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To Evaluate various anthropometric measurements and lipid profile in newly diagnosed Type 2 Diabetes Mellitus patients

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ABSTRACT

Backgeound: India has now earned the title of being the "diabetic capital of the world," with a staggering number of over 30 million individuals afflicted with diabetes. Coronary artery disease stands out as the most significant vascular complication among diabetics. Plasma cholesterol levels serve as robust predictors of cardiovascular events in both diabetic and non-diabetic individuals with coronary heart disease. Type 2 diabetes is linked to a centralized and disharmonious distribution of fat. The most used measure is the Body Mass Index (BMI), waist circumference (WC) and waist-to-hip ratio (WHR).

Objectives: The purpose of this thesis is to evaluate the utility of three of the most used anthropometric measures – Body Mass Index (BMI), Waist Circumference (WC), and Waist-to Height Ratio (WHtR) – to assess and correlate various Anthropometric parameters and lipid profile patterns in patients of newly diagnosed Type 2 Diabetes Mellitus.

Methodology: This cross-sectional study included newly diagnosed T2DM patients aged between 20 and 60 years, recruited from patients attending Medicine Department, Maharaja Agrasen hospital, Punjabi Bagh, Delhi over a period of one year from March 2018 to March 2019. The anthropometric measurements and physical examination findings were recorded at the same time. The blood sample (venous) was taken after overnight fasting (≥10 h) for biochemical analysis. Data were entered and analyzed using SPSS version 20 (IBM, USA).

Results: A total of 130 cases were studied in the present study. Mean age was found to be 41.8±10.84 years. Male: female ratio was found to be 1.28:1. Mean BMI was found to be 29.63 Kg/m2. Waist circumference had mean value equal to 91.86 cm; while hip circumference had mean value 102.89 cm. Mean waist to hip ratio (WHR) was found to be 0.89. Mean total cholesterol level was found to be 210 mg/dl. LDL and HDL had mean values 152.23 and 54.20 respectively. The correlation between BMI and TC, LDL and HDL was found to be significant statistically. A significant correlation was seen between TC and fasting blood glucose levels with p value 0.0133. Positive correlation coefficient suggests a positive relationship between TC and FBG levels.

Conclusion: The results of our study demonstrate a significant correlation between lipid profile and BMI in individuals with Type 2 Diabetes Mellitus (T2DM). Moreover, we observed a significant rise in fasting blood sugar (FBS) levels, which are directly associated with body mass index. Also, the study revealed notable correlations between lipid profiles and various anthropometric and clinical factors, suggesting that poor glycemic control and lifestyle habits have an impact.

KEY WORDS: *Type 2 Diabetes Mellitus, Fasting Blood Sugar, Body Mass Index, Dyslipidemia, Anthropometric*

INTRODUCTION

Over the past three decades, diabetes has emerged as a significant cause of morbidity and mortality, affecting both the younger and middle-aged populations. India has now earned the title of being the "diabetic capital of the world," with a staggering number of over 30 million individuals afflicted with diabetes. Recent population-based studies in various parts of India have been revived, revealing a five-fold increase in the prevalence of Type 2 diabetes, rising from 2.1% in 1975 to 12.1% in 2000.[1,2]

According to the Diabetes Atlas, jointly published by the International Diabetes Federation (IDF) and the World Health Organization (WHO), India is projected to have the highest prevalence of diabetes by the year 2025, with every fourth diabetic worldwide being of Indian origin.[3]

The association between altered serum lipids and vascular complications is particularly pronounced in diabetics compared to the general population. Population-based studies have demonstrated that Type 2 diabetes is generally linked to a 50% to

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100% elevation in plasma levels of total and VLDL triglycerides. These lipid abnormalities contribute to the development of both microvascular and macrovascular diseases in diabetic patients.[4]

Coronary artery disease stands out as the most significant vascular complication among diabetics, with diabetes being associated with a two to four times increased risk of this condition. Plasma cholesterol levels serve as robust predictors of cardiovascular events in both diabetic and non-diabetic individuals with coronary heart disease.

