Research Article

Correlating lipid profile with age, gender, and body mass index of patients with type 2 diabetes mellitus: A single-center prospective study

Seema Rana[1], Ambrish Singh[2], Navneet Agrawal[3]

[1]Consultant Dietitian, Diabetes, Obesity and Thyroid Center, Gwalior, Madhya Pradesh, India, [2]Independent Statistician, Bhopal, Madhya Pradesh, India, [3]Consultant Diabetologist and Director, Obesity and Thyroid Center, Gwalior, Madhya Pradesh, India

Correspondence to: Seema Rana, E-mail: seemar02@gmail.com

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ABSTRACT

Background: Diabetes mellitus is a group of metabolic disorder characterized by chronic hyperglycemia with disturbances in carbohydrate, fat, and protein metabolism due to defects in insulin secretion, insulin action, or both. Diabetic dyslipidemia is characterized by increases low-density lipoprotein cholesterol (LDL-C), decreased high-density lipoprotein cholesterol (HDL-C) level, and elevated triglyceride (TG) levels. **Objectives:** The objectives of this study were to correlate the lipid profile with age, gender, and body mass index (BMI) of type 2 diabetes mellitus (T2DM) patients. **Materials and Methods:** A total of 76 T2DM patients were studied at Diabetes, Obesity, and Thyroid Center, Gwalior, Madhya Pradesh, between May 2016 and May 2017. After detailed demographic details including age, sex, weight, height, and BMI, total cholesterol (TC), TG, LDL-C, very LDL-C (VLDL-C), and HDL-C were estimated for all the patients. **Results:** The mean age of diabetes patients was 54.80 ± 11.07 years. The mean duration of diabetes was 5.38 ± 4.90 years. Lipid profile of T2DM patients was similar across the different age and BMI groups ($P > 0.05$). Except HDL-C ($P < 0.001$) which was significantly low among males other lipid parameters such as TC, TG, LDL-C, and VLDL-C were comparable between genders ($P > 0.05$). TC, TG, LDL-C, and VLDL-C were showed positive correlation with fasting plasma glucose and postprandial glucose, whereas HDL-C showed negative correlation ($P > 0.05$). **Conclusion:** There was no significant difference in TC, TG, HDL-C, LDL-C, and VLDL-C level between different age and BMI groups. We found a significantly lower HDL-C level among the male population.

KEY WORDS: Abnormal Lipid Profile; Dyslipidemia; Type 2 Diabetes Mellitus; Cardiovascular Disease

INTRODUCTION

Diabetes mellitus is defined as the group of metabolic disorders which is characterized by the hyperglycemia due to defects in insulin secretion, its action, or both.[1,2] Chronic hyperglycemia can result into several microvascular (retinopathy, nephropathy, and neuropathy) and macrovascular complications (affecting large blood vessels of heart).[3] Type 2 diabetes patients have high risk of the development of cardiovascular diseases due to atherogenic abnormalities and dyslipidemia.

The previous reports have also reported that dyslipidemia is one of the major risk factor for macrovascular complications in type 2 diabetes mellitus (T2DM) patients. It affects around 10–73% of the T2DM population.[4]

T2DM patients are considered as having dyslipidemia when there is increased level of low-density lipoprotein cholesterol (LDL-C), decreased high-density lipoprotein cholesterol (HDL-C) levels, or elevated triglyceride (TG) levels. Landmark trial United Kingdom prospective diabetes study

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highlighted the point of decreasing HDL-C and elevated LDL-C in predicting the cardiovascular diseases in T2DM patients.[5,6]

Dyslipidemia is often affected by age, sex, and different degrees of body mass index (BMI). However, evidences are limited. Hence, in the present study, we tried to find out the association of lipid parameters with age, sex, and different BMI cutoff in T2DM patients.

MATERIALS AND METHODS

The present prospective cross-sectional study was performed on 76 T2DM patients attending the outpatient's department of Diabetes, Obesity, and Thyroid Center, Gwalior, Madhya Pradesh, between May 2016 and May 2017. The Institutional Ethics Committee approval was obtained before starting the study.

T2DM patients having age >18 years of either sex were included in the study. Type 1 diabetes patients (type 1 DM), T2DM patients with concomitant diseases or conditions affecting lipid levels such as chronic liver disease and hypothyroidism, and patients on drugs such as oral contraceptive pills, steroids, and diuretics were excluded from the present study.

Dyslipidemia was diagnosed as per the guidelines of the National Cholesterol Education Programme (NCEP) Adult Treatment Panel III which defines dyslipidemia by the presence of one or more than one abnormal serum lipid concentration.

BMI was classified as underweight (<18.5), normal (18.5–22.9), overweight (23–24.9), and obese (≥25) as per the WHO criteria for Asians (WHO, 2004).

