

ORIGINAL RESEARCH ARTICLE

Correlation of postprandial lipid profile with glycosylated hemoglobin (HbA1c) levels in Type 2 Diabetes Mellitus

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ABSTRACT

Background:

Post-prandial diabetic dyslipidemia creates proatherogenic conditions which are associated with microvascular and macrovascular complications. Its timely identification might help prevent complications.

Aim:

To study postprandial lipid abnormalities in Type 2 Diabetes Mellitus and its correlation with glycosylated hemoglobin levels in patients attending SGMH, Rewa, M.P.

Method:

This was a cross-sectional study done from April 2021 to March 2022 in SSMC & SGMH Rewa (M.P.). 200 cases were taken as per inclusion and exclusion criteria. Relevant examination and investigations including post-prandial lipid profile were done. All data were compiled and compared with previous studies.

Results:

The findings of the postprandial lipid profile in Type 2 diabetes mellitus and its correlation with glycosylated hemoglobin, revealed the following observation. In the postprandial state, triglyceride (TG) levels of >150 mg/dl were found in 82% of cases, very low-density lipoprotein cholesterol (VLDL-C) levels of >40 mg/dl, were found in 46% of cases, and, high-density lipoprotein cholesterol (HDL-C) levels of < 35 mg/dl, were found in 80% of cases. The study showed that cases had a statistically significant positive correlation between HbA1c and Triglyceride (r value 0.9756), VLDL (r value 0.9134), and Total Cholesterol (r value 0.3914) while a statistically significant negative correlation between HbA1c with HDL (r value -0.025)

Conclusion: In the postprandial state there was significant hyper-triglyceridaemia, increased VLDL-C, and decreased HDL-C levels in type 2 diabetics. In diabetics, the Triglyceride, VLDL-C, and Total cholesterol were positively correlated while HDL-C was negatively correlated with HbA1c.

Keywords: Diabetes Mellitus; Postprandial Lipid Profile; VLDL-C; Triglycerides; HDL-C, HbA1c, Glycated Hemoglobin.

1. INTRODUCTION

The worldwide prevalence of DM rose dramatically over the last two decades, from an estimated 30 million cases in 1985 to 536 million in 2021.¹

Diabetic dyslipidemia leads to proatherogenic conditions which are further associated with various microvascular and macrovascular complications. Timely identification of diabetic dyslipidemia could provide an opportunity for making efforts to prevent complications. In Type 2 DM, an abnormal lipid profile in the postprandial state has a more significant effect than an abnormal lipid profile in the fasting state as far as atherosclerotic complications are concerned.

Prolonged postprandial hyperglycemia and triglyceridaemia are associated with high cardiovascular morbidity and mortality in type 2 DM. Elevated total triglycerides (TGs), very low-density lipoproteins (VLDL), and decreased high-density lipoproteins (HDL) concentrations in the serum are the predominant components of diabetic dyslipidemia. Postprandial hypertriglyceridemia of type 2 diabetes mellitus, results in a proatherogenic environment which leads to atherosclerosis and various macrovascular complications.²

Nowadays, diabetes is considered a coronary artery disease(CAD) equivalent. Many studies have shown that postprandial hyperglycemia is an independent and direct risk factor for the development of cardiovascular diseases (CVD). Most of the cardiovascular risk factors are affected in the postprandial state in diabetics due to an acute increment in blood glucose levels. The mechanisms by which acute hyperglycemia spikes, exert their effects may be attributed to free radical generation. This alarming evidence suggestive of the harmful effects of postprandial hyperglycemia on diabetes complications has been sufficient to influence guidelines from important professional scientific societies. Correcting postprandial hyperglycemia may form an important part of the preventive strategy as well as the management of CVDs in diabetes.^{3,4,5,6,7}

In this study, we assess post-prandial lipid abnormalities in type 2 Diabetes Mellitus and correlate them with glycosylated hemoglobin.

Aim:

To study postprandial lipid abnormalities in Type 2 Diabetes Mellitus and its correlation with glycosylated hemoglobin in patients attending SGMH, Rewa, M.P.

2. MATERIAL AND METHODS

This was a cross-sectional study done from April 2021 to March 2022 at Shyam Shah Medical College and Sanjay Gandhi Memorial Hospital Rewa (M.P.). 200 cases of Type 2 Diabetes Mellitus based on HbA1c levels (as per WHO criteria) who were between 30 to 70 years of age and were on antidiabetic therapy, were taken.

Informed consent was obtained from all the study subjects. The study was pre-approved by the Institutional Ethics Committee.

Cases**Inclusion Criteria**

- Type 2 Diabetes Mellitus patients between 30-70 years of age who are on Antidiabetic drugs.
- HbA1c more than 6.5%.