Obesity is strongly associated with adverse cardiovascular risks, leading to an excess of cardiovascular morbidity and mortality. Its prevalence has surged in both industrialized and developing nations, prompting the World Health Organization (WHO) to officially classify obesity as a disease.[5]

Type 2 diabetes is linked to a centralized and disharmonious distribution of fat. Regional fat distribution shows a significant correlation with cardiovascular disease risk factors. Particularly, abdominal, or central adiposity emerges as the primary determinant of cardiovascular disease and Type 2 diabetes.[6]

While there are direct and accurate but expensive methods to determine body composition and fat distribution, these are impractical for use in epidemiological and clinical settings due to their cost and complexity. Therefore, simple anthropometric measurements have been explored to diagnose obesity in its early stages. The most commonly used measure is the Body Mass Index (BMI), which relates weight to height, but it does not account for body fat distribution.[7] Intra-abdominal deposition of adipose tissue plays a vital role in the development of hypertension, insulin resistance, diabetes, and dyslipidemia. As a result, other anthropometric indices such as waist circumference (WC) and waist-to-hip ratio (WHR) have gained acceptance as alternatives to BMI. Among these, waist circumference is increasingly considered the most reliable anthropometric indicator of abdominal adiposity and metabolic risk.[8]

The purpose of this thesis is to evaluate the utility of three of the most used anthropometric measures – Body Mass Index (BMI), Waist Circumference (WC), and Waist-to Height Ratio (WHtR) – to assess and correlate various Anthropometric parameters and lipid profile patterns in patients of newly diagnosed Type 2 Diabetes Mellitus.

MATERIAL AND METHODS

Study Design:

This cross-sectional study included newly diagnosed T2DM patients aged between 20 and 60 years, recruited from patients attending Medicine Department, Maharaja Agrasen hospital, Punjabi Bagh, Delhi over a period of one year from March 2018 to March 2019.

Participants:

A total of 130 patients meeting the inclusion criteria were enrolled in the study after obtaining informed consent.

INCLUSION CRITERIA

- Newly diagnosed Type 2 Diabetes Mellitus patient

EXCLUSION CRITERIA

- Patients with Type 1 Diabetes Mellitus
- Patients with known Thyroid Dysfunction
- Patients on long term steroid therapy or patients of Cushing Syndrome
- Patients with Chronic Kidney Disease, Coronary Artery Disease, and chronic edematous state like Nephritic Syndrome.
- Patients diagnosed with Gestational Diabetes
- Patients with malunited fracture
- Patients with known case of Type 2 Diabetes Mellitus • Patients on lipid lowering agents.

METHODS OF DATA COLLECTION:

The patients, who were either attending OPD of the Medicine Department or admitted in the hospital, diagnosed with Type 2 diabetes mellitus were examined for this study. Patient confidentiality was assured by coding the patients' information and removing the identifiable personal data before data compilation. All the data was part of routine base line and follow up measurements of these patients. The anthropometric measurements and physical examination findings were recorded at the same time. The blood sample (venous) was taken after overnight fasting (≥10 h) for biochemical analysis.

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Body weight and height were recorded with the subjects dressed in minimal light clothing and without wearing shoes. The waist circumference was measured from the center point of the distance between iliac crest and the lower most margins of the ribs. The hip circumference was measured between the maximum girths of the buttocks. Neck circumference was measured in centimeters midway between cervical spine and anterior neck to within 1mm using non elastic tape with subject in standing position. The means of three recordings were taken from each site for further calculations. The BMI was calculated as weight (in kilograms)/ height (in meters) squared. Similarly, WHR was calculated as ratio of waist to hip division.

