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Original article

Correlation Between Lipid Profile Parameters and eGFR in Patients with Type 2 Diabetes

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Abstract
Dyslipidemia and chronic kidney disease (CKD) are common comorbidities in patients with type 2 diabetes (T2D), and accumulating evidence suggests a bidirectional relationship between lipid abnormalities and renal dysfunction. This study aimed to evaluate the association between serum lipid parameters and estimated glomerular filtration rate (eGFR) in T2D. A cross-sectional study was conducted at the Benghazi Diabetic Center between June and December 2024, including 280 adults with T2D. Demographic data (age, sex, and diabetes duration) and clinical parameters, including lipid profile, renal function tests, and glycated hemoglobin (HbA1c), were collected from patient records during follow-up. eGFR was calculated using the CKD-EPI 2021 equation, and patients were categorized into six eGFR stages. Data were analyzed using SPSS version 27, and Spearman's correlation test was used to determine the association between eGFR and lipid profile parameters. The mean age of participants was 58.4 ± 11.5 years, with a mean diabetes duration of 11.7 years and a mean HbA1c of 7.8 ± 1.3%. Females comprised 55% of the cohort, while males represented 45 %. The study also found the following mean values: creatinine 1.0 ± 0.9, urea 36.6 ± 24.3, GFR 83.1 ± 26.9, cholesterol 174.7 ± 45.3, triglyceride 165.4 ± 86.6, HDL 46.3 ± 12.4, LDL 86.6 ± 30.9, and VLDL 33.1 ± 17.3. Spearman's correlation revealed statistically significant weak negative correlations between eGFR and triglycerides ($\rho = -0.206$, $P < 0.001$), HDL ($\rho = -0.198$, $P < 0.001$), and TC ($\rho = -0.158$, $P = 0.008$) while low-density lipoprotein (LDL) exhibited a weak positive correlation with eGFR ($\rho = 0.256$, $p < 0.001$). These findings suggest a potential relationship between lipid abnormalities and renal function in T2D, emphasizing the importance of early lipid profile monitoring.
Keywords. Type 2 Diabetes Mellitus, Estimated Glomerular Filtration Rate (eGFR), Renal Function, Lipid Profile Parameters, and Dyslipidemia.

Introduction

Among the types of diabetes, type 2 diabetes (T2D) is the most prevalent form, typically characterized by insulin resistance leading to progressive metabolic dysfunction [1]. The resulting sustained hyperglycemia induces major health consequences, manifested as microvascular and macrovascular complications, which are associated with long-term outcomes [2]. According to the International Diabetes Federation (IDF, 2025), 589 million adults (aged 20–79 years) are living with diabetes, representing approximately 11.1% of the adult population. Of these, an estimated 252 million are undiagnosed, placing them at higher risk of serious complications and early mortality [2]. In diabetic patients, dyslipidemia—characterized by abnormal lipid levels in the bloodstream—is a major risk factor for cardiovascular diseases, contributing to an increased incidence of atherosclerosis, stroke, and myocardial infarction [3].

Dyslipidemia-induced diabetic kidney disease (DKD) involves multiple pathogenic mechanisms. Lipid abnormalities lead to structural kidney alterations such as glomerulosclerosis and tubulointerstitial fibrosis, which impair renal function. Additionally, dyslipidemia promotes podocyte apoptosis and disrupts the integrity of the glomerular filtration barrier, resulting in proteinuria. It also contributes to renal tubular injury, which often precedes glomerular damage. Moreover, ectopic lipid deposition in the kidneys induces oxidative stress and inflammation, mediated by adipokine release and activation of various intracellular signaling pathways [4,5].

