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RESEARCH ARTICLE
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A STUDY OF BODY MASS INDEX, WAIST-HIP RATIO AND LIPID PROFILE IN TYPE 2 DIABETES MELLITUS PATIENTS

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Abstract

Background- Diabetes mellitus is a chronic, possibly debilitating condition that constitutes a significant public health and clinical risk due to the financial burden it places on the affected person, their family, and society as a whole. The problem has been made worse by the change from a traditional to a modern lifestyle, which includes eating diets heavy in calories and fats while also experiencing high levels of mental stress. Treatment for Type 2 DM patients who are overweight or obese must include weight management. Hence, we conducted a study in those patients with type II diabetes mellitus to correlate the BMI, WHR and lipid profile.

Methods- observational cross-sectional study that included a total of 60 patients, who had Type 2 Diabetes Mellitus patients (ADA 2018 Criteria), age >35yrs Age and those consenting for the study. Patient's detailed history along with thorough physical examination and relevant investigations was collected in a semi structured proforma. The data was entered into the Microsoft excel and the statistical analysis was performed by statistical software SPSS version 21.0.

Results- In our study, increased BMI was seen in 23.95% of the male participants and 34.49% of the female participants. Increased WHR was evident in 82.76% of the total female population and 40.85% of the total male population. All groups showed a greater prevalence of hypertriglyceridemia, which was followed by hypercholesterolemia, high LDL, and low HDL.

Conclusion- Even a small weight loss of 5% of one's starting weight can improve blood sugar regulation and lessen the need for hypoglycemic medication.

Keywords- waist-hip ratio, diabetes mellitus, metabolic syndrome

Introduction

The most common metabolic condition worldwide is diabetes mellitus. Estimates from 2011 place the number of individuals living with diabetes worldwide at 366 million, which represents a significant burden. About 62 million individuals in India had diabetes in 2011, making up roughly one sixth of the worldwide diabetes burden, which is expected to reach 101 million by 2030 1,2. Due to its consequences, it is one of the main risk factors for early mortality and morbidity. More than 95% of people with diabetes in India have type 2 diabetes, making it the most common kind of the disease. The prevalence of diabetes is uniformly high in all Indian urban cities (Chennai 13.5%, Bangalore 12.4%, Hyderabad 16.6%, Calcutta 11.7%, Mumbai 9.3%, and New Delhi 11.6%), but it is higher in Southern cities, according to the national urban diabetes survey (NUDS). There was no gender difference in the age-standardized prevalence of diabetes and IGT, which were 12.1% and 14%, respectively.

Obesity, especially visceral or central obesity (as shown by the hip-to-waist ratio), is extremely prevalent in type 2 diabetes (80% or more are obese). Insulin resistance, which is a significant hallmark of type 2 diabetes and is caused by a combination of genetic predisposition and obesity, is the diminished ability of insulin to function effectively on target tissues. A spectrum of illnesses are associated with the insulin resistance condition, with hyperglycemia being one of the easiest signs to identify. Insulin resistance, hypertension, dyslipidemia (lower HDL and higher triglycerides), central or visceral obesity, type 2 diabetes or IGT/IFG, and accelerated cardiovascular disease are all metabolic derangements collectively referred to as the metabolic syndrome, insulin resistance syndrome, or syndrome X.

Visceral lipids increase fatty acids and lipolytic activity, which reduce insulin action compared to a number of other anthropometric measurements, WHtR and WC are better predictors of the distribution of visceral and abdominal fat. When compared to BMI, these metrics are more reliable in predicting cardiovascular diseases. Even if this evidence has some biological value, the conclusions of the many study are still hotly debated. Although WC and BMI are closely related, it has been shown that the link between diabetes and WC is stronger than the relation of WC with BMI, which is a measurement of general adiposity.

