Research Article

Correlation between Blood Sugar Parameters and Lipid Profile Parameters Among Type 2 Diabetes Mellitus Patients

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ABSTRACT:

Background: The relationship between dyslipidemia and diabetes is particularly significant, as hyperglycemia not only induces apoptosis in the β-cells of the islets of Langerhans but also influences the extent of oxidized low-density lipoprotein (LDL) accumulation. Hence; the present study was conducted for assessing correlation between blood sugar parameters and lipid profile parameters among type 2 diabetes mellitus patients.

Materials & Methods: A detail history was taken and a complete physical examination and clinical evaluation of each subject was done and details were entered in the pre-designed proforma. Patients diagnosed as diabetes Mellitus according to ADA criteria were included in the present study. Serum Triglycerides, Total cholesterol and HDL cholesterol were analyzed by enzymatic methods with the help of Glaxo kits on ERBA Chem-5. Serum LDL cholesterol was calculated by Frederickson-Friedwald's formula according to which LDL cholesterol = Total cholesterol - (HDL cholesterol + VLDL cholesterol). VLDL cholesterol (VLDL-C) was calculated as 1/5 of Triglycerides. All the results were recorded in Microsoft excel sheet and was subjected to statistical analysis using SPSS software.

Results: The highest frequency of subjects was in the 51-60 age group (66 subjects, 33.0%) followed by the 41-50 age group (58 subjects, 29.0%).It was revealed that there exist significant correlations between HBa1c and TC ($r = .689$, $p < 0.01$) HBa1c and TG ($r = .581$, $p < 0.01$) and HBa1c and LDL ($r = .579$, $p < 0.01$).

Conclusion: Diabetes mellitus is one of the most serious global health problems.To conclude, the results of this study revealed a strong positive relationship betweenHbA1c and TC, TGs, and LDL, while showing a negative relationship with HDL and FBS, PPBS.

KEY WORDS: Diabetes Mellitus, Lipid, Blood sugar, LDL, HDL

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INTRODUCTION:

Type 2 Diabetes Mellitus (T2DM), a common metabolic disorders, results from a combination of two primary issues: reduced insulin secretion by pancreatic β-cells and the inability of insulin-sensitive tissues to respond properly to insulin. Since insulin release and function are essential for regulating glucose balance, the molecular mechanisms controlling insulin production, secretion, and receptor binding are tightly regulated. Any disturbance in these processes can lead to a metabolic imbalance, playing a role in the development of the disease.[1-3]

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As the disease progresses, insulin secretion becomes insufficient to sustain glucose homeostasis, resulting in hyperglycaemia. Patients with T2DM are typically identified by obesity or an increased body fat percentage, with fat primarily concentrated in the abdominal area. In this condition, adipose tissue contributes to insulin resistance (IR) by triggering multiple inflammatory pathways, such as elevated free fatty acid (FFA) release and disrupted adipokine regulation. The primary factors fueling the T2DM epidemic include the worldwide increase in obesity, physical inactivity, high-calorie diets, and an aging population, all of which have led to a fourfold rise in the disease's incidence and prevalence.[4,5]

High BG levels are linked to dyslipidemia. The connection between dyslipidemia and diabetes is especially important, since hyperglycemia not only causes β-cell apoptosis in the islets of Langerhans-a process known as glucotoxicity-but also affects the buildup of oxidized low-density lipoprotein (LDL). Furthermore, managing blood lipid levels can effectively mitigate the negative consequences of this condition.

It is noteworthy that over 75% of individuals with T2DM exhibit mixed dyslipidemia, which is characterized by reduced levels of high-density lipoprotein cholesterol (HDL-C) and elevated triglyceride (TG) levels.[6- 8] Therefore, this study was carried out to evaluate the relationship between blood sugar levels and lipid profile parameters in patients with T2DM.

