International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Researcher Article *DOI: 10.61336/im/26-1-02*

Lipid metabolism in Diabetes Investigating changes in lipid metabolism in patients with diabetes and their impact on cardiovascular risk

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Received: **November 16, 2025**
Revised: **December 15, 2025**
Accepted: **December 26, 2025**
Published: **January 08, 2026**

Abstract
Background: Chronic diabetes mellitus (DM) alters carbohydrate, protein, and lipid metabolism. Diabetes-related metabolic abnormalities including dyslipidaemia contribute to cardiovascular disease (CVD), the major cause of death and morbidity among diabetics. Lipid metabolic changes higher TG, LDL-C, and HDL-C help atherogenesis. This study assessed cardiovascular risk in diabetic UAE residents using lipid metabolism. ***Methods:*** Prime Healthcare Group, UAE, conducted a June 2024–June 2025 retrospective observational study of 100 diabetic patients. Medical records provided demographics, fasting lipid profiles, HbA1c, and cardiovascular risk factors. Total cholesterol (TC), TG, LDL-C, and HDL-C were tested. SPSS analyses lipid abnormalities and cardiovascular risk. A p-value < 0.05 indicates significance. ***Results:*** The average age of participants was 54.8 ± 10.6 years, with 56% males. The mean HbA1c was 8.4 ± 1.2% and BMI was 28.6 ± 3.9 kg/m^2. Average lipid values: TC 208.7 ± 42.6 mg/dL, TG 189.4 ± 56.3 mg/dL, LDL-C 132.5 ± 35.2 mg/dL, and HDL-C 38.2 ± 7.5 mg/dL. Patients had hypertriglyceridemia (72%), increased LDL-C (68%), and low HDL-C (74%). LDL-C linked positively with cardiovascular disease ($r = 0.46$, $p < 0.01$), while HDL-C correlated adversely ($r = -0.41$, $p < 0.01$). ***Conclusion:*** The study found high rates of diabetic dyslipidaemia and strong links between lipid metabolism and cardiovascular risk. These findings impulse early cholesterol screening and aggressive therapy to prevent cardiovascular problems in diabetics. Comprehensive metabolic monitoring and personalized treatment are necessary to reduce diabetes-related cardiovascular morbidity and mortality.

Keywords: Cardiovascular risk, Diabetes mellitus, Dyslipidaemia, Lipid metabolism, Retrospective study

INTRODUCTION

Diabetes Mellitus and Lipid Dysregulation

Diabetes mellitus (DM) induces hyperglycaemia due to insulin shortage or malfunction [1]. One of the most common endocrine illnesses globally, its long-term vascular repercussions cause significant morbidity and mortality. Diabetic dyslipidaemia impairs lipid metabolism. This condition causes atherosclerosis and CVD, the major diabetes killer. In diabetes, LDL-C, HDL-C, and TG indicate dysregulated lipid metabolism [2,3]. Endothelial dysfunction, plaque development, stroke, and coronary artery disease depend on this lipid triad.

Mechanisms of Altered Lipid Metabolism

Several insulin resistance-related pathways cause diabetes lipid abnormalities [4]. In healthy adults, insulin increases adipose tissue lipogenesis and decreases lipolysis. Type 2 diabetes and other insulin-resistant illnesses release Free Fatty Acids (FFA) from adipose tissue into the circulation [5]. The liver absorbs free fatty acids and raises VLDL and triglycerides. Triglyceride clearance decreases with lower lipoprotein lipase (LPL) activity, exacerbating hypertriglyceridemia [6].

Microscopically dense, atherogenic LDL particles are common in diabetics [7]. Oxidized particles can form atherosclerotic plaques in artery walls. Diabetes increases HDL particle catabolism and triglyceride exchange, lowering HDL-C [8]. These lipid abnormalities affect lipid homeostasis and increase oxidative stress and inflammation, creating a pro-atherogenic environment.

Cardiovascular Implications

Diabetes affects lipids and cardiovascular health [9,10]. Diabetics are two to four times more likely to have CVD, according to epidemiology. Endothelial dysfunction, inflammation, and thrombogenesis of dyslipidaemia produce microvascular and macrovascular problems [11]. High triglycerides and low LDL-C make plaque more unstable, while low HDL-C hinders reverse cholesterol transfer, which destroys arteries [12]. Atherogenesis is worsened by

oxidized LDL and apolipoprotein glycation in diabetics. Diabetes patients' lipid metabolism must be understood to prevent cardiovascular problems early.