As per NCEP ATP III criteria,[9] the subjects were classified dyslipidemia when presented with one or more of the following including: plasma cholesterol (TC) ≥6.22 mmol/L (240 mg/dl), LDLc ≥4.14 mmol/L (160 mg/dl), or HDLc<1.03 mmol/L (40 mg/dl).The venous blood samples collected from subjects were centrifuged; the plasma was separated and used for further analysis.

STATISTICAL ANALYSIS:

Data were entered and analyzed using SPSS version 20 (IBM, USA). Data were reported as mean and standard deviation for continuous variables, percentages for categorical variables and interquartile range for non-normally distributed data. Variables were compared using independent sample t-test for normally distributed data and Mann-Whitney U test for non-normally distributed data whichever appropriate. Pearson's and spearman's rank correlations were used to test the relationship of lipid profile with clinical and anthropometric variables. P-value <0.05 was considered statistically significant.

RESULTS

A total of 130 cases were studied in the present study, out of which 26 cases (20%) were of age 20-30 years old. Most patients (45 cases, 34.6%) belonged to the age group 41 to 50 years; followed by 30 cases (23.1%) from age group 31 years to 40 years and 29 cases (22.3%) from age group 51-60 years old. Mean age was found to be 41.8±10.84 years.

Our study showed preponderance of males over females in terms of disease distribution. 73 (56.2%) males suffered from diabetes mellitus type II while females suffering from disease were 57 (43.8%). Male: female ratio was found to be 1.28:1.

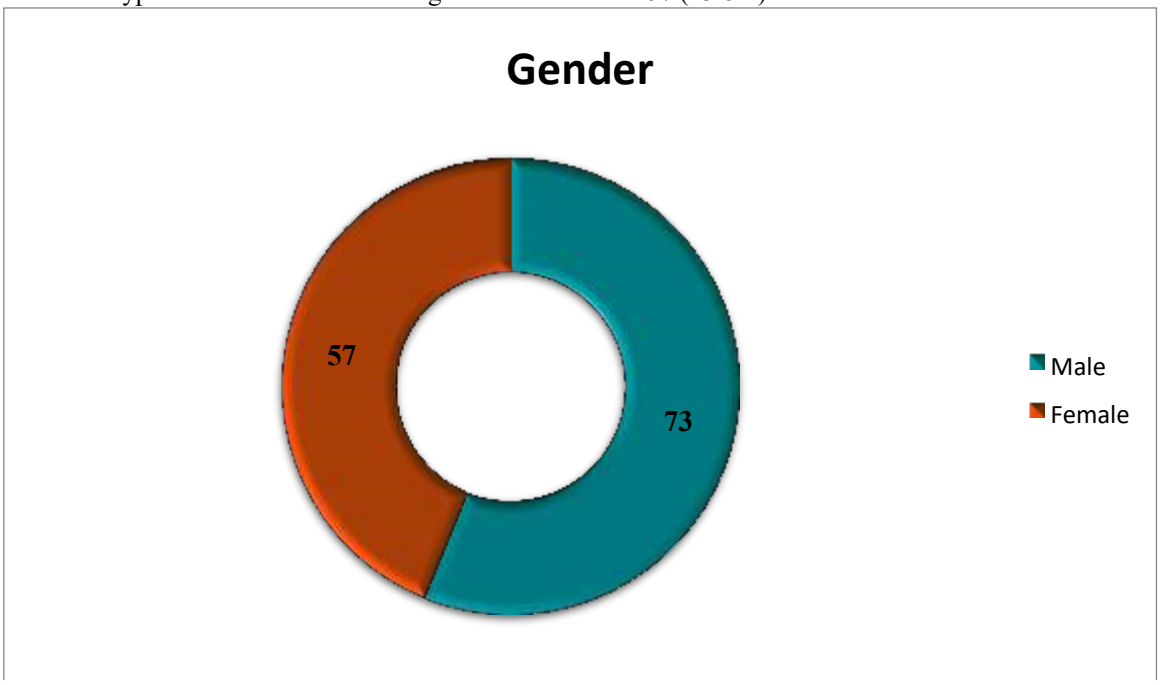

Figure 1: Gender distribution of patients.

