

ASSOCIATION BETWEEN FIBRINOGEN LEVELS AND LIPID PROFILE IN TYPE 2 DIABETES MELLITUS: AN OBSERVATIONAL STUDY

¹Dr Gurram Rajasekhar Reddy, ²Dr Gadsa Rakeshkumar Premjibhai, ³Dr Gupta Rajesh
Jawaharlal

¹Assistant Professor, Department of General Medicine, Dhanalakshmi Srinivasan Medical College and
Hospital, Perambalur, Tamilnadu

²Assistant Professor, Department of Obstetrics and Gynaecology, Gouri Devi Institute of Medical Science
& Hospital, Durgapur, West Bengal

³Assistant Professor, Department of General Surgery, Icare Institute of Medical Science and Research,
Haldia, West Bengal

Corresponding author
Gupta Rajesh Jawaharlal

ABSTRACT:

Background: Type 2 Diabetes Mellitus (T2DM) is commonly associated with dyslipidemia and increased cardiovascular risk. Plasma fibrinogen, an acute phase reactant and prothrombotic marker, has been implicated in the development of vascular complications in diabetic patients. The present study was conducted to evaluate the association between plasma fibrinogen levels and lipid profile abnormalities in patients with T2DM.

Methods: This observational cross-sectional study was conducted among 104 patients with Type 2 Diabetes Mellitus attending a tertiary care teaching hospital. Fasting blood samples were collected for estimation of plasma fibrinogen and lipid profile parameters including total cholesterol, triglycerides, HDL cholesterol, and LDL cholesterol. Correlation tests were applied to determine the association between fibrinogen levels and lipid parameters.

Results: Among the 104 study participants, 75 were males and 29 were females. A significant positive correlation was observed between plasma fibrinogen levels and serum total cholesterol, triglycerides, and LDL cholesterol levels. Patients with higher triglyceride levels showed markedly elevated plasma fibrinogen concentrations. An inverse correlation was observed between plasma fibrinogen and HDL cholesterol levels. The correlation between triglyceride levels and plasma fibrinogen was highly significant ($r=0.86$, $p<0.001$).

Conclusion: The present study demonstrated that elevated plasma fibrinogen levels are significantly associated with diabetic dyslipidemia in patients with T2DM. Regular monitoring of fibrinogen along with lipid profile may aid in early identification and management of cardiovascular complications in T2DM.

Keywords: Type 2 Diabetes Mellitus; Fibrinogen; Dyslipidemia; Lipid Profile; Cardiovascular Risk; Hypertriglyceridemia

INTRODUCTION:

Type 2 Diabetes Mellitus is one of the most prevalent chronic metabolic disorders worldwide and represents a major public health burden, particularly in developing countries such as India. The disease is characterized by insulin resistance, impaired insulin secretion, and chronic hyperglycemia, which contribute to long-term microvascular and macrovascular complications. Cardiovascular disease remains the leading cause of morbidity and mortality among patients with type 2 diabetes mellitus (T2DM) [1, 2].

Apart from traditional cardiovascular risk factors such as hypertension, obesity, and dyslipidemia, increasing evidence suggests that inflammatory and prothrombotic markers also play an important role in the pathogenesis of diabetic vascular complications. Among these markers, fibrinogen has gained considerable attention because of its role in coagulation, platelet aggregation, endothelial dysfunction, and atherosclerosis [3]. Fibrinogen is an acute phase reactant synthesized by the liver, and elevated plasma fibrinogen levels are associated with increased blood viscosity and thrombus formation, thereby enhancing cardiovascular risk [3, 4].

Patients with T2DM frequently exhibit abnormalities in lipid metabolism, including elevated total cholesterol, triglycerides, and low-density lipoprotein cholesterol (LDL-C), along with reduced high-density lipoprotein cholesterol (HDL-C) [5]. This characteristic diabetic dyslipidemia accelerates endothelial injury and atherogenesis. Several studies have demonstrated that plasma fibrinogen levels are significantly higher in diabetic individuals and correlate positively with adverse lipid parameters. Elevated fibrinogen levels have been linked with increased serum cholesterol, LDL-C, and triglycerides, while an inverse relationship has been observed with HDL-C levels [6, 7].