MATERIALS & METHODS:

This cross-sectional, observational, hospital-based study was carried out in the Department of Internal Medicine at People's College of Medical Sciences & Research Centre, Bhopal, involving T2DM patients over an 18-month period, following approval from the institutional ethics committee. The patients were informed about the study and a written consent was obtained from each participant. A detailed medical history was recorded, and each subject underwent a thorough physical examination and clinical evaluation, with the findings documented in a pre-designed proforma. Patients diagnosed with diabetes mellitus (DM) based on ADA criteria—defined as having a fasting blood glucose (FBG) level over 126 mg/dL and/or a postprandial blood sugar (PPBS) level exceeding 200 mg/dL—were included in this study. Individuals with nephropathy, liver disease, or hypothyroidism were excluded. For laboratory analysis, 5 ml of fasting venous blood was drawn aseptically from the antecubital vein of each participant into plain vials for assessing FBG and lipid profile. A second blood sample was collected two hours after a meal to measure PPBG and HbA1c levels. The blood was then centrifuged, and the serum was separated for lipid profile analysis. Serum triglycerides (TG), total cholesterol (TC), and HDL cholesterol (HDL-C) were measured using enzymatic methods, utilizing Glaxo kits on the ERBA Chem-5 analyzer. Serum LDL cholesterol (LDL-C) was determined using the Friedewald formula, which calculates LDL-C as: Total cholesterol minus the sum of HDL cholesterol and VLDL cholesterol. VLDL cholesterol (VLDL-C) was estimated as one-fifth of the triglyceride value. All data were documented in a Microsoft Excel sheet and analyzed statistically using SPSS software.

RESULTS:

The highest proportion of participants fell within the 51–60 age group (66 individuals), followed by those aged 41–50 years (58 individuals). The smallest age groups were 21–30 years (1 individual) and over 70 years (19 individuals). Most participants had been living with diabetes for less than 5 years (118 individuals), followed by those with a duration of 6–10 years (42 individuals). The fewest had diabetes for more than 15 years (13 individuals).The results are depicted in Table 1.Analysis of lipid profile parameters among the study participants showed that 53.0% (106 individuals) had abnormal LDL levels, while 47.0% (94 individuals) had normal LDL. Triglycerides exhibited the highest rate of dyslipidemia at 45.0%, whereas total cholesterol showed the lowest at 35.0%.Table 2 presents the correlation between BG parameters and lipid profile components among the study participants. The results demonstrated significant positive correlations between HbA1c and total cholesterol ($p< 0.01$), HbA1c and triglycerides ($p< 0.01$), and HbA1c and LDL cholesterol ($p< 0.01$).

Graph 1: Age-wise distribution.

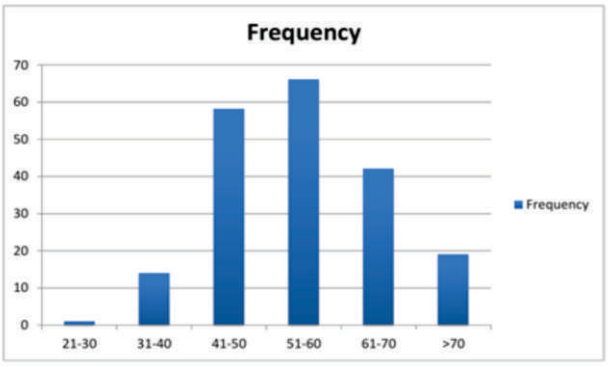

Table 1: Distribution of patients according to duration of diabetes.

Duration of Diabetes	Frequency	Percent
<5	118	59.0
6-10	42	21.0
11-15	27	13.5
>15	13	6.5

Table 2: Correlation between blood sugar parameters and lipid profile parameters among study subjects

		FBS	PPBS	HBalc	TC	TG	HDL	LDL
FBS	r value	1	.103	.034	-.058	.030	-.043	-.063
	p-value		.145	.628	.413	.678	.545	.328
PPBS	r value	.103	1	.079	.143 *	.082	-.007	.137
	p-value	.145		.264	.043 *	.249	.919	.054
HBalc	r value	.034	.079	1	.689 **	.581 **	.062	.579 **
	p-value	.628	.264		.000	.000	.387	.000
TC	r value	-.058	.143 *	.689 **	1	.607 **	.134	.884 **
	p-value	.413	.043	.000		.000	.058	.000
TG	r value	.030	.082	.581 **	.607 **	1	.010	.415 **
	p-value	.678	.249	.000	.000		.888	.000
HDL	r value	-.043	-.007	.062	.134	.010	1	-.005
	p-value	.545	.919	.387	.058	.888		.939
LDL	r value	-.063	.137	.579 **	.884 **	.415 **	-.005	1
	p-value	.378	.054	.000	.000	.000	.939	

*. Correlation is significant at the 0.05 level (2 – tailed).

