ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

To study fasting and post prandial lipid profile in type 2 diabetes mellitus in comparison to non diabetics

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Submission: 03-01-2022 Revision: 28-02-2023 Publication: 01-04-2023

ABSTRACT

Background: Postprandial diabetic dyslipidemia creates proatherogenic conditions which are associated with microvascular and macrovascular complications. Its timely identification might help prevent complications. **Aims and Objectives:** The aims of this study were to assess the fasting and postprandial lipid abnormalities in type 2 diabetes mellitus (DM) in comparison to non-diabetic patients attending SGMH, Rewa, M.P. **Materials and Methods:** This was a cross-sectional case–control study done from April 2021 to March 2022 in SSMC and SGMH Rewa (M.P). 200 cases and 200 controls taken as per inclusion and exclusion criteria, age, and sex matched. Relevant examination and investigations including fasting and postprandial lipid profile were done. All data compiled and compared with the previous studies. **Results:** The comparative findings of fasting and postprandial lipid profile in type 2 DM compared to controls (non-diabetics) revealed the following observations. In fasting state, 56% cases and 30% controls had triglyceride levels of >150 mg/dL, while, in postprandial state, it was 82% cases and 32% controls. In fasting state, 28% cases and 8% controls had very low-density lipoproteins-cholesterol (VLDL-C) levels of >40 mg/dL, while, in postprandial state, it showed 46% cases and 14% of controls. In fasting state, 70% cases and 60% controls had high-density lipoproteins-cholesterol (HDL-C) levels of <35 mg/dL, while, in postprandial state, it was found in 80% cases and 58% controls. **Conclusion:** In the postprandial state, there was significant hyper-triglyceridemia, increased VLDL-C, and decreased HDL-C levels in cases than controls. In the fasting state, there was significant hyper-triglyceridemia and increased VLDL-C levels in cases than controls.

Key words: Diabetes mellitus; Fasting and postprandial lipid profile; Very low-density lipoproteins-cholesterol-C (LDL-C); Triglycerides (TG); High-density lipoproteins-cholesterol (HDL-C)

Access this article online

Website: http://nepjol.info/index.php/AJMS

DOI: 10.3126/ajms.v14i4.51059

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

The worldwide prevalence of diabetes mellitus (DM) has risen dramatically over the past two decades, from an estimated 30 million cases in 1985–536 million in 2021.[1]

Diabetic dyslipidemia leads to proatherogenic conditions which are associated with microvascular and macrovascular complications. Timely identification of diabetic dyslipidemia could provide opportunity for efforts to prevent complications. In type 2 DM, abnormal lipid profile in the postprandial state has more significance than abnormal lipid profile in fasting state in causing atherosclerotic complications.

The high cardiovascular morbidity and mortality in type 2 DM are due to prolonged postprandial hyperglycemia and triglyceridemia. Elevated – total triglycerides (TGs), very low-density lipoproteins (VLDLs), and decreased high-density lipoproteins (HDLs) concentration in the serum are the predominant lipid abnormalities seen in DM. Postprandial hypertriglyceridemia results in a proatherogenic environment which leads to atherosclerosis and macrovascular complications in type 2 DM.[2]

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Many epidemiological and preliminary intervention 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 modified in the postprandial state in diabetics affected by an acute rise in blood glucose levels. The mechanisms by which acute hyperglycemia spikes exerts its effects may be attributed to the production of free radicals. This alarmingly suggestive evidence for harmful effects of postprandial hyperglycemia on diabetes complications has been sufficient to influence guidelines from important professional scientific societies. Correcting the postprandial hyperglycemia may form a key part of the strategy for the prevention and management of CVDs in diabetes.[3-7]

In this study, we try to compare fasting and postprandial lipid abnormalities in type 2 DM as compared to non-diabetics.

Aims and objectives

The aims of this study were to assess the fasting and postprandial lipid abnormalities in type 2 DM in comparison to non-diabetic patients attending SGMH, Rewa M.P.

MATERIALS AND METHODS

This was a cross-sectional case–control study done from April 2021 to March 2022 in Shyam Shah Medical College and Sanjay Gandhi Memorial Hospital Rewa (M.P.).

Two hundred cases of type 2 DM between 30 and 70 years of age were taken on the basis of HbA1c levels (as per the WHO criteria) who were on antidiabetic therapy. Two hundred non-diabetics and normotensive subjects between 30 and 70 years of age without any comorbidity or critical illness were taken as controls.