The routine assessment of renal function in diabetics is essential for evaluating kidney health, where the estimated glomerular filtration rate (eGFR) is regarded as the most practical indicator of kidney function. Expressed in milliliters per minute (mL/min), normal eGFR levels range from 90 to 125 mL/min. eGFR estimation is commonly derived from serum creatinine levels, with various equations, including the Modification of Diet in Renal Disease (MDRD) and the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) [6]. Multiple studies have linked renal function and dyslipidemia among diabetic patients. In Japan, a cross-sectional study evaluated the association between dyslipidemia and DKD, revealing that patients with DKD exhibited significant changes in their lipid profiles. It was also found that the severity of

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proteinuria and the degree of renal dysfunction were closely associated with the extent of dyslipidemia [7]. Another cross-sectional study conducted in China investigated which lipid index was most closely associated with DKD in patients with T2D. The results indicated that the LDL-C/Apo B ratio had the strongest association with the prevalence of DKD, even among patients with a normal lipid profile [8]. To further investigate the relationship between dyslipidemia and DKD, this cross-sectional study was conducted to examine the association between various lipid profile parameters and eGFR in patients with T2D.

Methods

This study follows a cross-sectional design and was conducted at the Benghazi Diabetic Center between June and December 2024. It included 280 patients with T2D (≥18 years old). Demographic data, including age, sex, duration of diabetes, and recent results of glycated hemoglobin (HbA1c), renal profile parameters (serum urea and creatinine), and lipid profile parameters [total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL)] were obtained from patients' files during follow-up. Data were collected using a data collection form, and verbal consent was obtained from all participants. The exclusion criteria included patients with types of diabetes other than T2D, lack of recent laboratory investigations, or refusal to participate. Using the CKD-EPI 2021 equation (which does not include race as a variable), eGFR was calculated, and patients were classified into six categories based on their eGFR values: G1 (≥90 mL/min/1.73 m²), G2 (60–89), G3a (45–59), G3b (30–44), G4 (15–29), and G5 (<15). The collected data were analyzed using SPSS version 27, and Spearman's correlation test was used to determine the association between eGFR and lipid profile parameters.

Results

General characteristics

The analysis of renal function and lipid profile parameters, as shown in (Table 1), revealed notable variability. The mean serum creatinine was 1.0 ± 0.9 mg/dL, and the mean urea was 36.6 ± 24.3 mg/dL. The mean eGFR was 83.1 ± 26.9 mL/min/1.73 m², falling within the normal-to-mildly reduced range, which could suggest early-stage kidney impairment if corroborated by other indicators of renal damage. Regarding lipid parameters, TC averaged 174.7 ± 45.3 mg/dL (within the desirable range), whereas TG averaged 165.4 ± 86.6 mg/dL, consistent with borderline hypertriglyceridemia. HDL averaged 46.3 ± 12.4 mg/dL, which is relatively low compared with optimal values. Mean LDL and VLDL levels were 86.6 ± 30.9 mg/dL and 33.1 ± 17.3 mg/dL, respectively.

Table 1. Illustrates the general characteristics

Factors		Mean±Std.
Diabetes	Age	58.4±11.5
	Diabetic duration	11.7±8.1
	HbA1C	7.8±1.3
RFT	Creatinine	1.0±0.9
	Urea	36.6±24.3
	eGFR	83.1±26.9
Lipid	TC	174.7±45.3
	TG	165.4±86.6
	HDL	46.3±12.4
	LDL	86.6±30.9
	VLDL	33.1±17.3

General Distribution of the Sample

(Figure 1) illustrates the gender distribution of the sample, with females comprising 55% of participants and males 45%.

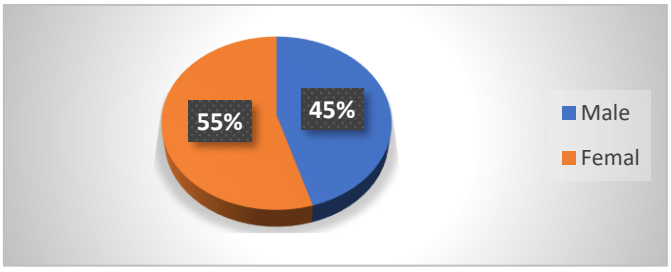

Figure 1. The pie chart demonstrates the gender distribution

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Classification of eGFR Categories with Corresponding Frequencies, Percentages, and Clinical Interpretations

(Table 2) illustrates the different categories of the included population according to their eGFR level, reflecting the current state of kidney function. The first category comprises the largest proportion, with 48.57% of patients classified as having normal or high eGFR (≥90), indicating that around half of the included patients have normal renal function. On the other hand, 30% of the patients had mildly decreased kidney function, while only 12.5% exhibited mild to moderate decreases in renal function, with eGFR levels ranging between 60-89 and 45-59, respectively. Notably, both the G3b and G4 categories had almost identical percentages, with around 3% of the total population showing moderate to severe or severe kidney dysfunction. Surprisingly, out of the 280 patients, only 3 had kidney failure, with eGFR levels less than 15.