Exclusion Criteria

- Type I Diabetes mellitus
- Critically ill patient
- Associated co-morbid illnesses which are likely to influence endothelial function: Hypertension, a known case of Chronic Liver disease, a known case of Chronic Kidney disease, Congestive Cardiac failure, smoking, and alcoholism, were excluded.
- Patients with Hypothyroidism, Cushing's disease, inherited disorders of lipid metabolism, clinical evidence of congestive cardiac failure, alcoholism, smoking, or use of medication affecting lipids were excluded.

INVESTIGATION DETAILS:

- Fasting Blood Sugar (FBS)/ Postprandial Blood Sugar (PPBS)/ Random Blood Sugar (RBS)
- Postprandial lipid profile
- HbA1C
- Blood Urea & S. Creatinine
- Serum Bilirubin, Aspartate Transaminase (AST), Alanine Transaminase (ALT)
- An Electrocardiogram.

A semi-structured pro forma was used to obtain a demographic profile as well as clinical history. Blood pressure was measured, general and systemic examination, and, optic fundus examination by fundoscopy (by direct ophthalmoscope) was done. The biochemical assessment included fasting blood sugar (FBS) and post-prandial blood sugar levels (PPBS), liver and kidney function tests, HbA1C, and a comprehensive lipid profile. All data were compiled and compared with previous studies.

Statistical analysis

Data were collected and managed on an Excel worksheet and the mean values were calculated and denoted as mean±standard deviation. Appropriate statistical tests were used to determine the significance of values (e.g. Chi-Square test, Pearson Correlation Coefficient, etc). P<0.05 was considered statistically significant.

3. RESULTS

This study used a postprandial lipid profile in 200 patients with Type 2 Diabetes Mellitus

Table 1: Postprandial Triglyceride levels among cases

Postprandial TG (mg/dl)	Diabetic Patients	
	No.	%
Up to 150	36	18%
151 - 200	76	38%

201 - 400	72	36%
Above 400	16	8%
Total	200	100%

In the post-prandial state, 82% of the cases had TG levels of >150 mg/dl (Table-1).

Table 2: Mean post-prandial triglyceride levels among the cases

Group	No.	Postprandial Triglyceride Levels	
		Mean	SD
Cases	200	232.52	105.08

In this study, in the post-prandial state, the cases had a mean TG level of 232.52 ± 105.08 mg/dl (Table-2).

Table 3: Postprandial VLDL-C levels among the cases

Postprandial VLDL-C (mg/dl)	Diabetic Patients	
	No.	%
Up to 20	16	8%
21 - 40	92	46%
41 - 60	60	30%
61 - 80	24	12%
81 - 100	8	4%
Total	200	100%

In the post-prandial state, 46% of cases had VLDL-C levels of >40 mg/dl (Table-3).

Table 4: Mean postprandial VLDL-C levels among the cases

Group	No.	Post Prandial VLDL Levels	
		Mean	SD
Cases	200	41.58	19.82

In this study, in the postprandial state, the cases had a mean VLDL-C level of 41.58 ± 19.82 mg/dl. (Table-4)

Table 5: Postprandial HDL-C levels among the cases

Postprandial HDL-C (mg/dl)	Diabetic Patients	
	No.	%
Up to 35	160	80%
36 - 45	36	18%
Above 45	4	2%
Total	200	100%

In this study, in the post-prandial state, 80% of the cases had HDL-C levels of <35 mg/dl (Table-5).

Table 6: Mean post-prandial HDL-C levels among the cases

Group	No.	Post Prandial HDL Levels	
		Mean	SD
Cases	200	30.86	11.04

In this study, in the postprandial state, the cases had a mean HDL-C level of 30.86 ± 11.04 mg/dl (Table-6).

Table 7 – Mean HbA1c levels among the cases

Group	No.	HbA1c	
		Mean	SD
Cases	200	8.595	1.407

This study showed, that mean HbA1c was higher in cases (8.595 ± 1.407) (Table 7)

Table 8- Mean Postprandial Lipid abnormalities in diabetics with HbA1c ≤ 7 and >7

Group	Mean Post Prandial Lipid abnormalities			
	Total Cholesterol	HDL	Triglyceride	VLDL
HbA1c ≤ 7	172 ± 35.2	32.93 ± 8.911	126 ± 5.6	41.34 ± 3.3657
HbA1c > 7	174 ± 44.2	31.72 ± 10.53	246 ± 103	49.04 ± 19.577

This study showed, that the mean value of Total Cholesterol, VLDL, and Triglyceride was higher in cases with HbA1c >7 while HDL was lower in cases with HbA1c >7 , as compared to cases with HbA1c ≤ 7 . (Table 8)

Table 9 - Correlation of Lipid Profile with HbA1c

S. No.	Lipid Parameters	Cases Value	r	Correlation	P Value
1	HbA1c/Triglyceride	0.9756		Positive	<0.0001
2	HbA1c /VLDL	0.9134		Positive	<0.0001
3	HbA1c /HDL	-0.025		Negative	<0.0001
4	HbA1c/Total Cholesterol	0.3914		Positive	<0.0001