Rationale for the Present Study

Cardiovascular problems remain a big issue, especially in fast-developing countries like the UAE, despite improved diabetes control. Lifestyle, nutritional, and genetic changes worsen it. Population dyslipidaemia and cardiovascular risk can be revealed by diabetic lipid metabolism. Prime Healthcare Group examined diabetes patients' lipid levels for cardiovascular disease risk in June 2024–2025.

Objectives

• To Assess lipid metabolism changes in diabetes patients, concentrating on critical parameters such total cholesterol, triglycerides, HDL-C, and LDL-C levels.
• To Examine the link between lipid abnormalities and cardiovascular risk factors in UAE-based diabetic patients at Prime Healthcare Group.
• To Evaluate the impact of diabetic dyslipidaemia on cardiovascular disease and identify early prevention and therapy opportunities.

MATERIALS AND METHODS

Study Design

A Retrospective observational study examined how lipid metabolism influences cardiovascular risk in many diabetics. Prime Healthcare Group in the UAE conducted a year-long study from June 2024 to June 2025. Clinical, biochemical, and demographic data from diabetic patients' medical records were studied. The study examined diabetic dyslipidaemia patterns and cardiovascular risk.

Study Population and Setting

100 individuals with type 1 as well as type 2 diabetes who attended Prime Healthcare Group's outpatient and inpatient departments were studied. Electronic medical records from the hospital were used. The UAE is multiethnic, hence the population was heterogeneous. To examine metabolic-clinical relationships, age, gender, diabetes duration, BMI, blood pressure, and cardiovascular disease history were gathered.

Inclusion criteria

1. Patients aged 18 years and above diagnosed with diabetes mellitus (type 1 or type 2).
2. Patients with complete records of fasting lipid profile and glycaemic control parameters (HbA1c, fasting glucose).
3. Patients with a minimum of one year of diabetes duration to ensure metabolic stabilization.

Exclusion criteria

1. Patients with secondary causes of dyslipidaemia such as chronic liver disease, hypothyroidism, or nephrotic syndrome.
2. Patients on lipid-lowering therapy prior to data collection.
3. Pregnant or lactating women.
4. Patients with incomplete or missing laboratory data.

Data Collection and Biochemical Parameters

Data from patient records were retrospectively obtained using a standard form. Important biochemical parameters were evaluated using enzymatic colorimetric assays after a 12-hour fast. The parameters are TC, TG, LDL-C, HDL-C, HbA1c, FBG, BMI, and blood pressure. Cardiovascular risk was assessed using lipid profiles and hypertension or cardiovascular disease history.

Statistical Analysis

Data was compiled and analysed using SPSS. Biochemical and demographic data were condensed using averages, standard deviations, and percentages. Chi-square tests and Pearson's correlation were used to assess lipid parameters and cardiovascular risk indicators. To compare subgroup lipid levels, we employed independent t-tests or ANOVA. A p-value below 0.05 indicated statistical significance.

RESULTS

Demographic Profile of Patients

This retrospective analysis included 100 diabetics. The study population had a mean age of 54.8 ± 10.6 years, with 56% males and 44% females. Patients aged 50–60 comprised the majority. The average duration of diabetes was 8.3 ± 4.2 years. The majority of patients were overweight or obese, with an average BMI of 28.6 ± 3.9 kg/m². Cardiovascular disease (CVD), including coronary artery disease and ischemic heart disease, was present in 64% of patients, and 32% had concomitant hypertension.

The results showed that this group of diabetics was middle-aged or older, overweight, and had the condition for a long time with poor glycaemic control (HbA1c > 8%). The high prevalence of hypertension and cardiovascular illness in this population emphasizes the need of researching lipid abnormalities as a risk factor for cardiovascular disease.

Lipid Parameters in Diabetic Patients

The average lipid parameters were found: TC = 208.7 ± 42.6 mg/dL, TG = 189.4 ± 56.3, LDL-C = 132.5 ± 35.2, and HDL-C = 38.2 ± 7.5 mg/dL. Approximately 68% of patients had elevated LDL-C levels (>130 mg/dL), 72% had hypertriglyceridemia (>150 mg/dL), and 74% had low HDL-C levels (<40 mg/dL).