All the data analyses were performed using IBM SPSS ver. 20 software. Frequency distribution was used for preparing tables. The first descriptive analysis was performed to obtain the mean, minimum, maximum, and standard deviation (SD) of each variable. Quantitative data were expressed as mean ± SD, whereas categorical data are expressed as percentage. One-way ANOVA and independent *t*-test were performed to compare the mean of each lipid parameters with age, sex, and different BMI ranges.

RESULTS

Findings of the present study are depicted in Tables 1-5.

DISCUSSION

Lipid parameters are affected by glucose levels. It is due to the carbohydrate and lipid metabolism is interrelated to each other. It is also shown by the previous authors that any abnormality in carbohydrates metabolism also results in abnormal lipid metabolism. Hence, increased level of TC, TG, and reduction in HDL-C levels leads to insulin resistance with or without hyperglycemia. This is related to qualitative changes in the lipid profile.[7,8]

The mean age of the study cohort was 54.80 ± 11.07 years which is in agreement to the study done by Sultania *et al*.[9] and Kumar *et al*.[10] who reported the mean age of 50.3 ± 11.90 and 52.42 ± 9.87 years, respectively. Sabahelkhier *et al*. studied 121 diabetes patients and compared with 60 control subject reported the mean age of 51.917 ± 11.22 years which is agreement to the present study mean age.[8] In the present study, we found male preponderance which is in agreement to the study done by Shankarprasad *et al*.[2] In the present study, we did not find any significant difference in any lipid parameters in different age groups. However, patients with the age group of 41–50 years had very high TC levels. The age group of 61–70 years had high TG levels and except the age group of <30 years, all the other age groups had low HDL-C levels. A similar study from Bareilly, India, including 50 T2DM patients also reported no significant difference in total cholesterol (TC) and absolute LDL levels across age groups.[9] A typical diabetic dyslipidemia is characterized by low HDL and high TG levels. The previous national and international epidemiological studies have reported similar pattern of dyslipidemia.[11-13] In the present study, we also found significantly low level of HDL in males as compared to females. Low HDL-C is attributed to TG enrichment by

Table 1: Descriptive analysis of characteristics of the study cohort

Variables (*n*=76)	Minimum	Maximum	Mean±SD
Age (years)	19	73	54.80±11.07
DOD (years)	1	25	5.38±4.90
Height (cm)	145	180	163.24±7.52
Weight (kgs)	40	99	68.91±10.82
BMI (kg/m^2)	17.5	35.1	25.84±3.67
SBP (mmHg)	100	170	130.03±15.02
DBP (mmHg)	70	110	79.82±7.56
FPG (mg/dL)	81.3	278.7	141.73±42.18
PPG (mg/dL)	89.2	555.0	225.80±84.86
TC (mg/dL)	80.0	279.4	151.60±38.79
TG (mg/dL)	49.3	812.2	138.42±134.54
HDL-C (mg/dL)	17.4	62.8	32.53±8.64
LDL-C (mg/dL)	9.6	217.2	92.62±36.67
VLDL-C (mg/dL)	9.9	162.4	27.68±26.90

DOD: Duration of diabetes, BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, FPG: Fasting plasma glucose, PPG: Postprandial glucose, TC: Total cholesterol, TG: Triglyceride, HDL-C: High-density lipoprotein cholesterol, LDL-C: Low-density lipoprotein cholesterol, VLDL-C: Very low-density lipoprotein cholesterol, SD: Standard deviation

Table 2: Comparing age with lipid parameters

Age of patient (years)	TC	TG	HDL-C	LDL-C	VLDL-C
<30 (*n*=2)	120.89±18.99	112.40±49.33	41.023±2.73	57.39±26.13	22.48±9.86
31–40 (*n*=5)	150.09±34.95	105.67±35.93	28.21±4.49	100.74±28.84	21.13±7.10
41–50 (*n*=19)	163.09±44.95	116.84±51.61	33.84±7.25	105.88±42.79	23.36±10.32
51–60 (*n*=26)	146.62±32.34	133.50±141.94	31.23±8.98	88.69±31.40	26.70±28.38
61–70 (*n*=20)	152.53±42.65	186.01±195.55	32.79±10.13	87.21±38.62	37.20±39.11
>70 (*n*=4)	142.04±41.14	88.94±13.77	34.58±9.48	89.67±35.22	17.78±2.75
P value	0.619	0.570	0.498	0.383	0.570

Data are expressed as mean±SD (mg/dL), TC: Total cholesterol, TG: Triglyceride, HDL-C: High-density lipoprotein cholesterol, LDL-C: Low-density lipoprotein cholesterol, VLDL-C: Very low-density lipoprotein cholesterol, SD: Standard deviation. *P*<0.05 is considered as statistically significant

Table 3: Comparing lipid parameters with gender

Gender	TC	TG	HDL-C	LDL-C	VLDL-C
F (*n*=18)	157.21±42.10	99.25±27.11	38.86±9.50	98.49±41.70	19.85±5.42
M (*n*=58)	149.86±37.92	150.58±151.53	30.56±7.40	90.79±35.16	30.11±30.30
P value	0.486	0.159	<0.001	0.440	0.159

