Serum Lipid Profile Variation with Body Mass Index (BMI) in Diabetic and Non-Diabetic Mellitus: A Tertiary Centre Study in Puducherry

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ABSTRACT

Introduction:

Around 77 million individuals >18 years are experiencing diabetes (type 2) in India. Obesity and dyslipidemia have shared pathophysiology linked "insulin resistance". Only very limited research works are available on diabetes with its relation to BMI and dyslipidemia. Hence, this study was planned to identify the correlation between the lipid profile and different body mass index categories among diabetes mellitus in Tertiary Care Centre.

Materials and methods:

This hospital based cross sectional study was done among 194 patients. Blood samples were collected for FBS, PPBS, and Serum Lipid Profile. Results were collected and entered in Microsoft Excel sheet then analysis was done using SPSS version 23.0.

Results:

Majority of patients 79 (40.8%) were in the age group of 40-60 years. Out of 194 patients 112(57.7%) of them are diabetic. About 54 (27.8%) patients are overweight and 48 (24.7%) are obese. It reveals that there is a significant difference in the lipid profile among diabetic and non-diabetic patients.

Conclusion:

This study reveals that higher serum levels of total cholesterol, triglycerides, low density lipoprotein, very low-density lipoprotein, and low level of HDL was noted among diabetes patient compared to non-diabetic patients. The chances of dyslipidemia increase in patients with type 2 diabetes with high BMI in our study.

INTRODUCTION

It is estimated that by 2025, number of people with diabetes in India will rise to 80 million (Diabetes Foundation of India) and this will make our country 'Diabetes Capital' of the world.(1) India, the largest country in the region, is also the largest contributor to the non-communicable disease (NCD) burden.(2) Diabetes is a non-communicable disease that occurs when the insulin produced by pancreas is deficient or when the insulin produced is not effectively used by the body.(3) Among Diabetes mellitus Type 2 account for 90%.(4) American Diabetes Association states that Diabetes Mellitus is a metabolic syndrome which is determined by hyperglycemia.

Imbalance of serum lipids such as cholesterol, low-density lipoprotein cholesterol (LDL-C), triglycerides, and high-density lipoprotein (HDL) is referred as Dyslipidemia. Dyslipidemia can lead to cardiovascular disease with severe complications.(5) Dyslipidemia in diabetes is common and is portrayed by hypertriglyceridemia (HTG) with diminished levels of high-density lipoprotein (HDL)-cholesterol.(6)

One of the possible causes of insulin resistance, which raises blood sugar or glucose levels and eventually leads to diabetes, is over nutrition. Compared to the populations of European and American countries, Asians are more susceptible to non-communicable diseases (NCDs), even at lower BMI levels, which increases their chance of developing chronic disorders.(1) Obesity raises the risk of dyslipidemia, type II diabetes, atherosclerotic cardiovascular diseases, hypertension, respiratory disorders, and stroke by raising the likelihood of aberrant lipid profiles. Various investigations have shown a connection between high plasma TG levels with fat and obesity.(7)

Research conducted throughout several regions of India has proved the increasing incidence of overweight and obesity in the nation, with overweight and obesity being identified as the primary factor contributing to the rising prevalence of diabetes in our country.(8) To account for the correlation between obesity and T2DM, BMI has been introduced as a composite covariate for adjustment in T2DM studies.(9)

Indians have a genetic phenotype that is low BMI, but it also has significant levels of insulin resistance, body fat percentage, and upper body adiposity. This low BMI is associated with a high body fat percentage, which raises the prevalence of metabolic disturbances and diabetes mellitus (DM). Obesity and dyslipidemia have a shared pathophysiology linked to "insulin resistance" and are closely related to type 2 diabetes.(10) International recommendations for the management of dyslipidemia in individuals with type 2 diabetes advocate a

rigorous reduction in low-density lipoprotein (LDL) in diabetic patients, based on strong evidence from clinical trials.(11)