The interaction between fibrinogen and lipid abnormalities may contribute substantially to the enhanced cardiovascular risk observed in T2DM patients. Chronic hyperglycemia induces oxidative stress and inflammatory responses, which stimulate hepatic fibrinogen synthesis and worsen dyslipidemia. Consequently, fibrinogen may serve not only as a marker of inflammation and thrombosis but also as an indicator of metabolic derangement in diabetes mellitus [8, 9].

AIMS AND OBJECTIVES:

The present study was undertaken to evaluate the association between fibrinogen levels and lipid profile abnormalities in patients with Type 2 Diabetes Mellitus. Understanding this relationship may contribute to improved risk stratification and early detection of cardiovascular complications in diabetic patients.

MATERIAL AND METHODS:

Study Design and Setting: This observational cross-sectional study was conducted in the Department of General Medicine at a tertiary care teaching hospital India over a period of 12 months.

Study populations: A total of 104 known and newly detected type-2 diabetic patients attended the out-patient department and admitted as in-patients in our hospital were included.

Inclusion Criteria

- Patients aged ≥ 18 years
- Diagnosed cases of Type 2 Diabetes Mellitus according to American Diabetes Association (ADA) criteria
- Patients willing to provide informed written consent

Exclusion Criteria

- Type 1 Diabetes Mellitus
- Patients with acute or chronic inflammatory disorders
- Known coagulation disorders
- Chronic liver disease or chronic kidney disease
- Patients on anticoagulant therapy, lipid-lowering drugs, or steroids
- History of malignancy, recent surgery, or trauma

Data Collection: Data collected were patient's age, gender, socio-economic status, history and clinical profile. All relevant investigation was done. Written informed consent was obtained from all the study participants. Following overnight fasting of 8–12 hours, venous blood samples were collected under aseptic precautions. Estimation of plasma fibrinogen was done by thrombin-clotting method by using FIBROQUANT KIT. Glycated Hemoglobin (HbA1c) and lipid profile also estimated.

Outcome Measures: The primary outcome measure was the correlation between plasma fibrinogen levels and lipid profile parameters in patients with T2DM.

Statistical Analysis: The data was analyzed by using SPSS 25.0 version. Quantitative data was

expressed as mean and standard deviation whereas qualitative data was expressed as percentages. Unpaired t test and correlation test was applied as a test of significance. A p value <0.05 was considered as significant whereas p<0.001 was considered as highly significant.

RESULTS:

Total 104 patients were involved in our study. Of which 75 were males and 29 females. Majority of type-2 diabetic patients were in the age group of 50-59 years (32 patients, 42.7%). The mean age of the patient was 61.5 years. The sex distribution showed male preponderance in each age group and as a whole (Table 1).

Table 1: Distribution of subjects according to age and gender

Age in years	Male		Female	
	Frequency	Percent	Frequency	Percent
40-49	9	12.0	11	37.9
50-59	32	42.7	8	27.6
60-69	11	14.7	6	20.7
70-79	9	12.0	3	10.3
>80	14	18.7	1	3.4
Total	75	100.0	29	100.0

Nine patients had serum cholesterol level between 100-149 mg/dL and mean plasma fibrinogen level of 7.43 ± 1.01 and 64 patients had serum cholesterol level between 150-199 mg/dL and mean plasma fibrinogen level of 6.76 ± 2.43 . 24 patients had serum cholesterol level between 250-249 mg/dL and mean plasma fibrinogen level of 6.08 ± 2.52 and remaining 3 patients had serum cholesterol level between 250-299 mg/dL with mean plasma level of 8.47 ± 3.82 . On applying correlation test, the correlation coefficient was found to be $r=0.65$ and $t=10.1$ ($p<0.00001$), which was significant. So, there was a significant positive correlation between plasma cholesterol level and plasma fibrinogen level (Table 2).

Table 2: Correlation of fibrinogen level with serum cholesterol

Cholesterol level (mg/dL)	N	Mean	SD
100 - 149	10	7.43	1.01

150 - 199	66	6.76	2.43
200 - 249	24	6.08	2.52
250 - 299	4	8.47	3.82

Table 3 shows a linear increase in plasma fibrinogen level as serum triglyceride level increases. The patients who had serum triglyceride level between 100-149 mg/dL had plasma fibrinogen level about 4.19 ± 0.1 g/L and those with serum triglyceride level more than 400 mg/dL had 9.01 ± 0.83 g/L plasma fibrinogen level. On applying correlation test, the correlation coefficient was found to be $r=0.86$ and $t=30.16$ ($p<0.001$), which was highly significant. So, there was a significant positive correlation between serum triglyceride level and plasma fibrinogen level (Table 3).