Data are expressed as mean±SD (mg/dL), TC: Total cholesterol, TG: Triglyceride, HDL-C: High-density lipoprotein cholesterol, LDL-C: Low-density lipoprotein cholesterol, VLDL-C: Very low-density lipoprotein cholesterol, SD: Standard deviation. *P*<0.05 is considered as statistically significant

Table 4: Comparing lipid profile with BMI

BMI (kg/m²)*	TC	TG	HDL	LDL	VLDL
Underweight (<18.5) (*n*=1)	134.32	77.519	42.955	75.870	15.504
Normal (18.5–22.9) (*n*=15)	145.89±29.12	106.76±44.95	33.00±8.33	91.53±27.92	21.35±8.99
Overweight (23–24.9) (*n*=16)	140.88±31.56	163.42±143.15	32.42±7.11	81.62±29.70	32.68±28.63
Obese (≥25) (*n*=44)	157.84±43.58	141.51±151.94	32.17±9.35	97.37±41.33	28.30±30.38
P value	0.416	0.665	0.673	0.501	0.665

Data are expressed as mean±SD (mg/dL), TC: Total cholesterol, TG: Triglyceride, HDL-C: High-density lipoprotein cholesterol, LDL-C: Low-density lipoprotein cholesterol, VLDL-C: Very low-density lipoprotein cholesterol, SD: Standard deviation. *P*<0.05 is considered as statistically significant. *Lim JU 2017

Table 5: Pearson's correlation of lipid profile with FPG and PPG values

Glycemic parameters	TC	TG	HDL-C	LDL-C	VLDL-C
FPG					
Pearson's correlation	0.177	0.082	−0.177	0.170	0.082
Sig. (two-tailed)	0.125	0.484	0.126	0.143	0.484
PPG					
Pearson's correlation	0.138	0.109	−0.212	0.130	0.109
Sig. (two-tailed)	0.234	0.348	0.066	0.262	0.348

FPG: Fasting plasma glucose, PPG: Postprandial glucose, TC: Total cholesterol, TG: Triglyceride, HDL-C: High-density lipoprotein cholesterol, LDL-C: Low-density lipoprotein cholesterol, VLDL-C: Very low-density lipoprotein cholesterol. *Correlation is significant at the 0.05 level (two-tailed), **Correlation is significant at the 0.01 level (two-tailed)

cholesterol ester transfer protein and increased hepatic TG lipase activity.[14] However, the present study failed to show any difference among the TG levels in different genders. This may be due to the small sample size and the absence of control group which would have resulted in significance difference in TG levels among diabetes and control groups. In the present study, majority of the patients were overweight and obese, but there was no significant difference in terms of lipid profile of patients in different BMI groups. However, TC and TG were higher in overweight and obese patients. We also observed low HDL-C levels among overweight and obese patients. In agreement to the present study, Sabahelkhier *et al*. also did not find any significant difference between BMI ranges and in levels of TC, TG, LDL-C, and HDL-C.[8] In the present study, we did not find any significant correlation of glycemic parameters (fasting plasma glucose [FPG] and postprandial

glucose [PPG]) with the any of the lipid parameters in T2DM patients. However, a positive correlation was obtained between glycemic parameters and TC, TG, LDL-C, and VLDL-C and negative correlation of with HDL-C. In the present study, we did not take HbA1c of the patients; however, FPG and PPG both are well correlated with the HbA1c in the previous study.[15] Similar results were reported by Sultania *et al.* where they also not found any significant correlation between HbA1c and TC, LDL, HDL, and TG.[9] A prospective study from Tamil Nadu done enrolling 162 T2DM patients has also reported no significant correlation of HbA1c with lipid parameters.[16] Contrary to the present study findings, a study of 430 T2DM western Indian populations reported a significant correlation of HbA1c with TC and LDL, but not with the TG and VLDL.[17] A Chinese study including 128 T2DM patients has only found a significant correlation between HbA1c and LDL cholesterol.[18]

The present study is not devoid of limitation; first, it has a small sample size due to which we may have found variable results in relation to BMI and lipid profile. Second, in the present study, we did not take age- and sex-matched healthy control, which would have given the more significant relation between age, sex, and BMI groups with lipid parameters. Finally, all the patients were not newly diagnosed T2DM and were on diabetes and lipid-reducing medication, which might have resulted in varying results as observed in the previous studies. There is a need of large randomized clinical trial to provide strength to the present study.

CONCLUSION

Dyslipidemia in T2DM patients is the result of low HDL-C, high TG, and high LDL-C levels. We did not find any significant difference in lipid levels between different age, sex, and BMI groups. However, we did find a significantly lower level of HDL-C among males. We also did not find any significant correlation between FPG and PPG with lipid parameters. It becomes very important to screen the T2DM patients for lipid profile early to start the early intervention which can minimize the future cardiovascular risk.

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