The risk of developing cardiovascular illnesses is increased by lipids in T2DM. An increase in the incidence of sudden cardiac mortality, particularly in metropolitan areas of India, may be partly ascribed to rising rates of CAD, diabetes, and hypertension. It’s true that Type-2 DM is linked to an up to fourfold increased risk of getting CAD. However, as other cardiovascular risk factors like hypertension and dyslipidemia also play a significant role, hyperglycemia alone cannot account for such an elevated risk. Additionally, it has been shown that diabetes individuals have a greater incidence of various cardiovascular risk factors than nondiabetic patients, including obesity, sedentary behavior and smoking.[16]

Compared to the general population, type 2 diabetes has a twice as high incidence of dyslipidemia. Dyslipidemia is a significant contributor to the development of atherosclerosis and a risk factor for cardiovascular disease (CVD).[20] These more complicated anomalies are brought on by the interactions between hyperinsulinism, insulin resistance, and obesity.[21] In T2DM, insulin resistance in liver is a reflection of hyperinsulinemias inability to control the process of gluconeogenesis, that leads to fasting hyperglycemia along with reduced postprandial glycogen storage in the liver.

People with T2DM and prediabetes often have aberrant lipid levels, but the distribution of these lipids may fluctuate depending on an individual’s ethnicity, socioeconomic status, and access to medical treatment. The risk of Type 2 DM can be partially predicted by abnormal levels of the lipid markers mentioned above, according to a recently published meta-analysis. We observed that the community of people in this region, with Type-2 diabetes who visited Sharda Hospital’s Medicine Department had a significant prevalence of increased Body Mass Index, waist-hip ratio, and deranged lipid levels.

Materials and Methods

This observational cross-sectional study, titled “A Study of Body Mass Index, Waist-Hip Ratio and Lipid Profile in Type 2 Diabetes Mellitus Patients”, was conducted in the Department of [Insert Department Name, e.g., General Medicine / Endocrinology], [Insert Institution Name], after obtaining clearance from the Institutional Ethics Committee (IEC) [IEC approval number if available]. The study was carried out over a period of one year (2021–2022).

Study Population and Sampling

A total of 60 patients diagnosed with Type 2 Diabetes Mellitus according to the American Diabetes Association (ADA) 2018 criteria were included.

Inclusion criteria: a.

Age >35 years

b.Confirmed diagnosis of Type 2 Diabetes Mellitus

Exclusion criteria: Patients with a.

Type 1 Diabetes Mellitus

b. Acute diabetic complications such as diabetic ketoacidosis (DKA) or hyperglycemic hyperosmolar state (HHS)
c. Acute cardiovascular or cerebrovascular events (myocardial infarction, stroke)
d. Endocrine disorders (e.g., hypothyroidism, Cushing's syndrome)
e. Chronic liver disease
f. Gestational diabetes mellitus
g. Genetic syndromes associated with diabetes

Data Collection Procedures

After obtaining informed consent, a detailed history was recorded, including demographic data, duration of diabetes, treatment history, lifestyle factors (dietary habits, physical activity), and relevant comorbidities. This was followed by a comprehensive physical examination which included:

Anthropometric measurements:

a) Body Mass Index (BMI): calculated as weight (kg) divided by height squared (m^2)
b) Waist circumference: measured midway between the lower rib margin and the iliac crest
c) Hip circumference: measured at the widest portion of the buttocks
d) Waist-to-Hip Ratio (WHR): calculated by dividing waist circumference by hip circumference
e) Vital signs: blood pressure, heart rate, and respiratory rate

Laboratory Investigations

All participants underwent fasting blood sample collection after at least 8–12 hours of overnight fasting. The following parameters were analyzed: a) Fasting Blood Glucose (FBG)

b) Lipid profile: total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), very low-density lipoprotein cholesterol (VLDL-C)

c) Laboratory measurements were carried out using standard enzymatic methods on automated analyzers, following manufacturer's protocols and internal quality control procedures.

Data Management and Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software, version 21.0. Quantitative variables (e.g., BMI, WHR, lipid levels) were expressed as mean ± standard deviation (SD). Qualitative variables (e.g., gender, presence of dyslipidemia) were expressed as frequency and percentage. The Student's t-test was applied to compare mean values between two groups (e.g., male vs. female participants). The Chi-square test was used to compare categorical variables. A p-value < 0.05 was considered statistically significant.

