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# The Correlation Between Lipid Profile and Renal Function Tests in Patients with Cardiovascular Disease in Erbil city, Kurdistan Region of Iraq

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**ABSTRACT**

***Cardiovascular disease patients frequently suffer from the incidence of renal dysfunctions, the prevalence of the correlation, however, remains ambiguous. This study aims to see how CVD and renal function are related to the subjected group of patients suffer from symptoms of CVD. The method recruited for this objective was using of serum lipid profile test as a marker for evaluating the CVD and making correlations to the blood urea, serum uric acid, and serum creatinine levels as markers for assessing renal function on 159 individuals with CVD symptoms in Erbil city. Two statistical analysis methods (The linear regression and Pearson's correlation) were employed for determining the existence from a lack of relationship between them. The results showed a statistically significant correlation $p<0.05$ by both methods between the renal function markers and TC. The UA was correlated to TG, LDL-C, and VLDL-C $p<0.05$ by regression analysis. The SCr was correlated to TG and LDL-C $p<0.05$ by both methods, and to VLDL by regression analysis. According to the outcome of the current study both lipid profile and renal function markers are correlated in mostly a statistically significant manner. Yet, the results are not conclusive, further studies are needed in this area for indemnify the irrefutable evidence concerning this relation.***

## 1. INTRODUCTION

Elevated lipid profile levels are well known as a major risk factor in the development of cardiovascular diseases (CVD). The risk of CVD increases in patients with comorbidities such as diabetes mellitus, hypertension, and obesity [1], [2]. Chronic kidney disease (CKD) and CVD are both causes in development of inflammations that induce changes in lipid balance [3]. The CVD which comprises a group of heart and blood vessel disorders such as coronary heart disease, hypertension, cerebrovascular disease, heart failure, peripheral vascular disease, congenital heart disease, rheumatic heart disease, and cardiomyopathies [4]. Hypertension, one of the highest risk factors for both CVD and CKD can increase the progression of CVD in CKD patients more than people with normal kidney function [5]. Lipid profile abnormalities play a part in the development of diabetic nephropathy other than CVD [6]. The lipoproteins in plasma are categorized into major groups by their size that is (HDL, IDL, LDL, VLDL, chylomicrons, chylomicron remnants, and lipoprotein-a) [7]. Any distortions from reference ranges of lipid profile components are called dyslipidemia. Dyslipidemia may occur because of many different reasons such as hereditary, obesity, age, and lifestyle [8]. Periodic and early lipid profile measurements are critical in avoiding the risks of CVD [9], [10]. The test named serum lipid profile includes serum total cholesterol (TC), serum triglycerides (TG), serum high-density lipoprotein cholesterol (HDL-C), serum low-density lipoprotein (LDL-C), and very low density lipoprotein (VLDL) [9], [10]. As a result of dyslipidemia, atherosclerosis which is a major risk factor for CVD is developing [11], [12]. Severe atherosclerosis along with CVD is considered as a major factor leading to death in patients who suffer from chronic kidney diseases [13]. Also, chronic renal failure is a major risk factor for CVD [14]. The risk of developing CVD is two to four times higher in patients who their kidney function is compromised and has high levels of albumin in their urine [15]. The assessment and monitoring of the proper kidney function are critical for CVD and renal disease patients. For routine kidney function analysis, markers including creatinine, urea, and uric acids are used [16]. The creatinine (Cr) is produced as the muscle creatine phosphate breaks down and produces energy at an estimated constant rate that depends on mostly the muscle mass of the body [17]. Urea, on the other hand, is the end product of amino acids and proteins catabolism which is the highest in concentration among non-proteinous nitrogen compounds in the body and is produced in the liver [18]. While the uric acid is formed as in the purine metabolism as an end product [19]. The levels of these markers elevate in renal failure patients. The higher mortality rates in severe renal failures are highly associated with dyslipidemia among many other factors. According to newer guidelines for CVD monitoring, performing renal function test is the major determinant in the assessment process [20]–[22]. Moreover, increased serum creatinine (SCr) level or lower than normal creatinine clearance is a robust indicator for higher mortality rates because of CVD [23]. Chronic renal failure and chronic kidney diseases (CKD) affect 10-16% of Europe, Asia, and the USA's general population, so, it's a major worldwide health problem. [14], [24], [25], [26]. The CKD is named after continuous decline of the estimated glomerular filtration rate (eGFR) of less than 60 mL per minute per 1.73 square meters or might also be defined if one marker of kidney damage lasts for at least three months. These markers include sediments in urine, structural or histological abnormalities or albuminuria. The CVD and CKD can occur simultaneously or they can lead to one another. Sometimes distinguishing the primary from the secondary disease might be a challenge [27]. In previous studies throughout the literature, the relationship between TC and LDL-C with low glomerular filtration rate (GFR) of kidney maintained unchanged, while for the TG an increase and for HDL-C a decrease was observed [28], [29], [30]. As the correlation between CVD and CKD comes under investigation, more researches are required worldwide for a better and comprehensive understanding of the way these two diseases interact and also for establishing a better strategy of diagnosis, early detection, prevention, treatment, and management of the diseases as well. For this purpose, an international multidisciplinary conference titled as "Heart Failure in CKD" is convened in April 2019. In one section of the conference, they prioritized the need of researches in certain fields for timely understanding of HF and CVD in