Table 1 Demographic of the Study Population

Parameter	Mean ± SD / n (%)
Age	54.8 ± 10.6
Gender (Men/Women)	56 / 44
Duration of Diabetes (years)	8.3 ± 4.2
BMI (kg/m²)	28.6 ± 3.9
Hypertension	64 (64%)
History of Cardiovascular Disease	32 (32%)
HbA1c (%)	8.4 ± 1.2
Fasting Blood Glucose (mg/dL)	162.5 ± 36.8

Table 2 Lipid Profile of Diabetic Patients

Lipid Parameter	Mean ± SD (mg/dL)	Normal Range	Patients with Abnormal Values (%)
Total Cholesterol (TC)	208.7 ± 42.6	<200	58 (58%)
Triglycerides (TG)	189.4 ± 56.3	<150	72 (72%)
LDL-C	132.5 ± 35.2	<100	68 (68%)
HDL-C	38.2 ± 7.5	>40	74 (74%)

Diabetic dyslipidaemia is indicated by high triglycerides, LDL-C, and HDL-C. The lipid triad's atherogenicity puts diabetics at risk for cardiovascular disease. This group's high lipid profile abnormality rate indicates poor glucose management and insulin resistance.

Correlation between Lipid Profile and Cardiovascular Risk

LDL-C and cardiovascular disease were strongly connected ($r = 0.46$, $p < 0.01$), while triglycerides as well as BMI were negatively correlated ($r = 0.39$, $p < 0.05$). A significant negative connection ($r = -0.41$, $p < 0.01$) exists between decreased HDL-C levels and increased risk of cardiovascular disease.

Table 3 Correlation between Lipid Parameters and Cardiovascular Risk Factors

Parameter	BMI (r)	Hypertension (r)	Cardiovascular Disease (r)	p-value (Significance)
Total Cholesterol	0.28	0.22	0.34	<0.05
Triglycerides	0.39	0.31	0.38	<0.05
LDL-C	0.35	0.29	0.46	<0.01
HDL-C	–0.32	–0.27	–0.41	<0.01

Dyslipidaemia, particularly high LDL-C and triglycerides and lower HDL-C, substantially corresponds with cardiovascular risk factors in diabetics. Higher BMI and hypertension caused worse lipid abnormalities. It appears that diabetes-related lipid metabolic disorders significantly enhance cardiovascular morbidity and mortality.

These findings underscore the significance of routine cholesterol monitoring and aggressive dyslipidaemia treatment in diabetics to prevent cardiovascular disease.

DISCUSSION

This retrospective study assessed 100 UAE Prime Healthcare Group diabetes patients' lipids and CVD risk. Diabetes raised triglycerides, LDL-C, and HDL-C. Hypertriglyceridemia affected 72% of patients, raising LDL-C 68%, lowering HDL-C 74%, and raising total cholesterol 50%. These findings support past studies in comparable groups that revealed poorly controlled diabetes was associated with mixed dyslipidaemia.

Poor metabolic control and obesity worsen lipid abnormalities, according to the study, which also identified a substantial positive correlation between LDL-C and cardiovascular disease and triglycerides and BMI. Supporting the prevention of atherosclerosis, HDL-C was negatively connected to cardiovascular disease. Since most participants had hyperglycaemia and hypertension, which increase cardiovascular risk, multifactorial therapy is essential for long-term success. The data reveal that diabetics' cardiovascular risk profile includes lipid abnormalities, not metabolic problems.

