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Relationship Between Serum High Density Lipoprotein Levels and Urine Albumin Levels in Chronic Kidney Disease Patients at ODSK Provincial Hospital, North Sulawesi

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Chronic Kidney Disease, High-Density Lipoprotein, Albuminuria

ABSTRACT
Chronic kidney disease (CKD) is a global health problem with an increasing prevalence and is estimated to be the fifth leading cause of death by 2040. The main cause of mortality in CKD is cardiovascular complications, particularly atherosclerosis. Damage to glomerular filtration causes urinary albumin, while High Density Lipoprotein (HDL) dysfunction disrupts the reverse transport of cholesterol and the antioxidant, anti-inflammatory, and vasoprotective properties of HDL. In CKD, changes in the quantity and quality of HDL and increased urinary albumin reflect vascular and renal damage. The research aims to determine the relationship between serum HDL levels and urinary albumin levels in patients with chronic kidney disease at the ODSK Provincial Hospital in North Sulawesi. Methods: The study design used was an observational analytical study with a cross-sectional approach. This study used primary data in the form of blood and urine samples from hemodialysis patients in November 2025. The study employed simple random sampling with a sample size of 30 patients who met the inclusion and exclusion criteria. Based on the results of Pearson's correlation test, a p-value of 0.237 (> 0.05) was obtained. There is no significant relationship between serum HDL levels and urinary albumin levels in chronic kidney disease at ODSK Provincial Hospital in North Sulawesi.

Introduction

Chronic kidney disease (CKD) remains a global health issue with increasing incidence and prevalence (Borg et al., 2023). The 2021 Global Burden of Disease (GBD) study reported that there were 673 million cases of CKD worldwide, accounting for 9% of the global population. Demographic changes and increased risk factors have caused the global prevalence of CKD to continue to rise. This situation places CKD as one of the fastest growing non-communicable diseases (NCDs), which is estimated to be the fifth leading cause of death by 2040 (Francis et al., 2024; Institution for Health Metrics and Evaluation, 2024).

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The British Medical Journal (BMJ) 2022 found that there were significant differences in the prevalence of CKD in Asia as a whole and in advanced stages (Estimated Glomerular Filtration Rate/eGFR <30 mL/minute/1.73 m^2). The overall prevalence of CKD ranged from 7.0% to 34.3%, and advanced-stage CKD from 0.1% to 17%. It is estimated that approximately 434.3 million adults in Asia have CKD (95% Confidence Interval (CI): 350.2--519.7 million), and approximately 65.6 million (95% CI: 42.2--94.9 million) are in the advanced stage (Liyanage et al., 2022).

Based on the 2023 Indonesian Health Survey (SKI), the prevalence of PGK in Indonesia was recorded at 0.18%, or around 638,178 cases. North Sulawesi Province itself has a PGK prevalence of 0.29%, which indicates that the prevalence of PGK in North Sulawesi is higher than the national average (SURVEI KESEHATAN INDONESIA 2023 DALAM ANGKA KEMENTERIAN KESEHATAN REPUBLIK INDONESIA, 2023). However, the actual number of cases is likely to be higher than the recorded data because PGK often does not cause symptoms in its early stages (Lacount & Tannock, 2025; Bikbov et al., 2020).

The progression of CKD will end in End-Stage Renal Disease (ESRD) with projected incidence and prevalence rates continuing to rise. Data from GBD 2021 states that the number of people receiving renal replacement therapy exceeded 2.5 million in 2021 and is projected to double to 5.4 million by 2030 (Lacount & Tannock, 2025; Bikbov et al., 2020). CKD screening is a priority so that interventions can be carried out to slow or prevent the progression of CKD to ESRD and cardiovascular complications (Lacount & Tannock, 2025).

Based on the 2024 Kidney Disease: Improving Global Outcomes (KDIGO) guidelines, CKD is classified into five stages based on eGFR values and three stages based on urine albumin-creatinine ratio (UACR). UACR testing is preferred because sampling is easier and non-invasive, and it can identify CKD before cardiovascular (CV) and renal manifestations are apparent (Christofides & Desai, 2021).