Informed consent was obtained from all the study subjects. Age and sex were matched. The study was pre-approved by the Institutional Ethics Committee.

Inclusion criteria

The following criteria were used in the study:

Cases

- Type 2 DM patients between 30 and 70 years of age who were on antidiabetic drugs
- Hba1c more than 6.5%.

Control

- Non-diabetic and normotensive individuals between 30 and 70 years of age without any critical or comorbid illness.

Exclusion criteria

The following criteria were used for the study:

- Type I DM
- Critically ill patient
- Associated comorbid illness which is likely to influence endothelial function is: Hypertension, known case of chronic liver disease, 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
- fasting and postprandial lipid profile
- Hba1C
- Blood urea and serum creatinine
- Serum bilirubin, aspartate transaminase, and alanine transaminase
- An electrocardiogram.

Patient's pro forma was maintained. Clinical examination included blood pressure measurement, proper history, general and systemic examination, and optic fundus examination. Biochemical assessment included FBS and PPBS levels, liver and kidney function tests, HbA1C, and comprehensive lipid profile. All data were compiled and compared with the 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 significance of values. $P<0.05$ was considered statistically significant.

RESULTS

In this study, fasting and postprandial lipid profile was done in 200 patients with type 2 DM and was compared with the fasting and postprandial lipid profile in 200 healthy controls, age, and sex matched.

In this study, in the fasting state, 56% of the cases had total TG levels of >150 mg/dL as compared with that of control group, wherein only 30% of them had TG levels of >150 mg/dL (Table 1).

Similarly in the postprandial state, 82% of the cases had TG levels of >150 mg/dL as compared with that of

control group, wherein only 32% of them had TG levels of >150 mg/dL (Table 2).

In this study, the cases had a mean TG level of 172.92±75.51 mg/dL in the fasting state and 232.52±105.08 mg/dL in the postprandial state. The controls had a mean TG level of 125.66±49.55 mg/dL in the fasting state and 133.66±48.79 mg/dL in the postprandial state (Table 3 and Chart 1).

In this study, in the fasting state 28% of cases had total VLDL-C levels of >40 mg/dL as compared with that of the control group, where only 8% of them had VLDL-C levels of >40 mg/dL (Table 4).

Similarly, in the postprandial state, 46% of cases had VLDL-C levels of >40 mg/dL as compared with that of control group, where 14% of them had VLDL-C levels of >40 mg/dL (Table 5).

In this study, the cases had a mean VLDL-C level of 36.76±20.01 mg/dL in the fasting state and 41.58±19.82 mg/dL in the postprandial state. The controls had a mean VLDL-C level of 26.2±13.41 mg/dL in the fasting state and 28.12±14 mg/dL in the postprandial state (Table 6) (Chart 2).

In this study, in the fasting state, 70% of the cases had HDL-C levels of <35 mg/dL as compared with that of control group, wherein 60% of them had HDL-C levels of <35 mg/dL (Table 7).

Table 1: Fasting triglyceride levels among the cases and controls

TG fasting	Control		Diabetic		Total	Chi-square	P
	n	%	n	%			
Up to 150	140	70	88	44	57	9.70	0.021*
151–200	48	24	60	30	27		
201–400	12	6	48	24	15		
Above 400	-	-	4	2	1		
Total	200	100	200	100	100		

*p value is significant.

Table 2: Postprandial triglyceride levels among cases and controls

TG post	Control		Diabetic		Total	Chi-square	P
	n	%	n	%			
Up to 150	136	68	36	18	43	28.02	<0.001*
151–200	44	22	76	38			
201–400	20	10	72	36	23		
Above 400	-		16	8	4		
Total	200	100	200	100	100		

*p value is significant.

Similarly in the postprandial state, 80% of the cases had HDL-C levels of <35 mg/dL as compared with that of control group, wherein 58% of them had HDL-C levels of <35 mg/dL (Table 8).

In this study, the cases had a mean HDL-C level of 33.44±11.42 mg/dL in the fasting state and 30.96±11.04 mg/dL in the postprandial state. The controls had a mean HDL-C level of 35.8±11.99 mg/dL in the fasting state and 33.14±11.15 mg/dL in the postprandial state (Table 9 and Chart 3).

Mean fasting and postprandial lipid levels among the cases and controls summarized (Table 10).

DISCUSSION

VLDL-C levels among the cases and controls

In this study, in the fasting state, 28% of cases had total VLDL-C levels of >40 mg/dL as compared with that of the control group, where only 8% of them had VLDL-C levels of >40 mg/dL. This association has P=0.029 which is statistically significant.