**. Correlation is significant at the 0.01 level (t – tailed).

DISCUSSION:

T2DM is a chronic condition where elevated blood sugar levels are closely linked to increased risks of heart attacks, strokes, microvascular complications, and death. The progression of the disease is mainly marked by reduced β-cell function and increasing insulin resistance. Clinically, this is reflected in the worsening of several indicators such as A1C, fasting plasma glucose (FPG), and postprandial glucose levels. β-cells are unable to compensate for impaired glucose tolerance. This dysfunction seems to be linked to both decreased insulin output from individual islets and a decline in the overall number of islets. The gradual deterioration of β-cell function, along with a smaller reduction in β-cell mass, contributes to poor glycemic control and the onset of complications. While existing treatments help reduce BG levels, they do not fully prevent the ongoing decline in β-cell function and are often linked to side effects such as hypoglycemia and weight gain.[8-10]

The highest frequency of subjects was in the 51-60 age group (33.0%) followed by the 41-50 age group (29.0%) The least number of subjects were in the 21-30 age group (0.5%).The highest dyslipidemia was observed in TG (45.0%) and the lowest in TC (35.0%).The correlation between blood sugar parameters and lipid profile parameters among study subjects results revealed significant correlations between HBa1c and TC (r =0.689) HBa1c and TG (r = 0.581) and HBa1c and LDL (r = 0.579). Wang L et al investigated the relationship between BG levels and lipid profiles or lipid ratios in a group of patients with T2DM. Their analysis included a total of 1,747 individuals diagnosed with T2DM. There was a positive association between BG and TG levels; every 1 mmol/L increase in BG levels resulted in a 0.34 mmol/L increase in TG. BG levels were also associated with high LDL, TG/HDL-C levels. After adjusting for demographic factors, health behaviors, and physical health indicators, the study found a positive correlation between BG levels and both TG and LDL-C levels, as well as an increase in the TG/HDL-C ratio. Their findings confirmed a link between BG levels and serum lipids or lipid ratios, showing that higher glucose levels

were associated with elevated TG, LDL-C, and increased TG/HDL-C and LDL-C/HDL-C ratios.[9]

The results of this study are consistent with previous research showing a positive relationship between BG levels and both TG and LDL-C, which are linked to a higher risk of obesity and cardiovascular disease. In the context of T2DM, maintaining good glycemic control may contribute to improved lipid profiles. A previous study showed that short-term intensive glycemic control can significantly lower TG levels in individuals with T2DM. Another study highlighted the importance of controlling blood lipid levels in maintaining proper BG regulation among individuals with T2DM. Moreover, high BG levels are associated with an increased risk of obesity, which in turn influences lipid levels and their ratios.[10-13]

Stamouli M and colleagues analyzed serum samples from 800 patients with T2DM over a three-year period, along with 200 age-matched individuals without a clinical history of diabetes. Among the diabetic patients, 70.0% exhibited at least one lipid abnormality. Specifically, elevated levels of LDL-C, TCHOL, and TRG, as well as decreased HDL-C levels, were observed in 28.37%, 36.37%, 39.01%, and 30.12% of cases, respectively. The most common combination of lipid abnormalities was elevatedTRG alongside reduced HDL-C levels. Additionally, significant gender-based differences were found in HDL-C, TCHOL, TG, and GLU levels. However, no significant difference was observed in GHbA1c levels between men and women. The study also identified a strong linear correlation between LDL-C and TCHOL.[14]

CONCLUSION:

Diabetes mellitus represents a major global health challenge. In conclusion, this study demonstrated a strong positive correlation between HbA1c and TCHOL, TGs, and LDL, while revealing a negative association with HDL, FBS, and PPBS.

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Nil.

Conflicts of Interest
There are no conflicts of interest.

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