RESULTS

The mean age was found to be 54.92±10.25 years, with majority belonging to 41-50 years (35.0%) followed by 51-60 years (26.7%), and above 60 years (25.0%). Amongst the study participants, we found that majority (60%) were males. The habits reported were Tobacco chewing (16.7%), Bidi (25.0%), Cigarette (8.3%), Beetal chewing (36.7%) and Alcohol abuse (18.3%). The mean Height (in metres) was 1.67±0.08, Weight (in kgs) was 75.34±12.36, Waist circumference (in cm) was 94.51±9.07, Hip circumference (in cm) was 100.61±5.05, BMI (kg/m2) was 26.98±4.52 and WHR was 0.94±0.08 (table 1). The mean HbA1c was 9.86%±2.94%, FBS was 252.08±87.03 and PPBS was 322.90±97.96 (table 2).

The mean Serum Total Cholesterol was 217.38±53.59, Serum TGL was 204.32±113.61, Serum HDLC was 48.87±12.93, Serum LDL-C was 97.54±27.71 and Serum VLDL was 40.87±22.72.

	Mean	Std. Deviation	Minimum	Maximum
Height (in metres)	1.67	0.08	1.49	1.86
Weight (in kgs)	75.34	12.36	52.00	110.00
Waist circumference (in cm)	94.51	9.07	77.00	120.00
Hip circumference (in cm)	100.61	5.05	90.00	112.00
BMI (kg/m2)	26.98	4.52	18.21	39.44
WHR	0.94	0.08	0.84	1.15

Table 1: According to anthropometric measurements and BMI

	Mean	Std. Deviation	Minimum	Maximum
HbA1c	9.86%	2.94%	5.00%	16.70%
FBS	252.08	87.03	132.00	456.00
PPBS	322.90	97.96	185.00	546.00

Table 2: Depending on blood sugar levels and HbA1c

When we analysed the relationship between BMI and HbA1c, we found a significant positive correlation is found between HbA1c with BMI (p value 0.003*).

It was additionally found that found that HbA1c, fasting blood sugar and post-prandial blood sugar is positively correlated with Waist circumference. Also that Serum LDL, VLDL and Total Cholesterol is positively correlated with Waist circumference and there was significantly negative correlation of Serum HDL-Cholesterol with Waist circumference.

		circumference of Waist
	r value	0.411
Serum Total Cholesterol	p - value	0.038*

Serum TGL	r value	0.036
	p - value	0.716
Serum HDL-C	r value	-0.367
	p - value	0.041*
Serum LDL-C	r value	0.409
	p - value	0.038*
Serum VLDL	r value	0.436
	p - value	0.017*
HbA1c	r value	0.216
	p - value	0.030*
FBS	r value	0.191
	p - value	0.055
PPBS	r value	0.159
	p - value	0.110

Table 3: Relation amongst circumference of waist with types of lipids and blood sugar levels

There was positive relation of HbA1c, FBS and PPBS with Hip circumference. Also Serum LDL, VLDL and Total Cholesterol show a positive relation with Hip circumference and significant negative correlation of Serum HDL-Cholesterol with Hip circumference.

		Hip circumference
Serum Total Cholesterol	r value	0.298
	p- value	0.046*
Serum TGL	r value	0.054
	p- value	0.589
Serum HDL-C	r value	-0.270
	p- value	0.047*
Serum LDL-C	r value	0.439
	p- value	0.026*
Serum VLDL	r value	0.354
	p- value	0.038*
HbA1c	r value	0.380
	p- value	0.021*
FBS	r value	0.361
	p- value	0.024*
PPBS	r value	0.259
	p- value	0.038*

Table 4 : Relation amongst circumference of hip with types of lipids and blood sugar levels

We also obbserved a positive relation of HbA1c, FBS and PPBS with Waist-Hip ratio. There was a significant relationship of Serum LDL, VLDL and Total Cholesterol with WHR. Also, negative correlation of Serum HDL-Cholesterol with WHR.
The mean Serum TC, Serum LDL-C, Serum VLDL and Serum TGL was significantly higher among subjects with higher BMI range. Serum HDL-C was significantly lower among subjects with higher BMI

The mean Serum Total Cholesterol and serum TGL was significantly higher among subjects with abnormal Waist circumference (in cm). The mean serum HDL-C was significantly higher among Normal Waist circumference (in cm).
The mean Serum Total Cholesterol and serum TGL were higher amongst population with abnormal WHR. Also, mean serum HDL-C was significantly high among normal WHR.

