthropometry and lipid parameters in the total study population. Yet another study conducted by Jayarama et al[21] found that WHR is not significantly associated with lipid parameters in type 2 Diabetics.

As there is inconsistency in the correlations seen between anthropometry and lipid parameters in different studies, it may be concluded that BMI and WHR may not be optimal to predict dyslipidemia in type 2 diabetics.In addition to the measurement of BMI and WHR,lipid profile should also be monitored separately in patients with type 2 DM.

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