Table 4 Comparison of the Present Study with Previous Research on Lipid Metabolism in Diabetes

Study	Study Type	Sample Size	Key Findings	Limitations
Current study	Retrospective cross-sectional	100 diabetic	Identified classical diabetic dyslipidaemia pattern with high TG, LDL-C, and low HDL-	Single-centre, small sample size, retrospective

	study	patients	C; strong correlation between lipid abnormalities and cardiovascular risk; obesity and hypertension further increased risk.	design, limited control over confounders.
Study 1 [13]	Cross-sectional observational study	350 diabetic patients	Reported increased prevalence of small dense LDL particles and reduced HDL-C in type 2 diabetes; dyslipidaemia strongly associated with poor glycaemic control and insulin resistance.	Did not assess direct cardiovascular outcomes; confined to a single ethnic population.
Study 2 [14]	Population-based study	500 Emirati diabetic patients	Found high rates of mixed dyslipidaemia; 70% of participants had elevated LDL-C; strong link between triglycerides and metabolic syndrome components.	Limited analysis of treatment impact; cross-sectional nature limited causal interpretation.
Study 3 [15]	Multicentre prospective study	1,200 type 2 diabetic patients	Demonstrated that atherogenic dyslipidaemia (high TG, low HDL-C) predicts future cardiovascular events despite statin use; emphasized need for comprehensive lipid management in diabetes.	Focused mainly on European populations; may not reflect Middle Eastern ethnic variations.

Pathophysiological Mechanisms

This study's lipid abnormalities are caused by insulin resistance, altered hepatic lipid metabolism, and decreased lipoprotein clearance. In diabetes, especially type 2, insulin resistance reduces insulin's inhibitory effect on adipose tissue lipolysis. FFAs are released into the bloodstream by overproduction and absorbed by the liver. Higher levels of FFA in the liver raise triglycerides and VLDL.

Reduced lipoprotein lipase activity reduces the breakdown of circulating triglycerides, causing persistent hypertriglyceridemia. High VLDL levels make cholesterol more easily transferred from HDL to LDL, making LDL more vulnerable to oxidation and endothelial uptake and speeding atherogenesis. The reverse cholesterol transport and antioxidant defence systems are further weakened by decreased HDL-C. Diabetes increases the risk of cardiovascular disease due to metabolic abnormalities like arterial inflammation, endothelial dysfunction, and atherosclerotic plaques.

Chronic hyperglycaemia causes oxidative stress and lipoprotein glycation, which impairs lipid metabolism. Impaired hepatic receptor clearance of glycated LDL particles increases their circulation-resident residence duration and plaque formation. This study shows that metabolic dysregulation, which causes diabetes, causes lipid abnormalities.

Study Strengths and Limitations

The retrospective analysis of multiethnic UAE diabetes hospital data makes this study valuable. Laboratory and correlation analysis produced valid lipid metabolism and cardiovascular risk data. Diabetes management should include metabolic evaluation beyond glucose control, according to the study.

Some factors in the retrospective analysis may have missing data from medical records. The results may not apply to all diabetics due to the limited sample size (n = 100). Dyslipidaemia and cardiovascular outcomes cannot be causally related due to cross-sectional evidence. Food, exercise, and medicine may affect lipid levels. Future prospective trials with larger cohorts and longitudinal follow-up must confirm and evaluate treatment implications.

CONCLUSION

UAE-based Prime Healthcare Group studied 100 diabetes patients' lipid metabolism and cardiovascular risk from June 2024 to June 2025. Diabetes dyslipidaemia high triglycerides (72%), elevated LDL-C (68%), and decreased HDL-C (74%) was common. Weight, blood pressure, and cardiovascular disease history strongly correlated with these anomalies. These data suggest that lipid dysregulation is a key metabolic issue in diabetes and a CVD risk factor. Dyslipidaemia and poor glycaemic control (mean HbA1c 8.4%) damage arteries, connecting glucose and lipid metabolism. Untreated dyslipidaemia increases diabetics' cardiovascular disease and death risk. Lipid, blood pressure, and glucose monitoring are needed to manage diabetes. Treating lipid abnormalities early reduces myocardial infarction, stroke, and peripheral vascular disease. Controlling glycaemic and lipids with statins, fibrates, and lifestyle changes may improve long-term effects. Clinicians should prioritize cardiovascular risk-based cholesterol control above glucose. Healthy diet, weight loss, and exercise instruction lower metabolic risk factors.

Recommendations

To examine the causal links among lipid metabolism as well as cardiovascular outcomes, prospective longitudinal designs with bigger, multi-centre cohorts are needed. Genetic, nutritional, and lifestyle factors

that induce dyslipidaemia in Middle Eastern populations should be investigated to understand regional variations. Diabetes's cardiovascular effects can be reduced by integrating lipid management, lifestyle changes, and glycaemic control.

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