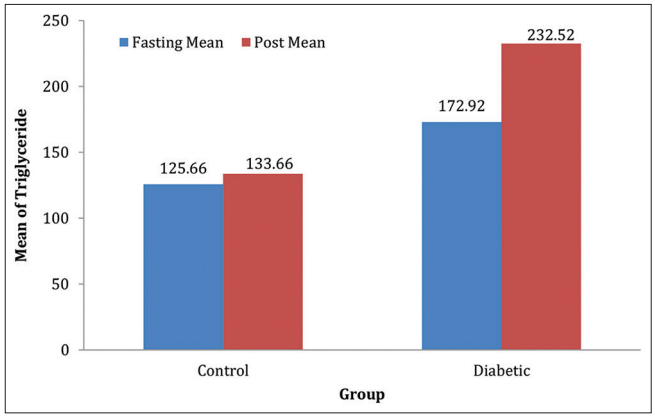

Chart 1: Comparison of the mean fasting and postprandial triglyceride levels among the cases and controls

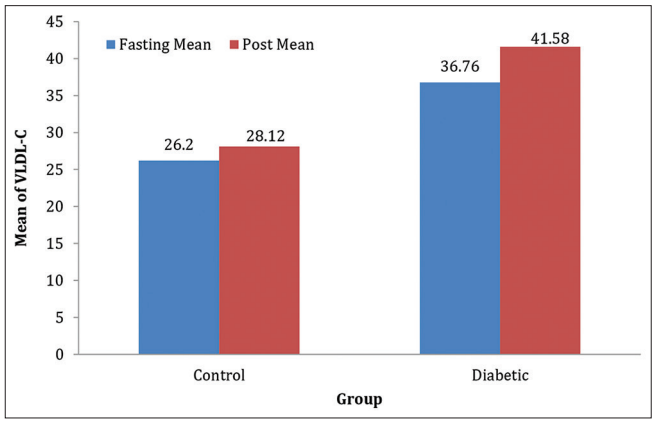

Chart 2: Comparison of the mean fasting and postprandial VLDL-C among the cases and controls

Table 3: Comparison of the mean fasting and postprandial triglyceride levels among the cases and controls

		TG							
Group	n	Fasting				Post			
		Mean	SD	t	P	Mean	SD	t	P
Control	200	125.66	49.55	3.7	0.0001*	133.66	48.79	6.03	0.0001*
Diabetic	200	172.92	75.51			232.52	105.08		

*p value is significant.

Table 4: Fasting VLDL-C levels among the cases and controls

VLDL-C fasting	Control		Diabetic		Total	Chi-square	P
	n	%	n	%			
Up to 20	84	42	36	18	30	10.76	0.029*
21–40	100	50	108	54	52		
41–60	8	4	32	16	10		
61–80	8	4	20	10	7		
Above 100	-	-	4	2	1		
Total	200	100	200	100	100		

VLDL-C: Very low-density lipoproteins-cholesterol, *p value is significant.

Table 5: Postprandial VLDL-C levels among the cases and controls

VLDL-C post	Control		Diabetic		Total	Chi-square	P
	n	%	n	%			
Up to 20	68	34	16	8	21	18.42	0.001*
21–40	104	52	92	46	49		
41–60	24	12	60	30	21		
61–80	-	-	24	12	6		
81–100	4	2	8	4	3		
Total	200	100	200	100	100		

VLDL-C: Very low-density lipoproteins-cholesterol, *p value is significant.

Table 6: Comparison of the mean fasting and postprandial VLDL-C levels among the cases and controls

		VLDL-C							
Group	n	Fasting				Post			
		Mean	SD	t	P	Mean	SD	t	P
Control	200	26.2	13.41	3.1	0.003*	28.12	14	3.92	0.0001*
Diabetic	200	36.76	20.01			41.58	19.82		

VLDL-C: Very low-density lipoproteins-cholesterol, *p value is significant.

Table 7: Fasting HDL-C levels among the cases and controls

HDL-C fasting	Diabetic		Control		Total	Chi-square	P
	n	%	n	%			
Up to 35	140	70	120	60	65	3.00	0.223
36–45	44	22	40	20	21		
Above 45	16	8	40	20	14		
Total	200	100	200	100	100		

HDL-C: High-density lipoproteins-cholesterol

Thus, cases with diabetes were found to have elevated VLDL-C levels when compared with that of controls. This correlates with the study done by Rivellese et al.[8]

Similarly, in the postprandial state, 46% of cases had VLDL-C levels of >40 mg/dL as compared with that of control group, where 14% of them had VLDL-C levels

of >40 mg/dL. This association has P=0.001 which is statistically significant.

