Correlation Between Low-Density Lipoprotein and EGFR in Type 2 Diabetes Mellitus Patients

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ABSTRACT

Introduction: Type 2 Diabetes Mellitus (T2DM) is a chronic disease with quite serious complications. One complication that often occurs is damage to the kidney structure. T2DM patients have elevated levels of Low-Density Lipoprotein (LDL), which can contribute to kidney damage. This study aims to determine the correlation between LDL and e-GFR in patients with T2DM.
Methods: This study employed an analytical observational design with a cross-sectional approach, using secondary data from medical records. Subjects included in the study were T2DM patients at UNS Hospital in 2022-2023.
Results: Based on the analysis using the Spearman correlation test, the p-value was 0.646 ($p>0.05$) and $r=0.049$. This shows that there is no correlation between low-density lipoprotein and e-GFR.

Conclusions: There is no statistically significant correlation between low-density lipoprotein and e-GFR in T2DM patients.

Keywords: low density lipoprotein 1; glomerular filtration rate 2; diabetes mellitus type 2

INTRODUCTION

There has been a sharp increase in the number of Diabetes Melitus (DM) sufferers globally [1]. The increase in the number of DM sufferers is proportional to the increase in its complications [2]. One of the complications of DM is diabetic kidney disease (DKD) which is described by a decrease in the estimated-Glomerular Filtration Rate (e-GFR) value. However, the prevalence of DKD that occurs purely due to uncontrolled blood sugar is difficult to know because there are many factors that can cause kidney damage in T2DM patients. One of the things that can cause kidney damage in DM patients is Low Density Lipoprotein (LDL) [3].

Low Density Lipoprotein is a group of lipoproteins with a smaller size and a higher affinity for its receptors, making it more at risk of causing atherosclerosis [4]. An optimal LDL value is a group with a value under 100mg/dL [5].

Estimated-Glomerular Filtration Rate is the volume of fluid filtered from the glomerulus to the Bowman's capsule in one minute. The e-GFR value is maintained in a normal condition. Measurement of creatinine levels using the blood, age and gender data. A low e-GFR value indicates a decrease in a person's kidney function [6]. The e-GFR value can be influenced by several things such as physiology due to aging, the use of NSAIDs and ACE-inhibitors, etc [7]. The chronic hyperglycemia condition that occurs in T2DM patients causes an increase in Reactive Oxygen Species (ROS) which ultimately causes an increase in intrarenal pressure, increased vascular permeability, proteinuria, and a decrease in e-GFR [8]. Over time, high LDL conditions in patients cause LDL to oxidize and foam cells form. These foam cells then cause the lumen to narrow and causes an increase in blood pressure in the glomerular capillaries. This increase then causes glomerulosclerosis and tubulointerstitial fibrosis which leads to kidney damage and a decrease in e-GFR values [9,10].

Several previous studies have carried out research regarding the relationship between LDL and PGD which is described by a decrease in e-GFR values. However, previous studies show differences in opinion and their respective weaknesses. Therefore, researchers are interested in updating this research by correcting existing weaknesses. This study aims to determine the correlation between LDL and e-GFR.

METHODS

Study Design and Setting

This study employed an observational analytic design with a cross-sectional approach. The research was conducted at the Internal Medicine Department of Universitas Sebelas Maret (UNS) Hospital, Sukoharjo, Indonesia. Data collection was carried out in September 2023, using medical record data from 2022 to 2023.

Participants

The study population consisted of patients diagnosed with Type 2 Diabetes Mellitus (T2DM) at UNS Hospital. A total of 90 subjects were selected using [insert sampling method, e.g., consecutive sampling or total sampling] techniques.

The inclusion criteria for this study were patients with a confirmed diagnosis of T2DM who had complete medical records regarding lipid profiles and kidney function tests during the study period. The exclusion criteria included [patients undergoing hemodialysis, patients with acute infection, or incomplete data].

Variables and Data Collection

The data were obtained retrospectively from medical records. The independent variable was Low-Density Lipoprotein (LDL) level, recorded in mg/dL. The dependent variable was the estimated Glomerular Filtration Rate (e-GFR). The e-GFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation based on serum creatinine levels, age, and sex retrieved from the medical records. Additional data regarding subject characteristics, including age, gender, blood pressure, HbA1c, and history of medication use (Diuretics, ACE-inhibitors, NSAIDs), were also collected.

