Section: General Medicine

Original Research Article

LIPID PROFILE IN CONTROLLED VS UNCONTROLLED TYPE 2 DIABETES MELLITUS

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ABSTRACT

Background: Diabetes mellitus is a significant public health issue in India, with the number of cases soaring from 17.5 million in 1994 to an estimated 57.2 million by 2020. A staggering 97% of those with diabetes also suffer from dyslipidemia, which worsens macrovascular complications like coronary artery disease (CAD), cardiovascular disease (CVD), and peripheral vascular disease (PVD). These complications are 2 to 4 times more common in diabetics compared to those without diabetes. This study aims to compare lipid profiles and macrovascular outcomes between individuals with controlled and uncontrolled Type 2 diabetes mellitus (T2DM). **Materials and Methods:** In terms of methods, we conducted a randomized study from 2014 to 2016 at NRI Medical College & General Hospital, enrolling 100 T2DM patients aged between 36 and 75 years. We divided participants into two groups: those with controlled diabetes (HbA1c <7%, fasting blood sugar 70–130 mg/dL, and postprandial blood sugar <180 mg/dL) and those with uncontrolled diabetes. We assessed lipid profiles according to NCEP ATP III criteria and evaluated macrovascular complications through clinical assessments and ECG/imaging. For statistical analysis, we used Student's t-test. **Result:** Looking at the results, our cohort consisted of 67 males and 33 females, with an average age of 56.7 years. Among them, 24% had controlled diabetes while 76% were in the uncontrolled group. Dyslipidemia was prevalent in both categories, with 79.2% of the controlled group and 82.9% of the uncontrolled group affected, showing no significant differences in average lipid levels. Hypertriglyceridemia was the most common issue, affecting 64% of participants, followed by elevated LDL levels in 62% and low HDL levels in 56%. We found that macrovascular complications were more common in those with uncontrolled diabetes (CAD: 21.05% vs. 12.5%) and in dyslipidemic individuals (CAD: 19.73% vs. 16.66% in those with normal lipid levels). **Conclusion:** In conclusion, dyslipidemia, especially hypertriglyceridemia, is widespread among individuals with T2DM, regardless of their glycemic control, and significantly increases the risk of macrovascular complications. Therefore, it's crucial to manage both hyperglycemia and lipid abnormalities.

INTRODUCTION

Diabetes mellitus is becoming a significant and escalating public health issue around the world, largely fueled by urban growth and an aging population. India, in particular, has seen a dramatic increase in cases, jumping from 17.5 million in 1994 to an estimated 57.2 million by 2020.[1] This metabolic disorder doesn't just throw carbohydrate metabolism out of whack; it also disrupts lipid and protein metabolism, leading to serious complications both in small and large blood vessels. A key concern is dyslipidemia, which affects nearly 97% of people with diabetes, especially those with Type 2 diabetes,[2] where the issues are often more severe and worsened by poor blood sugar control—even in those who are prediabetic.[3]

As a result, diabetic patients face a 2 to 4 times higher risk of serious macrovascular problems like coronary artery disease, cerebrovascular disease, and peripheral vascular disease compared to those without diabetes,[4] significantly impacting their health and longevity.[6,7] There are also ethnic differences, with Asian Indians showing a unique pattern marked by high insulin resistance and low levels of HDL cholesterol. Since diabetes is a major, modifiable risk factor for vascular disease, it's

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crucial to achieve good metabolic control to minimize complications.[5]

This means regularly assessing and managing related issues, especially dyslipidemia and hypertension. Therefore, this study aims to explore and compare the lipid profiles of patients with well-controlled versus poorly controlled Type 2 diabetes mellitus and to assess the presence of macrovascular complications in these groups.

MATERIALSANDMETHODS

Study Design and Participants

This randomized comparative study took place at NRI Medical College & General Hospital between 2014 and 2016. After getting informed consent, we enrolled 100 patients aged 36 to 75 years who had Type 2 diabetes mellitus (T2DM). We excluded individuals under 18, those with alcohol abuse issues, pregnant women, and patients with liver disorders, thyroid dysfunction, chronic kidney failure, nephrotic syndrome, jaundice, hemoglobinopathies, hemolyticanemia, or those taking beta-blockers, diuretics, steroids, protease inhibitors, or lipid-lowering medications.