Thus, cases with diabetes were found to have elevated postprandial VLDL-C levels when compared with that of controls.

In this study, the cases had a mean VLDL-C level of 36.76±20.01 mg/dL in the fasting state and 41.58±19.82 mg/dL in the postprandial state. The controls had a mean VLDL-C level of 26.2±13.41 mg/dL in the fasting state and 28.12±14 mg/dL in the postprandial state. This association has P=0.0001 which is statistically significant.

Hence, there was significant increase in the postprandial VLDL-C levels in diabetics. This does not correlate with the study done by Rivellese et al.[8]

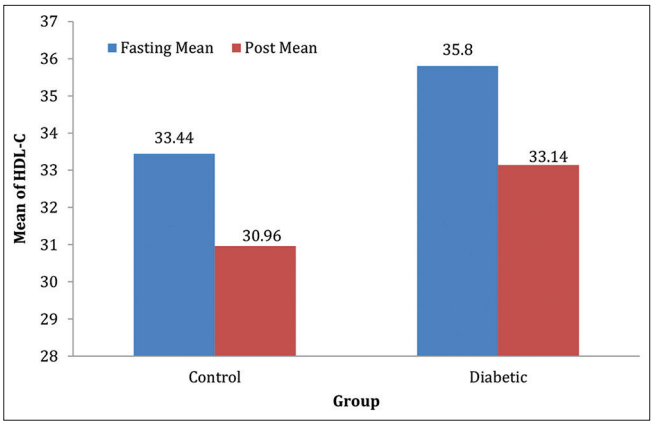

Chart 3: Comparison of the mean fasting and postprandial HLDL-C among the cases and controls

Table 8: Postprandial HDL-C levels among the cases and controls

HDL-C post	Diabetic		Control		Total	Chi-square	P
	n	%	n	%			
Up to 35	160	80	116	58	64	9.6	0.04*
36–45	36	18	60	30	26		
Above 45	4	2	24	12	10		
Total	200	100	200	100	100		

HDL-C: High-density lipoproteins-cholesterol

Table 9: Comparison of the mean fasting and postprandial HDL-C levels among the cases and controls

		HDL-C					
Group	n	Fasting			Post		
		Mean	SD	P	Mean	SD	P
Diabetic	200	33.44	11.42	0.316	30.96	11.04	0.04*
Control	200	35.8	11.99		33.14	11.15	

HDL-C: High-density lipoproteins-cholesterol, *p value is significant.

TG levels among the cases and controls

In this study, in the fasting state, 56% of the cases had total TG levels of >150 mg/dL as compared with that of control group, wherein only 30% of them had TG levels of >150 mg/dL. This association has P=0.021, which is statistically significant.

Thus, in the fasting state, cases with diabetes were found to have elevated TG levels when compared with that of the controls. This correlates with the studies done by Raj et al.,[3] Madhu et al.,[4] and Rivellese et al.[8]

In this study, the cases had a mean TG level of 172.92±75.51 mg/dL in the fasting state and 232.52±105.08 mg/dL in the postprandial state. The controls had a mean TG level of 125.6 in the fasting state and 133.66±48.79 mg/dL in the postprandial state. This association has P=0.0001, hence, statistically significant.

Table 10: Comparison of the mean fasting and postprandial lipid levels among the cases and controls

Group	n	Mean	SD	P
Fasting				
TC				
Control	200	163.78	36.29	0.166
Diabetic	200	176.36	52.43	
HDL-C				
Control	200	35.80	11.42	0.316
Diabetic	200	33.44	11.99	
LDL-C				
Control	200	99.82	36.21	0.857
Diabetic	200	101.16	38.17	
VLDL-C				
Control	200	26.20	13.41	0.003
Diabetic	200	36.76	20.01	
TG				
Control	200	125.66	49.55	0.0001
Diabetic	200	172.92	75.51	
Postprandial				
TC				
Control	200	165.42	35.36	0.323
Diabetic	200	173.30	43.56	
HDL-C				
Control	200	33.14	11.04	0.04
Diabetic	200	30.96	11.15	
LDL-C				
Control	200	103.74	35.60	0.383
Diabetic	200	97.38	36.93	
VLDL-C				
Control	200	28.12	14.00	0.0001
Diabetic	200	41.58	19.82	
TG				
Control	200	133.66	48.79	0.0001
Diabetic	200	232.52	105.08	

VLDL-C: Very low-density lipoproteins-cholesterol, TC: Total cholesterol, LDL-C: Low-density lipoproteins-cholesterol, HDL-C: High-density lipoproteins-cholesterol, TG: Triglyceride

Hence, there was a significant increase in the postprandial TG level in the cases compared to that of the controls.