Table 1: Distribution of means of anthropometric and diabetic parameters of patients.

Parameters	Mean	SD	Min-Max
Weight	83.02	10.15	59-107
Height	1.67	0.11	1.49-1.96
BMI	29.63	3.09	17.91-44.27
Waist circumference	91.86	10.28	73-115

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Hip circumference	102.89	10.32	82-127
Neck circumference	37.82	3.39	31-46
Waist : Hip	0.89	0.016	0.849-0.917
Fasting blood glucose	173.84	39.48	100-270
Fasting insulin	44.53	10.67	25-75

The majority of patients (68, 52.4%); were overweight and were included into BMI range 25 to 29.9 Kg/m2. 5 (3.8%) patients had normal physique along with healthy BMI <25Kg/m2. 57 (43.8%) cases were obese with BMI >30 Kg/m2. Mean BMI was found to be 29.63±3.09.

Mean weight was found to be 83.02 for our study population. Mean height was calculated as 1.67 m. Mean BMI was found to be 29.63 Kg/m2. Waist circumference had mean value equal to 91.86 cm; while hip circumference had mean value 102.89 cm. Mean waist to hip ratio (WHR) was found to be 0.89.

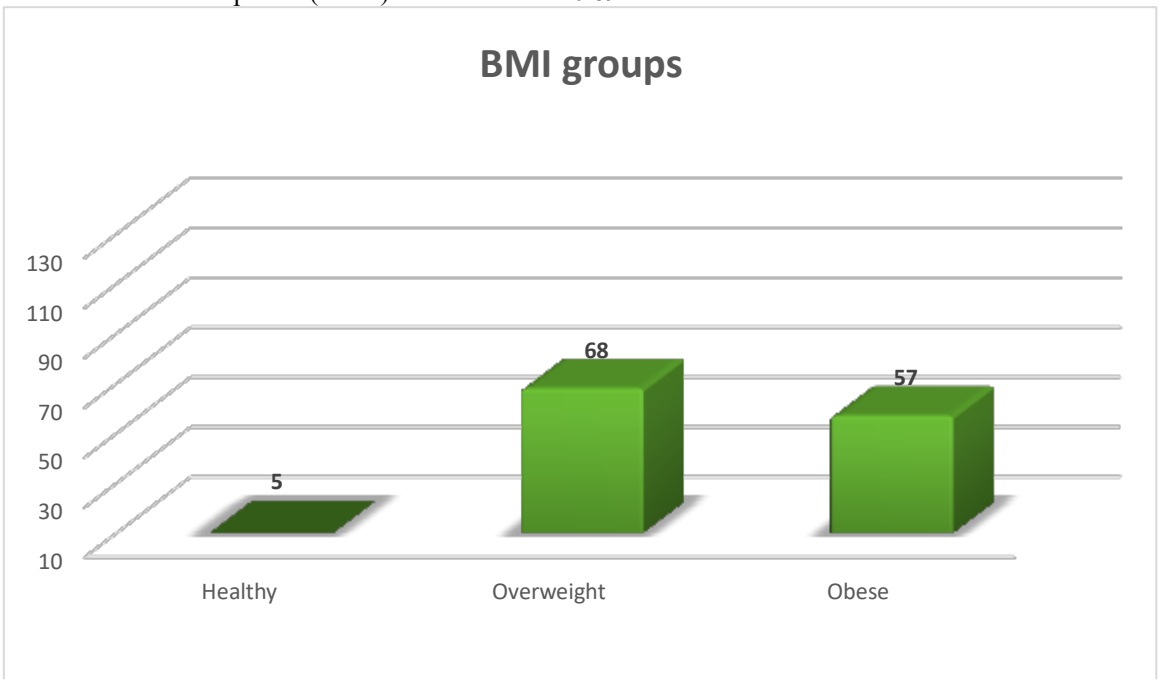

Figure 2: Distribution of patients based on BMI. Table 2: Distribution of lipid profile parameters

Parameters	Mean	SD	Min-Max
TC	210	52.39	110-320
LDL	152.23	27.42	100-210
HDL	54.20	14.46	34-94

Mean total cholesterol level was found to be 210 mg/dl. LDL and HDL had mean values 152.23 and 54.20 respectively.