Glycemic and Dyslipidemia Criteria

Participants were divided into two groups: controlled and uncontrolled diabetics, based on specific glycemic targets: HbA1c levels below 7.0%, fasting blood sugar (FBS) between 70 and 130 mg/dL, and postprandial blood sugar (PPBS) under 180 mg/dL. We defined dyslipidemia according to the NCEP ATP III guidelines, which state that total cholesterol should be over 200 mg/dL, triglycerides (TGL) above 150 mg/dL, LDL-C over 100 mg/dL, or HDL-C below 40 mg/dL.

Clinical and Laboratory Assessments

Every participant went through a thorough history and physical examination, along with several tests: complete hemogram, FBS, PPBS, glycated hemoglobin (HbA1c), fasting lipid profile, blood urea, serum creatinine, urinalysis (for sugar, albumin, and ketones), and an ECG. We also conducted additional tests, such as liver and thyroid function tests, chest X-ray, echocardiography, abdominal ultrasound, and CT scans of the brain, whenever clinically necessary.

Laboratory Methods: We measured HbA1c using the ion exchange resin method with whole blood that had been treated with EDTA as an anticoagulant. For lipid profiles, we took fasting serum samples after a 12-hour fast. To keep HDL from breaking down, we separated the serum within 2 hours of drawing the blood, centrifuging it at 5,000 RPM for 10 minutes, and then stored it at 4°C for analysis within 48 hours using a Merk Selectra Junior analyzer.

- Total cholesterol was determined using the enzymatic colorimetric CHOD-PAP method.
- Triglycerides were measured through enzymatic hydrolysis followed by glycerol colorimetry.
- For HDL-C, we precipitated non-HDL lipoproteins with phosphotungstic acid/Mg^{2+} and measured the cholesterol in the supernatant.
- LDL-C was calculated using the Friedewald formula: LDL-C = Total cholesterol – (TGL/5 + HDL-C).

Statistical Analysis: We compared the average lipid parameters (total cholesterol, TGL, LDL-C, HDL-C) between controlled and uncontrolled diabetic groups using Student's t-test, with statistical significance set at $p < 0.05$.

RESULTS

Study Population and Glycemic Control: The study involved 100 patients with Type 2 diabetes mellitus (T2DM), consisting of 67 men and 33 women, with an average age of 56.7 years and an average diabetes duration of 3.78 years. When we looked at glycemic control, we found that 24% (24 individuals) had their diabetes under control (HbA1c <7%), while a significant 76% (76 individuals) were not. Interestingly, men made up the majority in both categories, with 54.2% of the controlled group and 71.1% of the uncontrolled group being male [Table 1, Figure 1].

Table 1: Demographic and Glycemic Characteristics

Characteristic	Controlled (n=24)	Uncontrolled (n=76)	Total
Male	13 (54.2%)	54 (71.1%)	67
Female	11 (45.8%)	22 (28.9%)	33
Mean Age (years)	56.7	56.7	56.7

Lipid Profile Analysis: In our analysis, we didn't find any statistically significant differences ($p > 0.05$) in the average lipid levels between the controlled and uncontrolled groups. Both groups showed signs of dyslipidemia, with elevated triglycerides (controlled: 162.75 ± 26.07 mg/dL; uncontrolled: 169.13 ± 35.14 mg/dL), LDL-C levels exceeding 100 mg/dL (controlled: 117.68 ± 27.6 mg/dL; uncontrolled: 124.53 ± 31.08 mg/dL), and HDL-C levels below 40 mg/dL (controlled: 38.32 ± 4.15 mg/dL; uncontrolled: 37.93 ± 3.65 mg/dL) [Table 2, Figure 2]. Notably, the prevalence of dyslipidemia was higher among those with uncontrolled diabetes (82.9% compared to 79.2%), with hypertriglyceridemia being the most frequently observed issue (64% overall) [Figure 3].