CKD [27]. Although, the best predictor for measuring and assessing of the kidney function is the measured glomerular filtration rate (mGFR) [31], yet, in the current study, the correlation between the lipid profile variables with blood urea, UA, and SCr as measurement tools for kidney function in patients who visited internist clinic in Erbil city of Kurdistan region of Iraq is investigated in an attempt for participating in the worldwide prompt for understanding the relation between CVD and CKD.

## 2. METHODS AND MATERIALS

### *2.1 Study design*

Cross-sectional research that contained adult cardiovascular disease patients who visited internist clinics in Erbil city from (January–June 2020), some of the encounters of the study were pre-diagnosed CVD patients with renal complications, while others had symptoms which were not diagnosed with CVD or kidney problems yet. In the study a total number of 159 individuals including 92 (57.9%) males and 67 (42.1%) females were tested for their lipid profile (TC, TG, HDL-C, LDL-C, and VLDL-C), and renal function tests (blood urea, UA, and SCr). Informed consent was achieved from each individual who tested and their data used anonymously in this study.

### *2.2 Inclusion and exclusion criteria*

Out of 200 patients, 159 adults aged (18-85) had CVD symptoms. The mean age was (47±14.072). The average ages for males and females were 47 and 48 respectively. CVD is defined according to WHO's definition [4]. The outlier test results were eliminated from the results for the sake of higher accuracy in the statistical analysis.

### *2.3 Sampling and biochemical assessments*

Blood samples (5 mL) were taken by using a sterile syringe from fasting patients (10-12 hours) and transferred into gel separated tubes where it left to clot, then centrifuged at 3800 RPM for ten minutes. The obtained clear serum was pipetted into Eppendorf tubes and tested for lipid profile (TC, TG, HDL-C, LDL-C, and VLDL), and renal function tests (blood urea, UA, and SCr) using biochemical analyzer (ROCHE COBAS-E311). The normal reference ranges were calculated for TC below 200 mg/dL, [32], TG below 150 mg/dL [33], HDL-C higher than 40 mg/dL [34], LDL-C below 120 mg/dL [35], VLDL-C levels 40 mg/dL [32], urea between 15-48 mg/dL [36], UA from 3.4 – 7.0 mg/dL in males and 2.4 -6.0 mg /dL in females, while SCr normal range is from 0.6 to 1.2 mg/dL [37].

### *2.4 Statistical analysis*

The data were analyzed using statistical analyzing application SPSS (IBM SPSS statistics 26). The linear regression analysis recruited to examine the association between all variables. The Pearson correlation coefficients used to indicate the variables correlation rates. SPSS descriptive and frequency analysis used for viewing and summarizing the data. The results are presented using APA style. The statistically significant *p-value* calculated at smaller than *0.05*.