Only very limited research works are available on Diabetes with its relation to BMI and Dyslipidernia. Hence this study was planned to identify the correlation between the lipid profile and different Body Mass index categories among Diabetes Mellitus in tertiary care centre, also to detect the dyslipidernia among them which could improve the preventive measures in Diabetes to avoid further complications

AIM AND OBJECTIVES:
- To estimate prevalence of dyslipidemia in different Body Mass Index categories among Diabetes Mellitus and Non-Diabetes Mellitus.
- To analysis the effect of Body Mass Index on Dyslipidemia among Diabetes Mellitus and Non-Diabetes Mellitus.
- Correlation of Lipid profile and Body Mass Index

MATERIALS AND METHODS:
A hospital based analytical cross-sectional study done in a tertiary care hospital at Ariyur, Puducherry for a period of 18 months after approval from the institutional ethics committee (IEC: No: 45/SVMCH/IEC-Cert/Aug22) with a sample size of 194. Patients above the age of 18 years and diagnosed with diabetes mellitus were included in the study and patients with any other concurrent chronic diseases such as Cardiac disease, thrombotic stroke, pregnancy, anemia, immunocompromised patients and history of drug intake (statin) were excluded from the study. Demographic details and Medical History of patients were recorded using a semi structured questionnaire. After which BMI of patients were calculated and Blood samples were sent for Lipid Profile (Adult treatment panel - III) and Blood Glucose level (FBS and PPBS).

STATISTICAL ANALYSIS:
Results were collected and entered in Microsoft Excel sheet then analysis was done using SPSS version 23.0. Qualitative and Quantitative type variables were used. Frequency, proportion, student t test and correlation analysis were done.

RESULTS:
Distribution of patients based on Age, gender, and BMI:
Among, 194 participants the mean age found to be was 46 ± 14 years. Majority of them 79 (40.7%) were belonging to age group of 40 - 60 years. About 74 (38.1%) were less than 40 years and 41(21.1%) were more than 60 years of age. Based on gender, Majority of the participants were Male 122 (62.9%) and remaining were Female 72 (37.1%). Based on BMI, the participants shows that majority 61 (31.4%) belongs to Normal category. Followed by 54 (27.8%) Overweight, 48 (24.7%) Obese and 31 (16.0%) belonging to Lean category. This was given in table 1.

Table 1: Demonstrates frequency and Percentage for Age, Gender, and BMI

Based on Age		
Age (in years)	**Frequency**	**Percentage**
< 40 years	74	38.1%
40 -60 years	79	40.8%
>60 years	41	21.1%
Total	194	100%
Based on Gender		
Gender	**Frequency**	**Percentage**
Male	122	62.9%
Female	72	37.1%
Total	194	100%
Based on BMI		
BMI	**Frequency**	**Percentage**
Underweight	31	16.0%
Normal	61	31.4%
Overweight	54	27.8%
Obese	48	24.7%
Total	194	100%

Distribution of diabetes and non-diabetes among participants:
Among the total participants 112 (57.7%) were found diabetic and remaining 82 (42.3%) were non-diabetic.

Distribution of medication intake among Diabetes patients
Majority of patients is on OHA 37 (33.0%), about 35 (31.2%) participants were not on any type of treatment. While 21 (18.8%) take only Insulin and 19 (17.0%) take both OHA and Insulin.

Frequency Distribution of Lipid Profile among the participants:
Total Cholesterol was found abnormal among 123 (63.4%) and normal among 71 (36.6%) participants. About 113 (58.2%) had normal HDL level and 81 (41.8%) abnormal level. **LDL** level was abnormal among 115 (59.3%) and normal among 79 (40.7%). While 96 (49.5%) and 131 (67.5%) had abnormal VLDL and Triglycerides respectively.