Table 3: Correlation of fibrinogen levels with serum triglyceride level

Triglyceride level (mg/dL)	N	Mean	SD
100-149	6	4.19	0.1
150-199	10	4.8	0.18
200-249	18	5.63	0.45
250-299	35	5.12	0.43
300-349	25	6.35	0.21
350-399	8	9.43	0.13
>400	2	9.01	0.83

Twenty patients with HDL level 30-34 mg/dL had plasma fibrinogen level of 5.3 ± 1.72 g/L, thirty six patients with HDL level 35-39 mg/dL had plasma fibrinogen level of 5.9 ± 1.50 g/L, thirty patients with HDL level 40-44 mg/dL had plasma fibrinogen level of 5.4 ± 1.36 g/L, twelve patients with HDL level 45-49 mg/dL had plasma fibrinogen level 5.3 ± 1.10 g/L and lastly 3 patients with HDL level more than 50 mg/dL had plasma fibrinogen level of 5.3 ± 1.19 g/L. On applying correlation test, the correlation coefficient was found to be $r=-0.52$ and $t=8.09$ ($p<0.001$), which was significant. So, there was a significant negative correlation between serum HDL and plasma fibrinogen level (Table 4).

Table 4: Correlation of fibrinogen levels with serum HDL level

HDL level (mg/dL)	N	Mean	SD
30-34	20	5.3	1.72
35-39	36	5.9	1.5
40-44	31	5.4	1.36
45-49	13	5.3	1.1
>50	4	5.3	1.19

Five patients with LDL level less than 50 mg/dL had plasma fibrinogen level 7.01 ± 0.99 g/L. Thirty seven patients with LDL level between 50-99, had plasma fibrinogen level of 6.03 ± 0.47 g/L. Fifty four patients with LDL level between 100-149 mg/dL had plasma fibrinogen level of 7.1 ± 0.55 and lastly 4 patients with LDL level between 150-199 mg/dL had plasma fibrinogen level of 6.09 ± 1.05 . On applying correlation test, the correlation coefficient was found to be $r=0.65$ and $t=6.1$ ($p<0.01$) which was significant. So, there was a positive correlation between serum LDL level and plasmafibrinogen level (Table 5).

Table 5: Correlation of fibrinogen levels with serumLDL level

LDL level(mg/dL)	N	Mean	SD
<50	6	7.01	0.99
50-99	39	6.03	0.47
100-149	54	7.1	0.55
150-199	5	6.09	1.05

DISCUSSION:

The present study demonstrated a significant association between plasma fibrinogen levels and lipid profile abnormalities in patients with Type 2 Diabetes Mellitus (T2DM). Increased levels of total cholesterol, triglycerides, and LDL cholesterol showed a positive correlation with plasma fibrinogen, whereas HDL cholesterol showed a negative correlation. These findings suggest that dyslipidemia in T2DM is associated with increased inflammatory and prothrombotic activity.

In this study, serum cholesterol levels showed a significant positive correlation with plasma fibrinogen levels. Elevated cholesterol contributes to endothelial dysfunction and vascular inflammation, which may increase hepatic fibrinogen synthesis. Similar findings were reported by Barazzoni R, et al [10] and Patel HV, et al [11] observed a strong association between fibrinogen and atherogenic lipid parameters.

A strong positive correlation was also observed between serum triglyceride levels and plasma fibrinogen levels. Hypertriglyceridemia is known to promote oxidative stress and inflammatory responses, thereby enhancing coagulation activity. Similar observations were reported by Davi G et al [12], who found increased inflammatory and thrombotic markers in diabetic patients with elevated triglyceride levels.

The present study found an inverse relationship between HDL cholesterol and plasma fibrinogen levels. HDL has anti-inflammatory and endothelial protective effects; therefore, reduced HDL levels may contribute to increased fibrinogen production and vascular risk. Similar negative correlations were reported by Ceriello A et al [13] in diabetic populations.