Table 2. The distribution of EGFR categories by Frequency, Percentage, and Clinical Description

Categories	EGFR (mL/min/1.73m²)	Frequency	Percentage %	Description
G1	>=90	136	48.571	Normal or high
G2	60-89	86	30.714	Mildly decreased
G3a	45-59	35	12.5	Mild to moderate decrease
G3b	30-44	11	3.929	Moderate to severe decrease
G4	15-29	9	3.214	Severe decrease
G5	<15	3	1.071	Kidney failure

Comparative Analysis of eGFR vs. Lipid Profile parameters

a. EGFR vs. Triglycerides

The scatterplot shown in (Figure 2) illustrates the relationship between eGFR and TG. It demonstrates a weak negative correlation (ρ = -0.206), which is statistically significant (P < 0.001).

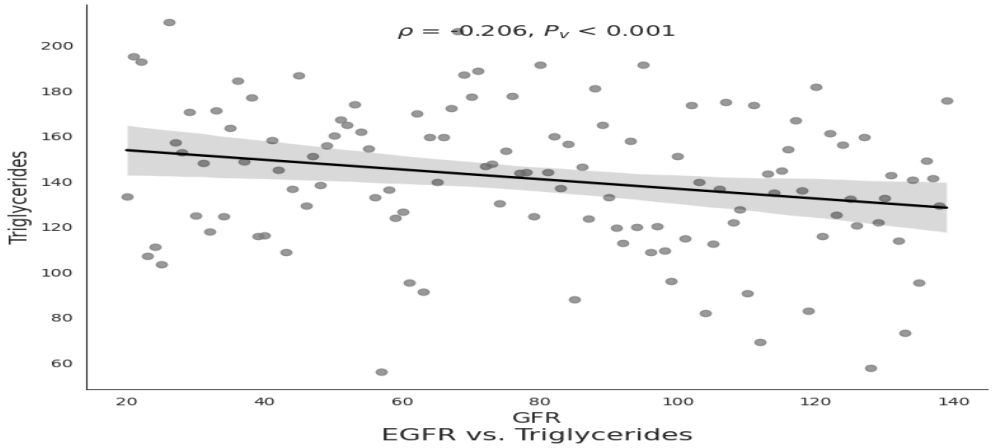

Figure 2. Demonstrate the Correlation between eGFR and TG

b. eGFR vs. TC

Alternatively, the scatterplot in (Figure 3) illustrates the relationship between eGFR and TC. A weak negative correlation was observed (ρ = –0.158), which was statistically significant (*P* = 0.008), indicating a small but measurable association between the two variables.