## 3. RESULTS

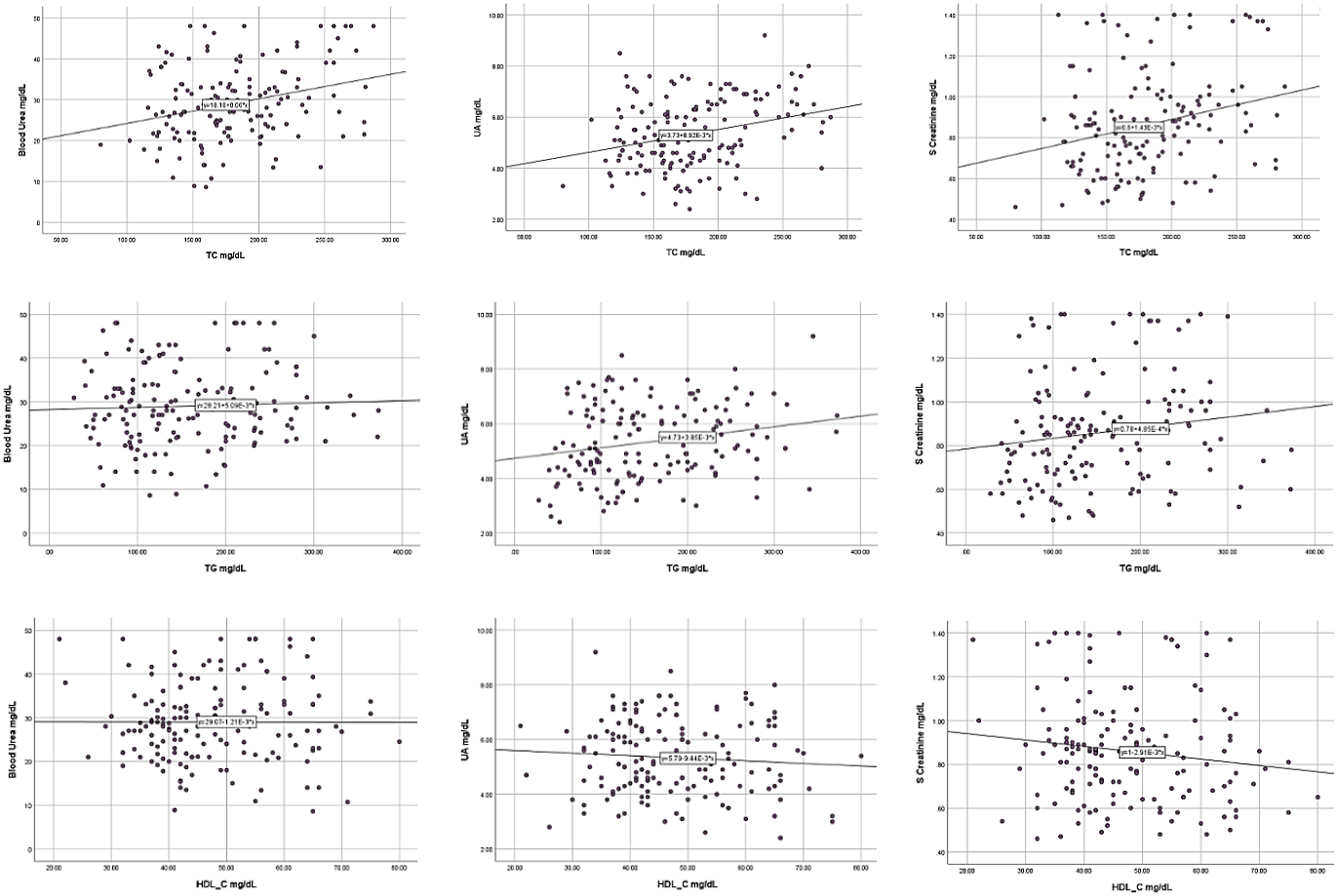
### *3.1 Linear regression analysis*

The linear regression analysis for determining the relationship between the lipid profile components and renal function test component are shown in (Table 1), and (Figure 1) demonstrates the regression line between different variables. According to the data, there is a positive linear regression between blood urea vs lipid profile variables. The regression is statistically significant for TC $p<.000$ (R= .284) and LDL-C $p<.001$ (R= .258). While the relationship between blood urea vs TG, HDL-C, and VLDL $p>0.05$, ns. was not statistically significant. Also, there is a positive linear regression between UA vs lipid profile variables. The regression is statistically significant for TC $p<.000$ (R= .281), TG $p<0.05$ (R= .220), LDL-C $p<.001$ (R= .268). While the relationship between UA vs HDL-C, and VLDL $p>0.05$, ns. was not statistically significant. Also, there is a positive linear regression between SCr vs lipid profile variables. The regression is statistically significant for TC $p<.001$ (R= .254), TG

*p*<0.05 (R= .156), LDL-C *p*<.002 (R= .248). While the relationship between SCr vs HDL-C, and VLDL *p*>0.05, ns. was not significant.