This study shows that diabetics had a statistically significant positive correlation between HbA1c and Triglyceride (r value 0.9756), VLDL (r value 0.9134), and Total Cholesterol (r value 0.3914) while a statistically significant negative correlation between HbA1c with HDL (r value -0.025). (Table 9)

4. DISCUSSION

Postprandial lipid abnormalities in Type 2 diabetes mellitus

Triglyceride levels

In this study, in post-prandial state, 82% of the cases had TG levels of >150 mg/dl in the post-prandial state and, a mean TG level of 232.52 ± 105.08 mg/dl, while in a study conducted by Chakraborty et al.,⁸ it was 191.8 ± 77 mg/dl.

VLDL-C levels

In this study, in the postprandial state, 46% of cases had VLDL-C levels of >40 mg/dl and a mean VLDL-C level of 41.58 ± 19.82 mg/dl, while in a study conducted by Vinod V Wali and Smita S Patil,⁹ it was 37.74 ± 8.22 mg/dl.

HDL-C levels

In this study, in the post-prandial state, 80% of the cases had HDL-C levels of <35 mg/dl and, a mean HDL-C level of 30.86 ± 11.04 mg/dl, while in a study conducted by Chakraborty et al.,⁸ it was 47.3 ± 10.1 mg/dl.

Correlation between HbA1c and Post Prandial lipid profile in type 2 diabetics

This study shows that diabetics had a statistically significant ($p < 0.0001$) positive correlation between HbA1c and postprandial Triglyceride (r value 0.9756), VLDL (r value 0.9134) and Total Cholesterol (r value 0.3914) while a statistically significant negative correlation between HbA1c and postprandial HDL (r value -0.025).

In a study by Sirsikar et al.,¹⁰ a significant correlation was observed between HbA1c and TC/HDL-C and LDL-C/HDL-C. They also showed a significant correlation between HbA1c and Non-HDL-C.

In a study conducted by Artha et al.,¹¹ they showed that total cholesterol (TC) and triglycerides (TG) were higher in patients in the poor glycemic control group ($p < 0.05$) and HDL-C was significantly lower in patients with poor glycemic control ($p = 0.001$). There is a significant positive correlation between total cholesterol (r value 0.472) and TG (r value 0.276) with HbA1c level which was similar to the current study. Meanwhile, a significant negative correlation was observed between HDL-C (r value -0.568) with the HbA1c level which was similar to the current study. The findings of LDL-C did not match with the current study.

The research conducted by Mahato et al.¹² involving 294 T2DM patients in Kathmandu, Nepal, showed a significant positive correlation between TC ($p = 0.017$) to the HbA1c level, similar to the current study.

The study by Khan et al.¹³ involving 1,011 T2DM patients showed a significant positive correlation between TC ($r = 0.127$; $p < 0.001$), TG ($r = 0.153$; $p < 0.001$), and HDL ($r = -0.128$; $p = 0.002$). The other findings of this study however did not match the current study.

Several investigations have reported a significant correlation between HbA1c and lipid

profile and suggested the importance of glycemic control in normalizing dyslipidemia.¹⁴ Non-HDLc was shown to be the stronger predictor of CVD in the diabetic population.¹⁵

5. CONCLUSION

- Diabetic dyslipidemia is characterized mainly by raised triglyceride levels, raised VLDL-C Levels, and decreased HDL-C levels.
- In the post-prandial state, there was significant hyper-triglyceridaemia, increased VLDL-C, and decreased HDL-C levels in diabetics.
- HbA1c levels in diabetics were positively correlated with postprandial hyper-Triglyceridaemia, increased postprandial VLDL-C and total Cholesterol, and negatively correlated with postprandial HDL-C, which was statistically significant.

Limitation of study

This was a cross-sectional study and long-term follow-up of patients could not be done.

The study suggests that:

- We should advise postprandial lipid profile in type 2 diabetics to have a better insight into the existing metabolic derangements.
- This might pave way for early identification and prevention of cardiovascular complications because post-prandial hyper-triglyceridaemia enhances atherogenesis which leads to atherosclerosis and macrovascular complications in type 2 diabetics.
- Since HbA1c is directly linked to diabetic dyslipidemia which in turn is linked to an increased risk of cardiovascular diseases, we can infer from this discussion that HbA1c levels in type 2 diabetic patients can help us in assessing the risk of cardiovascular diseases owing to postprandial dyslipidemia associated with diabetes mellitus.

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Author's Contribution:

PG-Concept and design of the study prepared the first draft of the manuscript; **MT**- Interpreted the results; Reviewed the literature and manuscript preparation; **DKM**- Coordination, preparation, and revision of the manuscript, Statistical analysis, and interpretation; **MP**-Data Interpretation and review; **PS** – review of literature and manuscript revision.

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