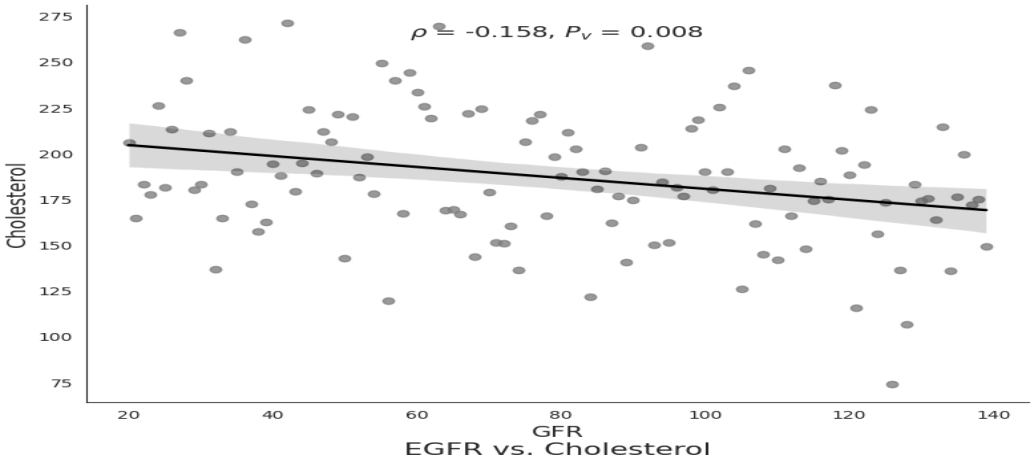

Figure 3. Demonstrate the Correlation between eGFR and TC

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c. eGFR vs. HDL

By examining the plot in (Figure 4), a weak negative correlation (ρ = -0.198) is observed between eGFR and HDL, which is statistically significant.

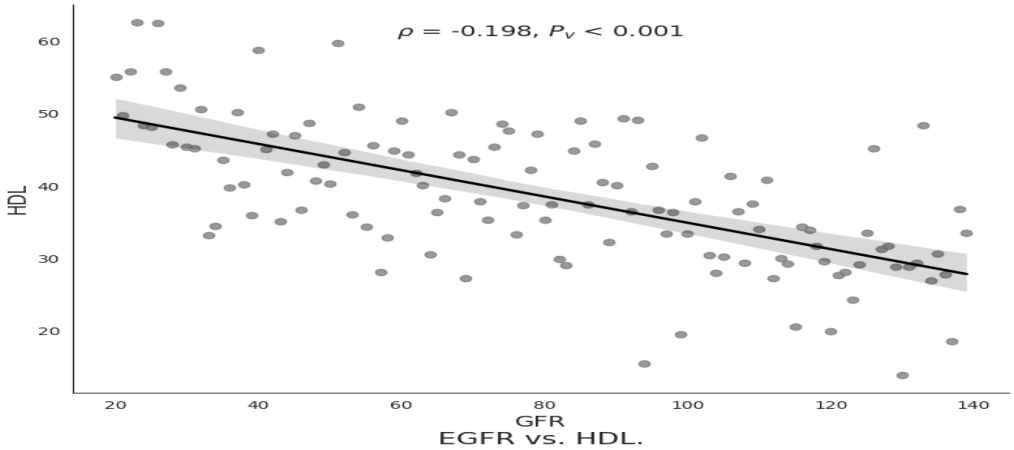

Figure 4. Demonstrate the Correlation between eGFR and HDL

d. eGFR vs. LDL

The scatterplot shown in (Figure 5), which depicts the relationship between eGFR and LDL, was the only plot to exhibit a weak positive correlation (ρ = 0.256), which was also statistically significant (P < 0.001).