DISCUSSION
T2DM is a complex disorder that affects a person's ability to perform a number of daily activities, as is well recognized. If it is treated properly, diabetes is not lethal, but it can have dangerous side effects. It has been found that different derangements can be used to predict T2DM. (4,5)
Additionally, three times as many persons were obese when the Asian criteria were used (21 versus 7). Similar to this, 70% of patients had aberrant WCs according to WHO standards, but when Asian criteria were used, 16% more patients (86%) had higher WCs.(7-9). In current study, there was a significantly positive correlation of Serum Total Cholesterol with Hip circumference and significantly negative correlation of Serum HDL-Cholesterol with Hip circumference and WHR. Recently, favorable relationships between men's WHR, TC, LDL, and TGs in the 41-50 year age range as in our study, were similarly observed by Sandhu *et al*.(9)
Additionally, there's strong association (p= 0.027) in between baseline weight and blood LDL levels. The relationship between waist size and Serum Triglycerides (p=0.034) and Total Cholesterol (p=0.005) was statistically significant.
The most prevalent dyslipidemia, found in a South-East Asian study on newly diagnosed diabetics, was hypertriglyceridemia (81%), followed closely by low HDL (77.5%).[103] Low HDL was the most prevalent lipid anomaly (72.3%) in a study on diabetic dyslipidemia in a representative group from three Indian states.
According to a multi-centric study on newly diagnosed diabetes in India (CINDI), 27% of newly diagnosed diabetics had dyslipidemia. However, this study did not include anthropometry or specific information on diabetic dyslipidemia.
The link between dyslipidemia and CVD risk is scientifically tenable and consistent with the pathogenesis of CVD as currently understood. The proposed mechanism linking dyslipidemia and CVD has been laid out.
Researchers found that increased levels of oxidative stress-related plasma lipid and lipoprotein may cause endothelial dysfunction. Another route for CVD pathogenesis is LpL dysregulation, which results in a dyslipidemic lipid profile.*Ge et al*.reported that WC exhibited the greatest OR (3.211 and 1.452) and AUC (0.783 and 0.614).
In the current investigation, the lipid profile, BMI and WHR showed comparable correlations. This result supports a findings with Reddy et al. (4) that there is a positive connection between BMI and WHR with regard to TC and TAG. But according to a prior study, there was just a link between BMI and VLDL. In diverse populations, it was discovered that the variables over the cut-off threshold values were CVD predictors. In the current investigation, we found that participants with T2DM had statistically significant increases in their mean BMI and WC values when compared to the controls. Himabindu and team (5), on the contrary, observed lack of consistency between anthropometry and

lipid profile in various studies shows that anthropometrical parameters are not ideal for predicting lipid abnormalities in type 2 diabetics.

In a study by Biadgo et al, they attempted to correlate lipid profiles with various clinical and anthropometric variables, and they observed a statistically significant increases in the mean values of BMI and the WC in T2DM participants compared to the controls. In the present study, lipid profile correlated in a comparable manner with BMI and WHR. This finding is consistent with a previous study () which showed positive correlation between BMI and WHR with respect to TC, TAG. However, previous study reported that correlation existed only in BMI and VLDL (44).

A recent study by Blebil Q and team (8) demonstrated significant differences in anthropometric variables and lipid profile in T2DM in three different ethnic groups in Malaysia. In another recent study in Iran by Ghorbanian et al (9), it was observed that correlation happened between BMI and TC, LDL cholesterol, TAG, which is consistent with the present study. In another recent study by Sandhu et al, they noted a positive correlations between WHR, TC, LDL cholesterol in healthy subjects in (10).

Limitations

The present study has certain limitations. As an observational cross-sectional design, it cannot establish causal relationships between BMI, WHR, lipid profile, and Type 2 DM. The relatively small sample size (n=60) drawn from a single center may limit the generalizability of the findings to broader populations. Furthermore, potential confounding factors such as dietary habits, physical activity levels, and genetic predispositions were not assessed or controlled for, which could have influenced the observed associations.

Conclusion

There is a significant association between BMI and lipid profile parameters. As there is significant negative correlation of BMI and waist circumference to lipid profile parameters, these could be potential predictors of cardiovascular risk in patients with type 2 diabetes mellitus.

These parameters also help us in guiding the patient about dietary management, lifestyle modifications and optimal glycemic control.

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