Table 3: Pearson's correlations (r) between anthropometric parameters and lipid profile

BMI	TC	LDL	HDL
R	0.2724	0.3768	-0.1891
P	0.0016*	<0.0001*	0.0311*
WHR			
R	0.1022	0.0662	0.1220
P	0.2471	0.4540	0.1667

Pearson's correlation coefficient was calculated to study correlation between anthropometric parameters and lipid profile. The correlation between BMI and TC, LDL and HDL was found to be significant statistically with p value 0.0016, <0.0001 and 0.0311 respectively. The correlation coefficient of TC and LDL was found to be positive, which means as BMI increases amount of TC and LDL also increases simultaneously. Negative coefficient of HDL is associated with lowered HDL levels in raised BMI cases.

Table 4: Pearson's correlations (r) between diabetic parameters and lipid profile

Fasting blood glucose	TC	LDL	HDL

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R	0.2158	0.0041	0.0170
P	0.0133*	0.9623	0.8473
Fasting insulin			
R	0.0382	-0.0086	-0.0001
P	0.6656	0.9223	0.9984

Pearson's correlation coefficient was studied to find out any association between fasting blood glucose, fasting insulin, and lipid profile. A significant correlation was seen between TC and fasting blood glucose levels with p value 0.0133. Positive correlation coefficient suggests a positive relationship between TC and FBG levels. As TC goes up; FBG also tends to increase.

DISCUSSION

The prevalence of Type 2 diabetes mellitus is rapidly surging across the globe, constituting a pressing health concern in both developed and developing nations. Key risk factors, such as obesity, particularly central obesity, sedentary lifestyles, and diets abundant in saturated fatty acids, contribute significantly to the increased susceptibility to Type 2 DM.[10]

The utilization of straightforward anthropometric measurements has emerged as a valuable tool for early obesity diagnosis, offering practical benefits for routine monitoring and patient assessment. Among the routinely employed anthropometric measures are Body Mass Index (BMI), Waist Circumference (WC), and Waist-to-Hip Ratio (WHR).[11,12] While BMI is widely adopted for obesity classification, it fails to account for variations in fat distribution. On the other hand, Waist Circumference stands out as a superior anthropometric index for assessing abdominal visceral adipose tissue and predicting cardiovascular disease (CVD) risks.[13]

Recognizing the potential for prevention through lifestyle modifications and dietary changes, this study was conducted on 130 cases to evaluate various anthropometric measurements and lipid profiles in Type 2 diabetes mellitus.

Within the study's cohort, a majority of patients fell into the age group of 41 to 50 years, with a mean age of 41.8 years. There was a slight male preponderance, with a male-to-female ratio of 1.28:1. Only 5% of cases were deemed healthy, displaying a BMI of less than 25, while the majority of patients were overweight, with a mean BMI of 29.63. The mean waist-to-hip ratio was found to be 0.89, with observed waist and hip circumferences measuring 91.8 and 102.8, respectively.

Regarding lipid profiles, the mean total cholesterol level was 210 mg/dL, and LDL (low-density lipoprotein) was measured at 152.23 mg/dL, both of which exhibited elevated values, whereas HDL (high-density lipoprotein) levels were decreased. Statistically significant correlations were observed between BMI and total cholesterol, LDL, and HDL levels, whereas no significant correlation was found between WHR and lipid profile. Notably, a significant correlation was identified between total cholesterol and fasting blood glucose levels, with a p-value of 0.0133.