Statistical Analysis

Data analysis was performed using [Insert Software Name and Version, e.g., IBM SPSS Statistics version 26.0]. Univariate analysis was conducted to present the frequency distribution of subject characteristics. Bivariate analysis was performed to determine the correlation between LDL levels and e-GFR. The normality of the data was tested using the [Insert Normality Test, e.g., Kolmogorov-Smirnov or Shapiro-Wilk] test. Since the data distribution was [abnormal], the Spearman Rank correlation test was utilized. A p-value of < 0.05 was considered statistically significant.

Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki. The protocol was approved by the Health Research Ethics Committee of the Faculty of Medicine, Universitas Sebelas Maret, under the ethical clearance number 190/UN27.06.11/KEP/EC/2023.

RESULTS

Secondary data collection from medical records was taken in September 2023 at the Internal Medicine Clinic, Sebelas Maret University Hospital. The number of samples included in this study were 90 subjects suffering from Type 2 Diabetes Mellitus.

Characteristics of the Research Sample

Data on the characteristics of the research samples were grouped into 2 groups based on low e-GFR values (<60mL/min/1.73m2), normal e-GFR values (>60mL/min/1.73m2) and total and are displayed as in the following table:

Table 1. Characteristics of the Research Sample.

Variabel	Total	e-GFR<60mL	e-GFR>60ml
Sex			
Female	46	15 (32.6%)	31 (67.4%)
Male	44	8 (18.2%)	36 (81.8%)
Age	90	60.97±9.023	56.91±11.281
LDL	90	111.65±54.229	115.87±49.601
HbA1C	15	10.7000%	9.8664±3.66668%
GDP	31	119.71±28.494	163.08±85.115
GDS	86	234.96±150.426	257.24±118.539
Proteinuria			
-	40	7 (17.5%)	33 (82%)
+	6	0 (0%)	6 (100%)
++	4	4 (100%)	0 (0%)
+++	4	3 (75%)	1 (25%)
Diuretics			
Yes	25	8 (32%)	17 (68%)
No	65	5 (20%)	20 (80%)
ACE-i			
Yes	65	18 (27.7%)	47 (72.3%)
No	25	5 (20%)	20 (80%)
NSAID			
Yes	27	5 (18.5%)	22 (81.5%)
No	63	18 (28.6%)	45 (71.4%)

Table 2. Bivariate Correlation Analysis.

Title 1	Title 2	LDL	e-GFR
LDL	r	1.000	0.049
	Sig.	.	0.646
	N	90	90
e-GFR	r	0.049	1
	Sig.	0.646	.
	N	90	90

Based on the results of the bivariate analysis using the Spearman correlation test in Table 2, the p-value was 0.646, which is>0.05; thus, LDL and e-GFR are not significantly related. The correlation between LDL and e-GFR is shown in the scatter plot below in Figure 1

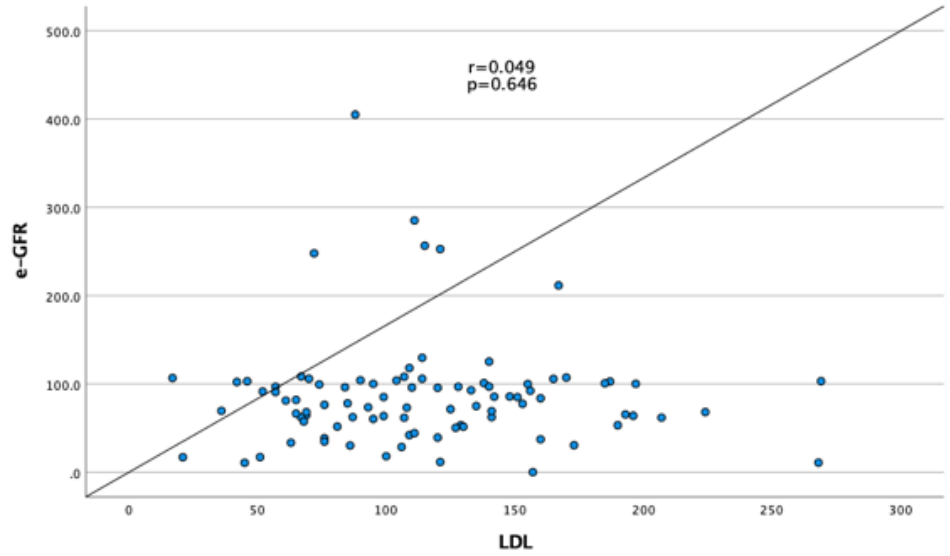

Figure 1. Scatter plot of correlation between LDL and e-GFR.