**Table 1:** The linear regression analysis between lipid profile variables (TC, TG, HDL-C, LDL-C, and VLDL-C) and renal function markers (Blood urea, UA, and SCr).

| No. | Regression | R | R Square | Sig. |
|---|---|---|---|---|
| **1** | **B. Urea vs. TC** | .284 | .081 | .000 |
| **2** | **B. Urea vs. TG** | .043 | .002 | .586 |
| **3** | **B. Urea vs. HDL-C** | .002 | .000 | .985 |
| **4** | **B. Urea vs. LDL-C** | .258 | .066 | .001 |
| **5** | **B. Urea vs. VLDL-C** | .085 | .007 | .285 |
| **6** | **UA vs.TC** | .281 | .079 | .000 |
| **7** | **UA vs. TG** | .220 | .048 | .005 |
| **8** | **UA vs. HDL-C** | .080 | .006 | .318 |
| **9** | **UA vs. LDL-C** | .268 | .072 | .001 |
| **10** | **UA vs. VLDL-C** | .193 | .037 | .015 |
| **11** | **SCr vs. TC** | .254 | .065 | .001 |
| **12** | **SCr vs. TG** | .156 | .024 | .049 |
| **13** | **SCr vs. HDL-C** | .139 | .019 | .081 |
| **14** | **SCr vs. LDL-C** | .248 | .061 | .002 |
| **15** | **SCr vs. VLDL-C** | .155 | .024 | .051 |



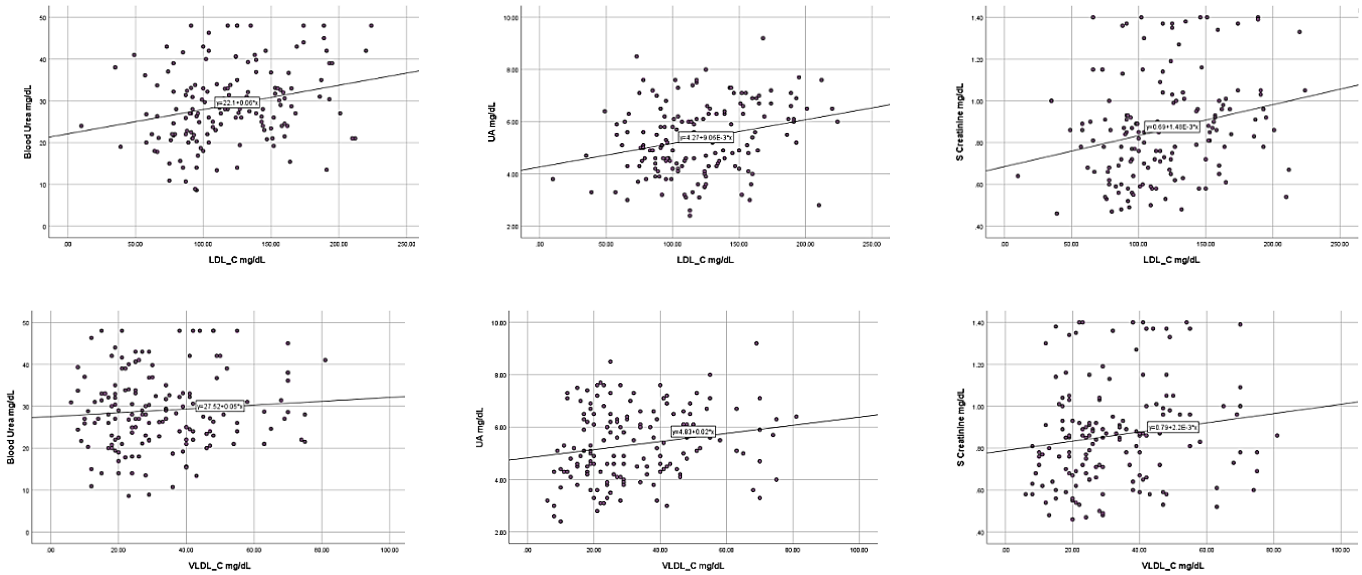



**Figure 1:** The linear regression analysis between lipid profile variables (TC, TG, HDL-C, LDL-C, and VLDL-C) with renal function markers (Blood Urea, UA, and SCr).