Distribution of participants based on BMI and Age:
Among 74 participants of age less than 40 years 15 (20.3%) are underweight, 20 (27.0%) has
normal BMI, 21 (28.4%) belongs to overweight and 18 (24.3%) Obese. Of the 79 Participants belonging to the age group of 40 to 60 years 10 (12.7%) are underweight, 23 (29.1%) are normal, 21 (26.6%) overweight and 25 (31.6%) obese. Whereas out of 41 participants with age more than 60 years 6 (14.7%) are underweight, 18 (43.9%) normal, 12 (29.3%) overweight and 5 (12.1%) obese

Distribution of Body Mass Index based on Age:
There is no significant difference in the level of Body Mass Index in the participants based on their age as depicted by 'F' value of 2.477 (pvalue-0.087). The average BMI among participants who are below 40 years is 25.492±5.7300, 26.744±6.0210 in patients who are between 40 to 60 years of age and 24.295±5.7491 in the participants who are above 60 years of age.

Distribution of participants based on BMI and Gender:
In our study out of 122 males, 19 (15.6%) were underweight, 39 (32.0%) normal, 33 (27.0%) overweight and 31 (25.4%) obese. Among 72 females, 12 (16.7%) are underweight, 22 (30.6%) normal, 21 (29.1%) overweight and 17 (23.6%) obese. Table 2 shows the significance test for association between Gender and BMI. There is no significant difference in the Body Mass Index based on Gender as the 't' statistic (-0.172) with insignificant p-value (0.864). The Mean BMI in male participants is 25.693±5.8026 and female participants is

25.844±6.0993

Table 2: Distribution participants based on BMI and Gender (n=194)

Gender	N	Body Mass Index (Kg/m²)		't' test Value
		Mean	Std. Deviation	
Male	122	25.693	5.8026	-0.172 df =192 P-value (0.864)
Female	72	25.844	6.0993	

Distribution of Mean BMI values (Kg/m²) by Age and Gender (n=194)

Table 3 shows the Mean BMI by age and gender. The overall mean BMI is similar in both Males (25.69±5.803) and Females (25.84±6.099). The mean BMI is higher among 40 to 60 years (26.72±5.875) in Males followed by age less than 40 years (26.16±5.552) and more than 60 years (23.12±5.459). Whereas among Female the mean BMI is higher among age more than 60 years (26,84±5.733) followed by 40 to 60 years (26.79±6.388) and less than 40 years (24.57±5.935)

Table 3: Distribution of Mean BMI values (Kg/m²) by Age and Gender (n=194)

Age range (years)	Male			Female		
	Number	BMI (Kg/m²) Mean	Std. Deviation	Number	BMI (Kg/m²) Mean	Std. Deviation
Less than 40	43	26.16	5.552	31	24.57	5.935
40 to 60	51	26.72	5.875	28	26.79	6.388
More than 60	28	23.12	5.459	13	26.84	5.733
Total	122	25.69	5.803	72	25.84	6.099

Distribution of Lipid Profile based on Gender:

Table 4 shows that there is no significant difference in Total cholesterol, High Density Lipoprotein and Low-Density Lipoprotein among Gender with p-value <0.05. Whereas Very Low-Density Lipoprotein shows significant difference with p-value 0.032 among Male (37.36±15.889) and Female (32.56±13.367). The Mean value of Triglycerides found among Male is 186.35±80.046 and among Female is 163.79±65.931 with p-value 0.045 (<0.05).

Table 4: Distribution of Lipid Profile based on Gender (n=194)

Lipid Profile (mg/di)	Gender		*p-value
	Male (N=122) Mean±SD	Female (N=72) Mean±SD	
Total Cholesterol	199.95±37.045	197.63±33.584	0.663
High Density Lipoprotein	34.61±10.956	36.15±12.150	0.363
Low Density Lipoprotein	128.16±34.519	129.31±32.486	0.819
Very Low-Density Lipoprotein	37.36±15.889	32.56±13.367	0.032
Triglycerides	186.35±80.046	163.79±65.931	0.045

*Independent 't' test done

Distribution of Lipid Profile based on Diabetic status:

Table 5 shows that there is significant difference in the lipid profile among Diabetic and Non-Diabetic as the 't' statistic is significant with p value <0.05. The Mean±SD value of Total Cholesterol among Diabetic is 205.01±31.375 and non-diabetic is 191.00±39.723 with significant p-value 0.007. The Mean value of High-Density Lipoprotein among Diabetes and non-diabetes is 31.33±10.296 and 40.44±10.784 respectively with p-value 0.000. While the LDL was to be 134.78±30.888 among diabetes and 120.12±35.677 among non-diabetes with p-value 0.003. The mean value of VLDL among diabetes is 39.39±14.745 and 30.37±14.181 among non-diabetes with 0.000 asp-value. The triglycerides mean in diabetes and non-diabetes was found to be 197.20±72.321 and 151.73±72.736 respectively with p-value

0.000.

Table 5: Distribution of Lipid Profile based on Diabetic status (n=194)

Lipid Profile (mg/di)	Diabetic status		*p-value
	Diabetic (N=112) Mean±SD	Non-Diabetic (N=82) Mean±SD	
Total Cholesterol	205.01±31.375	191.00±39.723	0.007
High Density Lipoprotein	31.33±10.296	40.44±10.784	0.000
Low Density Lipoprotein	134.78±30.888	120.12±35.677	0.003
Very Low-Density Lipoprotein	39.39±14.745	30.37±14.181	0.000
Triglycerides	197.20±72.321	151.73±72.736	0.000

*Independent 't' test done

Correlation between BMI and Dyslipidemia:
There is significant correlation between BMI and TC, HDL, LDL, VLDL, TG with p value 0.005, 0.000, 0.000, 0.001, 0.001 respectively (p value <0.05). This shows that as BMI increases the Lipid profile (TC, LDL, VLDL &TG) also increases showing a Positive Correlation and there is Negative correlation between BMI and HDL (R value= -0.459) that is as BMI increases HDL decreases.

Effect of BMI on Dyslipidemia among Diabetes Mellitus:
Table 6 represents the effect of BMI on Dyslipidernia among Diabetes Mellitus and Non diabetes participants. It shows that HDL is higher among non-diabetes compared to Non diabetes with different BMI and it is statistically significant with p value 0.000 (<0.05). Whereas the mean values of other lipid profiles LDL, VLDL, TC and TG were higher among diabetes when compared to non-diabetes but it was not statistically significant.

Table 6: Effect of BMI on Dyslipidemia among Diabetes Mellitus (N=112) and Non-Diabetes patients (N=82)

Effect of BMI on Dyslipidemia among Diabetes Mellitus (N=112)					
BMI	TC	HDL	LDL	VLDL	TG
Underweight (N=ll)	204.64 ±29.757	49.82 ±9.683	123.64 ±26.174	33.91 ±10.074	165.64 ±44.225
Normal (N=35)	206.20 ±27.362	31.83 ±8.542	135.09 ±33.768	39.31 ±13.455	197.06 ±66.954
Overweight (N=38)	199.37 ±38.688	29.13 ±8.412	131.71 ±31.957	38.87 ±16.345	195.18 ±78.465
Obese (N=28)	211.32 ±25.243	26.43 ±6.397	142.89 ±26.478	42.36 ±15.504	212.50 ±77.729
P value	0.496	**0.000**	0.294	0.445	0.340
Effect of BMI on Dyslipidemia among Non-Diabetes patients (N=82)					
BMI	TC	HDL	LDL	VLDL	TG
Underweight (N=20)	201.65 ±31.369	30.95 ±9.886	135.60 ±36.382	35.60 ±7.870	178.75 ±39.295
Normal (N=26)	200.00 ±36.718	34.54 ±13.399	128.92 ±31.991	38.50 ±15.258	190.96 ±75.434
Overweight (N=l6)	193.63 ±34.787	30.75 ±9.227	124.31 ±31.629	37.94 ±19.175	187.38 ±93.915
Obese (N=20)	202.25 ±26.441	31.75 ±8.831	131.40 ±29.007	39.30 ±13.712	197.90 ±67.952
P value	0.863	0.615	0.764	0.861	0.862

Biochemical parameters among lean diabetes:
Biochemical parameters done among Lean Diabetes shows that the mean Fasting Blood Glucose is 142.73±29.20, Post Prandial Blood Glucose is 249.55±45.40, Total cholesterol is 204.64±29.75, High Density Lipoprotein is 49.82±9.68, Low Density Lipoprotein is 123.64±26.17, Very Low-Density Lipoprotein is 33.91±10.07 and Triglyceride is 165.64±44.22.