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Table 2. Lipid Parameters in Controlled vs. Uncontrolled Diabetics (Mean ± SD)

Parameter	Controlled (n=24)	Uncontrolled (n=76)	p-value
Total Cholesterol (mg/dL)	191.37 ± 29.2	203.10 ± 33.89	>0.05
Triglycerides (mg/dL)	162.75 ± 26.07	169.13 ± 35.14	>0.05
LDL-C (mg/dL)	117.68 ± 27.6	124.53 ± 31.08	>0.05
HDL-C (mg/dL)	38.32 ± 4.15	37.93 ± 3.65	>0.05

Macrovascular Complications: People with uncontrolled diabetes showed significantly higher rates of coronary artery disease (CAD: 21.05% compared to 12.5%), cerebrovascular accidents (CVA: 3.94% versus 4.16%), and peripheral vascular disease (PVD: 5.26% against 4.16%) when compared to those whose diabetes is well-managed [Table 3, Figure5]. Among dyslipidemic individuals (n=82), the occurrence of macrovascular complications was greater (CAD: 19.73%; PVD: 5.26%) than in normolipidemic subjects (n=18; CAD: 16.66%) [Figure6].

Table 3: Macrovascular Complications by Glycemic and Lipid Status

Complication	Controlled (n=24)	Uncontrolled (n=76)	Dyslipidemic (n=82)	Normolipidemic (n=18)
CAD	3 (12.5%)	16 (21.05%)	15 (19.73%)	4 (16.66%)
CVA	1 (4.16%)	3 (3.94%)	3 (3.94%)	0 (0%)
PVD	1 (4.16%)	4 (5.26%)	4 (5.26%)	1 (4.16%)