### *3.2 Pearson's correlation*

Pearson's correlation value demonstrates the way two variables are associated together, Pearson's correlation table (Table 2) shows how all the variables are correlated to each other with the exact correlation value. For blood urea, there is a statistically significant $p<.000$ correlation for each of UA, SCr, and TC with Pearson correlation value of .669**, .765**, and .339** respectively. While the blood urea's correlation for TG, HDL-C, LDL-C, and VLDL-C is not statistically significant $p>0.05$ ns. For UA, there is a statistically significant p<.000 correlation for each of SCr and TC with Pearson correlation value of .557** and .280** respectively. While, the UA's correlation for TG, HDL-C, LDL-C, and VLDL-C is not statistically significant $p>0.05$ ns. For SCr, there is a statistically significant $p<.000$ correlation for TC with Pearson correlation value of .342**, for TG, LDL-C, and VLDL-C $p< .05$ with Pearson's correlation value of .184*, .177*, and .191* respectively. While the SCr's correlation for HDL-C is not statistically significant $p>0.05$ ns. For TC, there is a statistically significant $p<.001$ correlation for TG, HDL-C, LDL-C, and VLDL-C with Pearson correlation values of .327**, .255*, .889**, and .284** respectively. For TG, there is a statistically significant $p<.001$ correlation for LDL-C, and VLDL-C with the Pearson correlation values of .197* and .949** respectively. For HDL-C, there is a significant $p<.000$ with VLDL-C the correlation value is -.408** and non-significant $p>0.05$ to LDL-C. For LDL-C, there is a non-statistically significant $p> .05$ ns. correlation for VLDL-C with Pearson correlation value of .139.

**Table 2:** Pearson's correlation analysis between all lipid profile variables and renal function markers.

| | | UA mg/dL | SCr mg/dL | TC mg/dL | TG mg/dL | HDL-C mg/dL | LDL-C mg/dL | VLDL-C mg/dL |
|---|---|---|---|---|---|---|---|---|
| **Blood Urea mg/dL** | **Pearson Correlation** | .669** | .765** | .339** | .116 | .036 | .145 | .145 |
| | **Sig. (2-tailed)** | .000 | .000 | .000 | .146 | .651 | .068 | .068 |
| **UA mg/dL** | **Pearson Correlation** | | .557** | .280** | .110 | .093 | .089 | .122 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Sig. (2-tailed)** | .000 | .000 | .169 | .241 | .262 | .125 |
| **S Creatinine mg/dL** | **Pearson Correlation** | | .342** | .184* | -.006 | .177* | .191* |
| | **Sig. (2-tailed)** | | .000 | .020 | .942 | .025 | .016 |
| **TC mg/dL** | **Pearson Correlation** | | | .327** | .255** | .889** | .284** |
| | **Sig. (2-tailed)** | | | .000 | .001 | .000 | .000 |
| **TG mg/dL** | **Pearson Correlation** | | | | -.400** | .197* | .949** |
| | **Sig. (2-tailed)** | | | | .000 | .013 | .000 |
| **HDL-C mg/dL** | **Pearson Correlation** | | | | | .044 | -.408** |
| | **Sig. (2-tailed)** | | | | | .584 | .000 |
| **LDL-C mg/dL** | **Pearson Correlation** | | | | | | .139 |
| | **Sig. (2-tailed)** | | | | | | .080 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

## 4. DISCUSSION

There is a strong relationship between renal function and heart in CVD patients, the connection is shown in many previous studies [38]. According to a study in the UK, the CVD patients had a 63% prevalence of kidney dysfunctions [39]. The higher mortality rate because of reduced renal sufficiency in Swedish heart failure patients is seen. The increase in mortality rate is regardless of the age or other comorbidities [40]. In this cross-sectional study, 159 CVD patients were included, of which the renal function of many of them is compromised. The relationship between CVD and renal function is investigated in the current study through comparing the lipid profile markers (TC, TG, HDL-C, LDL-C, and VLDL-C) to renal function markers (blood urea, UA, and SCr tests) which are widely used for interpretation of renal function in the clinical practice. The linear regression analysis demonstrated positive regression between all of the lipid profile variables and renal function markers. The relationship was significant $p<0.05$ between blood urea, TC, and LDL-C. However, $p>0.5$ ns. non-statistically significant results were observed between blood urea, TG, HDL-C, and VLDL-C. The linear regression between UA and TC, TG, and LDL-C is a positive linear regression that has a statically significant value. Yet, HDL-C and VLDL-C have greater than significant level p-value. While SCr vs. lipid profile variables have linear positive regression with statistically significant p-value for each of TC, TG, and LDL-C. However, the HDL-C and VLDL-C are non-statistically significant to SCr. The results of the present study are in agreement with the majority of literature, yet, in many studies, the direct and independent relationship between higher levels of lipids with the progression of kidney diseases was missing [41]. The relation between HDL-C with kidney dysfunction is presented in many studies, yet, the topic remains controversial whether it can be used as an indicator for predicting renal dysfunctions [42]. In a previous study, lipid dyslipidemia in kidney disease patients is linked to high TG levels, normal or slightly low LDL-C, and decreased HDL-C levels [43]. The exact mechanism for the dependability of lipid profile and renal function is ambiguous, moreover, many studies propose that HDL-C roles as anti-inflammatory, antioxidant, and anti-thrombotic factor that reduces the risk of atherosclerosis development in the arteries of kidneys, which maintains normal kidney function [44]. However, pathogenesis of kidney diseases in association with dyslipidemia has been known since 1860 when first suggested by Virchow as he was examining renal tissue biopsy from Bright's disease patients