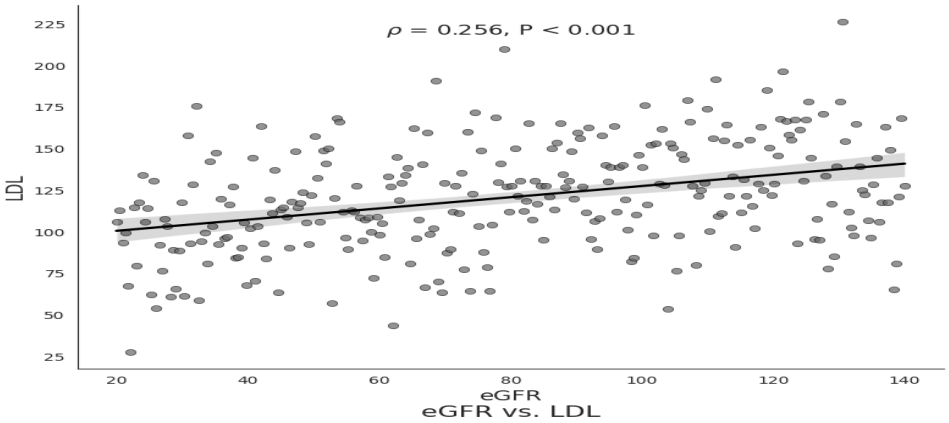

Figure 5. Demonstrate the Correlation between eGFR and LDL

Discussion

This study investigates the correlation between lipid profile parameters and eGFR among patients with T2D. It was hypothesized that the detection and management of lipid parameters at an early stage could contribute to reducing the risk of chronic kidney dysfunction in diabetic patients. The study findings demonstrated a direct correlation between abnormal changes in lipid parameters and decreasing eGFR, which points to partial or complete kidney impairment. According to our results, diabetic patients with poor glycemic control had elevated HbA1c levels, averaging 7.8 ± 1.3%, which is above the recommended target and may increase the risk of developing diabetic complications.

Previous studies revealed that dyslipidemia potentially contributes to increased renal dysfunction rates. It is noteworthy that in a prospective study involving 8,678 diabetic patients monitored for up to three years, elevated values of lipid profile parameters such as TG and TC were strongly related to decreased eGFR levels and chronic kidney impairments [9]. The comparative analysis of lipid profile parameters and RFT revealed statistically significant weak negative correlations between eGFR and TG (ρ = –0.206, $P < 0.001$), HDL (ρ = –0.198, $P < 0.001$), and TC (ρ = –0.158, $P = 0.008$). Notably, LDL demonstrated a weak but statistically significant positive correlation with eGFR (ρ = 0.256, $p < 0.001$). These findings point to a possible association between CKD and abnormal lipid levels. Notably, recent studies have reported a strong correlation between the increasing prevalence of kidney impairment and dyslipidemia among diabetic patients, which supports both our hypothesis and the findings of the present study [10,11]. For instance, a study conducted in an Iranian population demonstrated a significant inverse relationship between TG levels and eGFR, suggesting that elevated TG may predict the development of urinary complications in individuals with T2D [12]. Additionally, another study involving 2,732 diabetic patients—of whom 2,420 had T2D—

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found that patients with CKD were at higher risk of elevated lipid parameters. The average TC and TG levels in this group were 195.5 ± 51.7 mg/dL and 187.6 ± 99.8 mg/dL, respectively [13].
A cross-sectional study conducted in Japan, involving 1,073 diabetic patients who had been treated continuously for over a year, found that abnormalities in proteinuria and kidney function were independently associated with hyperlipidemia. The study revealed that diabetic renal dysfunction is strongly linked to elevated TG levels. Patients were classified into subgroups based on proteinuria status: proteinuric and non-proteinuric, with or without DKD. Notably, the proteinuric group exhibited higher levels of lipid parameters compared to the non-proteinuric group, with TG-rich lipoprotein cholesterol levels averaging 33 [23–36] mg/dL, indicating an increased risk of cardiovascular disease. However, for all kidney disease groups, lipoprotein(a) levels were elevated independently of proteinuria status [7]. Similarly, an observational study conducted in China with a total of 936 diabetic patients used lipid ratios, rather than traditional lipid parameters, to enhance the investigation. The study found that the LDL-Cholesterol (LDL-C) to apolipoprotein B (Apo B) ratio (LDL-C/Apo B) was strongly associated with eGFR. It revealed that the LDL-C/Apo B ratio was lower in kidney-diseased groups compared to non-diseased groups, suggesting that this ratio could serve as a predictor for the risk of renal disease in patients with T2D [8]. In conclusion, our findings support a potential relationship between abnormal lipid levels and declining renal function in T2D. However, the study's cross-sectional design prevents a causal determination, and the single-center data limit the generalizability of our results. Future research should use a longitudinal design to better understand the temporal relationship between these factors and include a wider range of patient demographics.

Conclusion

The correlation between lipid abnormalities and declining eGFR in patients with T2D aligns with existing evidence of a link between dyslipidemia and renal dysfunction. This relationship underscores the importance of routine monitoring and early detection of lipid and kidney function parameters to reduce the risk of cardiovascular and renal complications in diabetic patients. While the precise causal mechanisms remain to be clarified, further research is needed to better understand this association.

Conflicts of Interest

The authors declare that they have no conflicts of interest related to this study.

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