Similar observations were made in the studies done by Madhu et al.,[4] wherein the cases had a mean TG level of 187.1±63.45 mg/dL in the fasting state and peak mean TG level of 425.2±204.47 mg/dL in the postprandial state. The controls had a mean TG level of 156.85±76.57 mg/dL in the fasting state and peak mean TG level of 283.9±116.94 mg/dL in the postprandial state. Similar observations were also made in the studies done by Raj et al.,[3] (P<0.01), and Rivellese et al.[8]

HDL-C levels among the cases and controls

In this study, in the fasting state, 70% of the cases had HDL-C levels of <35 mg/dL as compared with that of control group, wherein 60% of them had HDL-C levels of <35 mg/dL.

This association has P>0.05, which is not significant. Hence, there was no significant difference in the HDL-C levels in both the cases and controls in the fasting state.

This correlates with the study done by raj et al.,[3] which showed no significant difference in the HDL-C levels in the diabetics and controls. This does not correlate with the study done by Madhu et al.,[4] which showed that diabetics had lower HDL-C levels compared to that of the controls.

In this study, the cases had a mean HDL-C level of 33.44±11.42 mg/dL in the fasting state and 30.96±11.04 mg/dL in the postprandial state. The controls had a mean HDL-C level of 35.8±11.99 mg/dL in the fasting state and 33.14±11.15 mg/dL in the postprandial state.

This association has P=0.04 for postprandial state which is statistically significant. Hence, there was a significant decrease in the postprandial HDL-C level in the cases compared to that of the controls.

Similar observations were made in the studies done by Madhu et al.,[4] in which the cases had a mean HDL-C level of 35.15±10.84 mg/dL in the fasting state and 28.05±10.94 mg/dL in the postprandial state. The controls had a mean HDL-C level of 42.9±14.11 mg/dL in the fasting state and 37.15±13.52 mg/dL in the postprandial state.

In type 2 DM, abnormal lipid profile in the postprandial state has more significance than abnormal lipid profile in fasting state in causing atherosclerotic complications.

The high cardiovascular morbidity and mortality in type 2 DM are due to prolonged postprandial hyperglycemia and triglyceridemia. Elevated – total TGs, VLDL, and decreased HDL concentration in the serum are the predominant lipid abnormalities seen in DM. Postprandial hypertriglyceridemia results in a proatherogenic environment which leads to atherosclerosis and macrovascular complications in type 2 DM.[2]

Limitations of the study

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

Study suggests that

- A close check to be kept on the lipid abnormalities in type 2 diabetic patients as it will further help us in preventing complications associated with it and might help in decreasing comorbidity and mortality as well.
- Advising postprandial lipid profile in type 2 diabetics will give a better insight into the existing metabolic derangements and will hopefully pave way for better identification and prevention of cardiovascular complications, because postprandial hypertriglyceridemia enhances atherogenesis which leads to atherosclerosis and macrovascular complications in type 2 diabetics.

CONCLUSION

- The diabetic dyslipidemia is characterized mainly by raised TG levels, raised VLDL-C Levels, and decreased HDL-C levels
- In the postprandial state, there was significant hypertriglyceridemia, increased VLDL-C, and decreased HDL-C levels in diabetics when compared to that of the controls
- In the fasting state, there was significant hypertriglyceridemia and increased VLDL-C levels in diabetics when compared to that of the controls but insignificant decrease in HDL-C levels.

ACKNOWLEDGMENT

We thank all the individuals included in the study and the institute, Shyam Shah Medical College and Sanjay Gandhi Medical Hospital Rewa for providing platform to conduct the study.

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https://doi.org/10.1210/jc.2003-031764

Authors Contribution:
PG- Concept and design of the study, prepared first draft of manuscript; **MT-** Interpreted the results; Reviewed the literature and manuscript preparation; **DKM**- Coordination, preparation and revision of manuscript, Statistical analysis and interpretation.

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Source of Support: Nil, **Conflicts of Interest:** None declared.