[45]. The mechanism by which lipoproteins participate in kidney pathogenesis is through making changes in glomerulosclerosis and tubulointerstitial [46]. In order of pertaining a profound understanding of the correlation between all of the variables in the current study, Pearson's correlation statistical analysis was performed. The results of this test determine the exact mechanism of connection between two variables whether being related to each other or not. Other than the correlation of lipid profile and renal function markers, Pearson's correlation between each group of markers is also performed to indicate how they are correlated between themselves. The blood urea is strongly correlated to UA, SCr, and TC, meaning that the value of blood urea increases directly as UA, SCr, and TC elevates. Since UA and SCr are both markers for renal function, its common sense to be related in such a strong correlation. However, the way TC is related to blood urea is noteworthy. The TG, HDL-C, LDL-C, and VLDL-C however, showed a non-statistically significant yet positive correlation value. Seemingly, SCr is significantly correlated only with UA and TC other than TG, HDL-C, LDL-C, and VLDL-C. The SCr on the other hand is to TC, and also has a statistically significant correlation to TG, LDL-C, and VLDL-C. While the HDL-C and SCr have a strong negative correlation. Throughout the literature, similar results are observed for these similar correlations [45]. Advanced stages of renal failure that is linked to proteinuria is mostly associated with lipoprotein transport abnormalities [47]. The lipid profile variables in this study used as markers of CVD showed a strong correlation between themselves, TC is strongly correlated with TG, HDL-C, LDL-C, and VLDL-C. Seemingly, TG is on a strong correlation with HDL-C and LDL-C. The VLDL-C and TG are almost in a linear dependent statistically significant correlation between each other. The HDL-C is significantly correlated to VLDL-C, however, its relation to LDL-C is non-significant. The key strength point of this study is that the correlation between renal function markers namely blood urea, UA, and SCr with lipid profile markers including TC, TG, HDL-C, LDL-C, and VLDL-C is determined in a specific population who are CVD patients visiting internist clinic seeking treatment for their symptoms in Erbil city of Kurdistan region of Iraq. Although the outcome of the current study observes a strong correlation between the variables, however, there are some limitations in the decisiveness of the results of the study, one important limitation is the study design which is a cross-sectional study that can't be compared to randomized controlled trials. Another limitation is using the TC, TG, HDL-C, LDL-C, VLDL-C, blood urea, UA, and SCr as the only markers for pertaining CVD and renal dysfunctions respectively and not considering other methods for the assessment of the diseases, though, these variables are widely employed for evaluating the CVD and renal dysfunctions in clinical practice in Kurdistan region of Iraq.

## 5. CONCLUSION

Dyslipidemia and renal dysfunctions are correlated to each other in which the serum lipid profile assessment markers are highly correlated with renal function assessment markers in CVD patients who visited internist clinic in Erbil city of Kurdistan region of Iraq. The strongest statistically significant correlation is between TC vs blood urea, UA, and SCr. While TG is only correlated to SCr. The LDL-C and VLDL-C, however, are only correlated to SCr as well. The lipid profile markers show robust correlation between themselves except for HDL-C vs LDL-C and LDL-C vs VLDL-C. The renal function assessment markers have strong correlation with each other as well. The outcome proposes that patients with higher lipid profile values are at higher risk of developing renal dysfunctions.

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