Additionally, LDL cholesterol showed a positive correlation with plasma fibrinogen levels. Elevated LDL contributes to endothelial injury and atherosclerosis, which may stimulate fibrinogen synthesis. Similar findings were observed by Khan A, et al [14] and Agrawal P, et al [15] reported that higher fibrinogen levels were associated with adverse cardiovascular risk profiles.

CONCLUSIONS:

The present study demonstrated a significant association between plasma fibrinogen levels and lipid profile abnormalities in patients with Type 2 Diabetes Mellitus. Plasma fibrinogen levels showed a positive correlation with total cholesterol, triglycerides, and LDL cholesterol, while an inverse correlation was observed with HDL cholesterol. These findings indicate that elevated fibrinogen levels are associated with diabetic dyslipidemia and may reflect increased inflammatory and prothrombotic activity in T2DM patients. Therefore, plasma fibrinogen may serve as a useful biomarker for early identification of patients at higher risk of cardiovascular complications. Regular monitoring of fibrinogen levels along with lipid profile may help in better cardiovascular risk assessment and management in patients with Type 2 Diabetes Mellitus.

Conflicts of interest: none

Source of funding: none

REFERENCES:

1. Bembde AS. A study of plasma fibrinogen level in type-2 diabetes mellitus and its relation to glycemic control. *Indian J Hematol Blood Transfus.* 2012;28(2):105-108.
2. Desai VA, Chandrakala, Takalkar AA. Correlation of fibrinogen level with lipid profile in

- type 2 diabetes mellitus. *Int J Adv Med*. 2020;7(5):849-852.
3. Razak MKA, et al. The importance of measurement of plasma fibrinogen level in patients with type 2 diabetes mellitus. *Diabetes Metab Syndr*. 2019;13(2):1157-1161.
 4. Kamath SD, et al. The study of relationship between plasma fibrinogen level and macrovascular complications in type 2 diabetes mellitus patients. 2022.
 5. Anjula J, Gupta HL, Narayan S. Hyperfibrinogenemia in patients of diabetes mellitus in relation to glycemic control and urinary albumin excretion rate. *JAPI*. 2001; 49:227-30.
 6. Naik MR, Mukkamalla S. Plasma fibrinogen levels in deranged lipids of type-2 diabetes. *Int J Curr Med Appl Sci*. 2020; 26(1):1-5.
 7. Gupta P, Bhambani P, Narang S. Study of plasma fibrinogen level and its relation to glycemic control in type-2 diabetes mellitus patients attending diabetes clinic at a tertiary care teaching hospital in Madhya Pradesh, India. *Int J Res Med Sci*. 2016; 4:3748-54.
 8. Ko GT, Chan JC, Tsang LL, Cockram CS. Hyperfibrinogenaemia did not improve after treating hyperglycaemia in Chinese type 2 diabetic patients. *Ann Clin Biochem*. 2000 Sep 1; 37(5):655-61.
 9. Sakkinen PA, Wahl P, Cushman M, Lewis MR. Clustering of procoagulation, inflammation, and fibrinolysis variables with metabolic factors in insulin resistance syndrome. *Am J Epidemiol*. 2000;152(10):897–907.
 10. Barazzoni R, Zanetti M, Davanzo G, Kiwanuka E, Carraro P, Tiengo A et al. “Increased fibrinogen production in type-2 diabetic patients without detectable vascular complications; Correlation with plasma glucagon concentration. *J Clin End Metab*. 2000; 85(9):1321-5.
 11. Patel HV, et al. Association of plasma fibrinogen and development of complications of diabetes mellitus. *Int J Res Med Sci*. 2023;11(5):1558-1562.
 12. Davi G, Santilli F, Patrono C. Nutraceuticals in diabetes and metabolic syndrome. *Cardiovasc Ther*. 2010; 28(4):216–226.
 13. Ceriello A. The emerging challenge in diabetes: the “metabolic memory”. *Vasc Pharmacol*. 2012; 57(5-6):133–138.
 14. Khan A, Rahman M, Hossain F, et al. Association of plasma fibrinogen with lipid abnormalities and glycemic status in type 2 diabetes mellitus patients. *Diabetes Metab Syndr*. 2021;15(4):102203.

15. Agarwal P, Sharma N, Verma S. Correlation of plasma fibrinogen levels with lipid profile and cardiovascular risk in patients with type 2 diabetes mellitus. *J Family Med Prim Care*. 2022;11(6):2874–2879.