DISCUSSION

The Mean age of participants in our study is 46 ± 14 years similar to the studies done by SD Janaki Rama Raju with 48.4±10.6 years and Himabindu et al., with 51.8±10.72 as mean age [12, 13]. Majority of the participants 40.8% in our study were belonging to the age group of 40 - 60 years similar to other studies like Bansal et al., 61% and Sharahili A Y et al 72%. [9,14].

The distribution of gender was also similar to study findings of Bansal et al with 59.6% Male and sharahili et al.,53.3% male; whereas in a study by Sandhu et al., Biadgo et al., and Hussain et al., larger contribution was given by females.[9, 14, 15,16,17]

In the present study maximum participants 31.4% belong to normal range of BMI followed by overweight similar to the study by Omoteye et al.[18]

In our study 57.7% were diabetic and 42.3% were non diabetic; among the diabetic patients 33.0% were on oral hypoglycemic agents on par to the study done by Das B et al.[19]

In current study the lipid profile reveals that total cholesterol 63.4%, LDL 59.3%, and 67.55% are abnormal among study participants. Similar finding is noted in study done by Biadgo et al., and Wang et al.[9,20]. Only LDL abnormality was noted in study done by Sharahili et al.[14]

The present study shows no significant difference among BMI and Gender (p=0.864) and the same was noted in a study by Hussain A et al (p=0.889).[15] On contrary study done by Sharahili A Y et al., noted that there is significant difference among BMI and Gender with p<0.001.[14]

In our study lipid values were stratified in gender wise manner; in male patients mean values of TC, VLDL and TG were higher than Female and vice versa in HDL. Whereas LDL is slightly higher in Females (129.31±32.486) compared to males (128.16±34.519). This was similar to study Omotoye FE et al where the mean TC, TG were elevated more among female than in male.[18]

In this study it was observed that apart from an increase in mean value of total cholesterol, triglycerides, Low density lipoprotein, very low-density lipoprotein and decrease in HDL (31.33±10.296) among diabetes compared to non-diabetes. These findings corroborated with the study conducted by Mazzone et al., where he documented an increase in triglycerides.[21]

A study conducted by Otamere HO et al also documented similar findings an increase in triglycerides, total cholesterol, LDL and decrease in HDL.[22] Studies such as Das B et al, Albrki W M et al, Biadgo B et al and S D Janaki Rama Raju also documented increased levels of TG's, VLDL, LDL, TC and decreased levels of HDL which was pretty much the picture of our study.[12,17,19,23]

In our study the biochemical parameters of lean diabetes shows that the mean FBS is 142.73±29.20 and PPBS is 249.55±45.40 which is similar to study done by Barma PD et al shows similar finding with FBS 254.2±63.1 and PPBS 361.2±76.6.[24]

CONCLUSION

Several studies have extensively analysed the thread linking diabetes, lipid profile, Obesity and their pattern of presentation. This study reveals that higher serum levels of Total cholesterol, Triglycerides, Low density lipoprotein, Very Low Density Lipoprotein, Low level of HDL was noted among Diabetes patient compared to non-diabetic patients. The chances of dyslipidemia increases in patients with type 2 diabetes with high BMI in our study proving that high BMI is a risk factor for both Diabetes and Dyslipidemia using simple screening methods in younger ages itself like measuring BMI and Lipid profile it is possible to identify individuals at high risk at an early age and accordingly lifestyle modifications can be adopted to delay the complications of the disease and reduce the burden on the community and the nation.

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