It is worth noting that the Expert Consultation Group convened by the World Health Organization (WHO) acknowledged the heightened predisposition to diabetes and cardiovascular disease among certain Asian populations, even at the WHO cut-off point for overweight (BMI >= 25). Nevertheless, the WHO continues to uphold uniform cutoff points for international references, classifying both sexes in this study as overweight based on WHO criteria.[14]

Our research outcomes align with a study conducted by Mayur Patel *et al*,[15] wherein a mean BMI of 27.06 ± 4.57 was observed. According to BMI criteria, only 16% of the participants fell into the normal weight category, while the majority were classified as either overweight (BMI 23.0-24.9 kg/m²) or obese (BMI ≥ 25 kg/m²). Similarly, another study conducted by Maria AK *et al*[16] reported mean BMI values of 28.62 and 28.50 for female and male subjects, respectively.

Additionally, our study aimed to explore the correlation between lipid profiles and various clinical and anthropometric variables, some of which have been identified as predictors of Cardiovascular Disease (CVD) in diverse populations. Notably, we observed a statistically significant increase in the mean BMI value, reinforcing the need for vigilant monitoring of these anthropometric and laboratory parameters, especially in the context of India, where a substantial risk exists even at moderate degrees of overweight.[14] This cautious approach represents a cost-effective alternative to initiating antihypertensive treatment, particularly for a large population in the prehypertensive category, who also have diabetes or other metabolic risk factors. Lifestyle modifications, such as increased physical activity, moderate alcohol consumption,

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reduced salt intake, and dietary changes encapsulated in the Dietary Approaches to Stop Hypertension (DASH) plan,[17] are recommended to mitigate these risks.

Our findings revealed a comparable correlation between lipid profile and BMI as well as Waist-to-Hip Ratio (WHR), in line with a previous study[18] that demonstrated a positive correlation between BMI and Total Cholesterol (TC) and Very Low-Density Lipoprotein (VLDL). However, in contrast, the previous study reported correlation only between BMI and VLDL.[19]

In line with our study, a recent research endeavor showcased significant differences in anthropometric variables and lipid profile among individuals with Type 2 Diabetes Mellitus (T2DM) from three different ethnic groups in Malaysia.[20] Similarly, another recent study in Iran found a correlation between BMI and TC, LDL cholesterol, and Triglycerides (TAG), consistent with our results.[21] A study from North India also reported positive correlations between WHR, TC, and LDL cholesterol in healthy subjects.[22]

Consistent with our study, research conducted in Saudi Arabia and Korea found a positive correlation between BMI and TC, LDL cholesterol.[23, 24] Likewise, a similar study in Brazil demonstrated an association between lipid profiles and body adiposity.[25]

Furthermore, in our study, Fasting Blood Sugar (FBS) exhibited a statistically significant correlation with Total Cholesterol in T2DM patients. In congruence with our findings, a study in India reported higher TC, TAG, and LDL cholesterol levels in patients with poor glycemic control.[26] Similarly, a study in Nepal on T2DM patients reported significant correlations with TC, LDL cholesterol, and a significant negative correlation with HDL cholesterol.[27] However, in contrast to our study, research on a healthy population in India showed significant correlation of FBS with
TAG, LDL, and a negative correlation with HDL cholesterol, while not correlating with TC in the control group.[28]

CONCLUSION

The results of our study demonstrate a significant correlation between lipid profile and BMI in individuals with Type 2 Diabetes Mellitus (T2DM). Moreover, we observed a significant rise in fasting blood sugar (FBS) levels, which are directly associated with body mass index. Also, the study revealed notable correlations between lipid profiles and various anthropometric and clinical factors, suggesting that poor glycemic control and lifestyle habits have an impact. Thus, regular follow-up and effective glycemic control strategies are essential in preventing and delaying the progression of T2DM in patients with diabetes. Additionally, we recommend periodic medical checkups and lifestyle modifications for apparently healthy individuals as a means of improving their overall quality of life, promoting weight loss goals, and effectively managing dyslipidemia, which reduces cardiovascular risks.

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