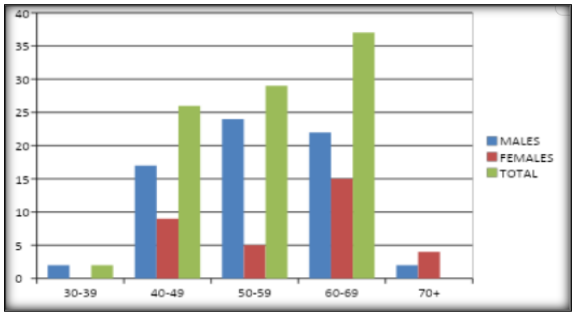

Figure 1: Age and Sex Distribution

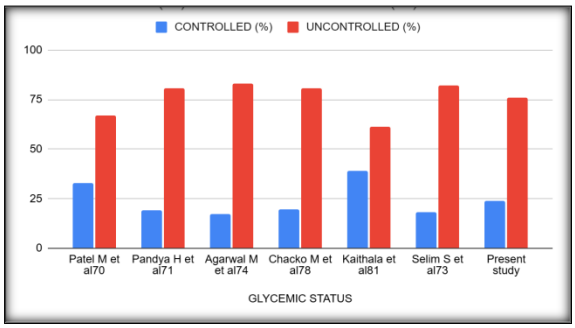

Figure 2: Glycemic Status

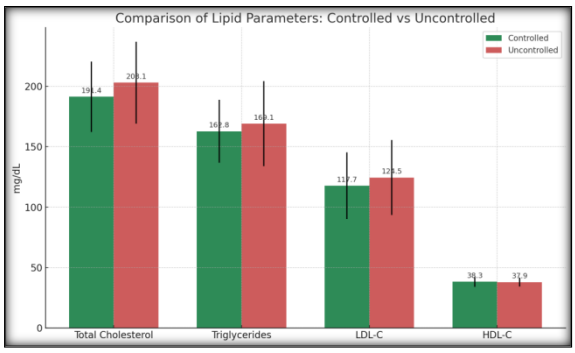

Figure 3: Lipid Levels by Glycemic Control

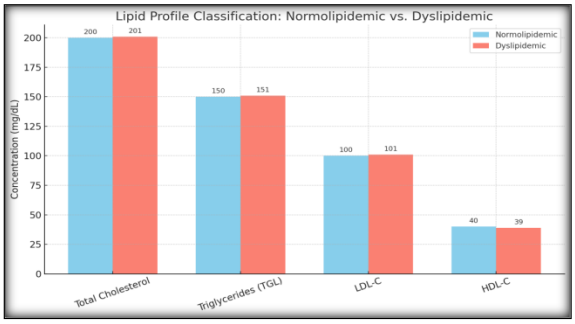

Figure 4: Dyslipidemia Prevalence

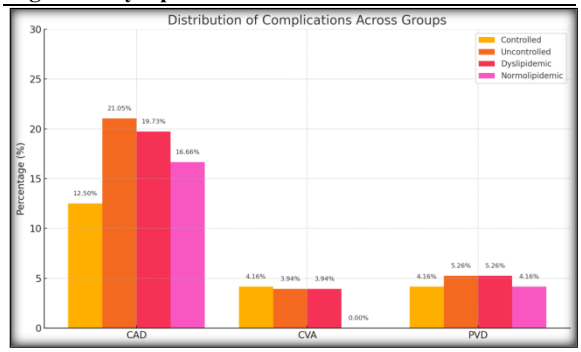

Figure 6: Macrovascular Complications by Glycemic Control and Lipid Status

DISCUSSION

This study highlights that dyslipidemia is quite common among both controlled (79.2%) and uncontrolled (82.9%) Type 2 diabetes mellitus (T2DM) patients. The most frequently observed issue is hypertriglyceridemia, affecting 64% of patients, followed by elevated LDL levels at 62% and low HDL levels at 56%. These results are consistent with global trends, where insulin resistance in T2DM leads to the liver producing too many atherogenic lipoproteins, especially VLDL and triglycerides, while also hindering HDL production.[8-10] Interestingly, there were no significant differences ($p > 0.05$) in average lipid levels between the controlled and uncontrolled groups, reinforcing the idea that simply managing

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blood sugar levels isn't enough to fix lipid metabolism issues—a point that has been noted before.[11,12]

The high prevalence of hypertriglyceridemia in our group (ages 60–69, with a mean age of 56.7 years) is in line with findings from Battisti et al,[13] and Unger et al., who also found that elevated triglycerides and low HDL are key characteristics of diabetic dyslipidemia. Our findings further support international studies showing that dyslipidemia can persist even after reaching glycemicgoals,[11,12] highlighting the importance of managing lipids independently. The slightly higher rates of macrovascular complications in uncontrolled diabetics (CAD: 21.05% vs. 12.5%) and those with dyslipidemia (CAD: 19.73% vs. 16.66% in those with normal lipid levels) underscore the combined effect of high blood sugar and dyslipidemia on vascular risk.[14] This is consistent with the Framingham Heart Study, which identified diabetes as a "CHD risk equivalent" due to its role in accelerating atherosclerosis.

In our mainly Indian group (67% male), we noticed some ethnic differences, particularly regarding dyslipidemia rates, which were quite similar for both genders (67.1% in males and 66.6% in females). This stands in contrast to other studies that have found distinct lipid patterns based on gender. The overall dyslipidemia rate we observed was quite high at 82%, which is above some figures reported in Indian studies (like ICMR-INDIA B at 79%), but it does match the findings of Agarwal et al. (82.58% in those with uncontrolled diabetes). This really emphasizes how risk profiles can vary by population. Importantly, we found a strong connection between dyslipidemia and macrovascular complications, backing up Grundy et al.'s claim that lipid issues play a significant role in vascular problems related to diabetes.

While we did see a slight drop in dyslipidemia rates with better glycemic control (79.2% compared to 82.9%), it’s clear that just managing blood sugar isn’t enough to fully normalize lipid levels, which means we need to consider additional treatments. This aligns with findings from the UKPDS, which showed that while improving glycemic control helped reduce microvascular complications, it didn’t have as much effect on macrovascular events.[15] Therefore, it’s crucial to tackle both high blood sugar and dyslipidemia—especially high triglycerides and low HDL—to lower vascular risks in those with type 2 diabetes.

Our study's single-center approach and relatively small sample size (n=100) might limit how broadly we can apply these findings. Additionally, by excluding patients on lipid-lowering medications, we may not fully capture the true prevalence of dyslipidemia in the real world. Gathering longitudinal data would help clarify the relationship between control status and complications over time.