DISCUSSION

Based on the results of the bivariate analysis with the Spearman correlation test that was carried out, the significance results showed a p-value = 0.646 where p> 0.05 stated that statistically, there was no correlation between LDL and e-GFR in T2DM patients. The results of this study were influenced by several circumstances such as the number of samples used, the drugs consumed by the patient as well as medical and physiological conditions that could influence the e-GFR value in T2DM patients. Based on the results of the analysis of the characteristics of the research sample, it can be seen that the mean LDL value from both groups with an e-GFR value <60ml/min/1.73m2 and the group with an e-GFR value >60ml/min/1.73m2 is in the same LDL value group which values above normal (100-129 md/dL). Therefore, the e-GFR value is not only influenced by LDL.

One of the things that can affect the e-GFR value is diseases related to muscle metabolism. This will affect the creatinine value which is the basis for calculating e-GFR using the CKD Epi formula. Several diseases related to muscle metabolism according to Ebert et al (2021) are neuromuscular diseases that can increase eGFR, cachexia due to malignancy, and obesity which causes body composition to vary including a decrease in muscle mass[11]. Certain jobs such as athletes from various sports and other jobs that require high muscle work can also affect muscle mass [12].

Another thing that influences the e-GFR value is the glucose level in the patient's body. As written in previous research by Basundoro and Adhipireno (2017), high blood glucose values can reduce e-GFR values. The value of glucose in the blood can be determined through the value of HbA1C, fasting blood sugar (GDP), and random blood sugar (GDS) [13]. All three have a similar influence on the e-GFR value as written in research by Syaifudin et al (2022) which explains HbA1C, Basundoro, and Adhipireno (2017) regarding GDP, and Tuna et al (2022) regarding GDS [13–15]. Meanwhile, low e-GFR values in T2DM patients with kidney complications experience a decrease in kidney function in clearing insulin in the body. As a result, insulin will last longer and cause the GDP and GDS values in the subject to decrease [16].

Another thing that also affects the e-GFR value is hypertension which cannot be controlled by the patient. Continuous high blood pressure conditions cause increased glomerular capillary pressure and glomerulosclerosis. This leads to an increase in vasoactive substances which cause vasoconstriction of afferent arterioles and based on tubuloglomerular feedback this will reduce renin release thereby reducing e-GFR values [17].

Medications consumed by subjects such as diuretics, ACE inhibitors, and NSAIDs also affect e-GFR values in patients. This is in line with the results of previous research by Virginia and Fenty (2016) which stated that increasing LDL levels did not cause a decrease in e-GFR values. This is influenced by the drugs that the patient is taking to treat T2DM and the patient's high LDL levels [18]. As in the subjects of this study, the majority took ACE inhibitors which cause afferent arteriolar vasodilation so that renal vasoconstriction and renal obstruction can be prevented and renal function through e-GFR images will be well maintained.

This research is not in line with previous studies conducted by Senge et al (2018) and Chen and Chen (2013) which stated that there was a significant negative correlation between LDL and e-GFR. The differences in the results of this study were influenced by the characteristics of the subjects. In Senge et al (2018) study, the patient's age was 51-60 years, and in Chen and Chen's (2013) study it was not known whether the patients included in the study received dialysis therapy. Both studies did not know what medicines that being taken by the patients [19–20]. Therefore, kidney function in these two studies cannot describe the influence of LDL on kidney function, namely e-GFR. As for this study, all the weaknesses in the two other studies have been corrected and have illustrated the actual influence of LDL on the kidney function of the patients who were research subjects.

However, there are still limitations to this research. This limitation is due to the researcher's inability to control the things previously mentioned regarding conditions that can affect the subject's e-GFR value, such as the drugs consumed and other diseases the subject has.

CONCLUSIONS

Based on the results of the analysis using the Spearman correlation test and discussion, it can be concluded that statistically, there is no correlation between Low Density Lipoprotein and e-GFR in Type 2 Diabetes Mellitus patients.

Author Contributions

Conceptualization, B.A. and D.P.; methodology, M.A.; software, B.A.; validation, D.P., M.A. and E.L.; formal analysis, B.A.; writing—original draft preparation, B.A.; writing—review and editing, B.A.; visualization, B.A. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of the Faculty of Medicine, Sebelas Maret University, with number 190/UN27.06.11/KEP/EC/2023.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

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Conflicts of Interest

The authors declare no conflict of interest.

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