CONCLUSION

This study highlights that Type 2 diabetes mellitus tends to hit older adults the hardest, with men showing a greater vulnerability compared to women. Most patients in the study had trouble managing their blood sugar levels and also faced issues with lipid levels, which points to how widespread lipid abnormalities are among both those with controlled and uncontrolled diabetes. While there was a slight uptick in dyslipidemia among those with uncontrolled diabetes (82.9% compared to 79.2%), the differences in specific lipid levels—like total cholesterol, triglycerides, LDL, and HDL—were not statistically significant between the two groups. Hypertriglyceridemia was the most common lipid issue, followed by low HDL, high LDL, and elevated cholesterol levels. Importantly, patients with uncontrolled blood sugar and dyslipidemia experienced more macrovascular complications (like coronary artery disease, cerebrovascular accidents, and peripheral vascular disease), highlighting how these metabolic issues can work together to harm vascular health. These results stress the importance of a comprehensive approach that focuses on both blood sugar management and improving lipid levels to reduce cardiovascular risks in people with diabetes.

REFERENCES

1. Mc carty D, Zimmet P. Diabetes 1994- 2010, Global estimates and Projections. Inst Melbourne 1994.
2. Tan CE, MaS, WaiD, Chew SK, Tai ES. Can We Apply the National Cholesterol Education Program Adult Treatment Panel Definition Of Metabolic Syndrome to Asians ? Diabetes Care , 2004; 27:1182-1186.
3. Haffner SM, Stern MP, Hazuda HP, Mitchell BD, Patterson JK. Cardiovascular risk factors in confirmed prediabetic individuals. Does the clock for coronary heart disease start ticking before the onset of clinical diabetes ?JAMA1990 ;263:2893-8.
4. Stamler J, Vaccaro O, Neaton JD, Went worth D. Diabetes, other risk factors , and 12 yrs cardiovascular mortality for men screened in the Multiple Risk Factor Intervention Trial . Diabetes Care 1993;16:434-44.
5. Mc KeiguePM , Shah B, Marmot MG. Relation of central obesity and insulin resistance with high diabetes prevalence and cardiovascular risk in South Asians. Lancet 1991;337:382-6.
6. Powers AC. Diabetes Mellitus. In : Harrisons Principle Of Internal Medicine, 16th Edition ;Pg . 2152-90.
7. Mohan V , Ravi kumar R, Shanthirani S, Deepa R. Intimal medial thickness of the carotid artery in South Indian diabetic and non-diabetic subjects: the Chennai Urban Population Study(CUPS).Diabetologia.2000;43:494-499.
8. Alvin. C. Powers, Henry. N, Ginsbrg. Diabetes Mellitus and Diabetic dyslipidemia- Disorders of lipoprotein metabolism–Textbook of Harrison”s principles of internal medicine 15th edition 2001, chapter 333 and 344, Page No.2120-25 and 2251-52.
9. American Diabetes Association. Management of dyslipidemia in adults with diabetes (Position Statement). Diabetes Care 1998;13:1-11.
10. Uusitupa M, Siitonen O, Voutilainen E, et al. Serum lipids and lipoproteins in newly diagnosed non-insulin dependent (type-II) diabetic patients, with special reference to factors influencing HDL-cholesterol and triglyceride levels. Diabetes Care 1986; 9:17-22.

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11. Abdul Hamid Zargar. Serum cholestrol, triglycerides and total lipids in well controlled NIDDM. Journal of diabetic association of India 1997,37,No.3240.
12. Parhofer KG, Laubach E, Geiss HC, Otto C . Effect of glucose control on lipid levels in patients with type 2 diabetes. Dtsch Med Wochenschr 2002;127(18):958-62.
13. Battsti WP, Palmissano J, Keane WE. Dyslipidemia in patients with type 2 diabetes. Relationships between lipids, kidney disease and cardio vascular disease. Cli Chem Lab Med.2003;41(9):1174-81.
14. Mohan V, Premalatha G, Sastry NG . Peripheral vascular disease in NIDDM in South India . Diabetes Research and clinical practice. 1995;27:235-240.
15. Drivsholm T, de Fine Olivarius N, Nielsen AB, Siersma V. Symptoms, signs and complications in newly diagnosed type 2 diabetic patients, and their relationship to glycaemia, blood pressure and weight. Diabetologia 2005;48(2):210-4.

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