The main cause of mortality in PGK patients is cardiovascular disease, particularly coronary artery disease due to atherosclerosis. The development of atherosclerosis is closely related to dyslipidemia, which can be caused by low levels of High Density Lipoprotein (HDL) (Pavanello & Ossoli, 2023). Chronic kidney disease affects the ability of HDL to promote cellular cholesterol efflux and eliminates the vasoprotective properties of HDL, as well as promoting the transformation of HDL into harmful particles that can inhibit the production of endothelial Nitric Oxide (NO). Changes in the HDL system play a role in the progression of CKD. A decrease in HDL concentration is the only lipid change associated with the progression of kidney disease in hemodialysis patients and in patients with mild to moderate CKD. This results in patients entering dialysis programs earlier or experiencing a twofold increase in plasma creatinine levels, regardless of risk factors such as diabetes and hypertension (Pavanello & Ossoli, 2023).

To date, there has been no research on the relationship between serum HDL levels and urinary albumin levels specifically in PGK patients. Previous research was conducted on patients with coronary heart disease (CHD) by He et al. (2025) at the Fourth Wuhan Hospital with a sample of 2,568 patients. The results showed that HDL and albumin levels had a negative relationship in

CHD patients, where lower HDL levels were associated with higher albuminuria levels, which in turn impacted CHD incidence. Research on hypertensive patients by Lee et al. (2016) from the 2011-2012 Korean National Health and Nutrition Examination Survey with a sample size of 2,330 hypertensive patients found that there was a negative relationship between HDL levels and albuminuria levels in women with hypertension, while in men, no significant relationship was found between HDL and albuminuria. In Indonesia, research on the relationship between HDL levels and urinary albumin levels was conducted on patients with type 2 diabetes mellitus by Thamrin et al. (2019) at Dr. Soetomo General Hospital in Surabaya and found that there was no significant relationship between low HDL levels and albuminuria levels.

The Optimalisasi Daerah Sehatkan Keluarga (ODSK) Regional General Hospital in North Sulawesi Province is a type B hospital designed to provide excellent service for kidney and hemodialysis patients (Kodongan, 2021). Given the increasing burden of CKD in North Sulawesi and the critical importance of understanding cardiovascular risk factors in this population, investigating the HDL-albuminuria relationship has significant clinical and public health implications for early detection and management strategies. Currently in North Sulawesi, particularly at the ODSK Regional General Hospital, there has been no research specifically exploring the relationship between HDL levels and albumin levels in urine in CKD patients, which represents a knowledge gap in understanding local disease patterns and risk profiles. Therefore, this study aims to provide contextual evidence from the North Sulawesi population, so researchers are interested in exploring the topic "The Relationship Between Serum HDL Levels and Urine Albumin Levels in Chronic Kidney Disease Patients at the ODSK Regional General Hospital in North Sulawesi Province."

Materials and Method

The type of research used was observational analytical research using a cross-sectional approach. This study used primary data where researchers examined HDL and albuminuria in patients with chronic kidney disease at the ODSK Provincial Hospital in North Sulawesi.

Research Location

1. The research was conducted at ODSK Provincial Hospital in North Sulawesi.
2. Urine samples were examined at Patra Laboratory.

Research Period

The research was conducted in November 2025.

Population

1. Target population: All chronic kidney disease patients at ODSK Provincial Hospital in North Sulawesi undergoing hemodialysis in November 2025
2. Accessible population: All adult (≥ 18 years) chronic kidney disease patients undergoing hemodialysis at ODSK Provincial General Hospital, North Sulawesi, from September to November 2025. To determine the accessible population, the researcher used Cochran's limited population formula to calculate the minimum sample size required.

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$$n = \frac{N \times Z^2 \times p(1-p)}{(N-1) \times e^2 + Z^2 \times p(1-p)}$$

n = minimum sample size
N = total population, 78 patients
Z = Z-score (constant for confidence level), determined to be 1.96 for a 95% confidence level
p = estimated population proportion, determined to be 0.5
e = margin of error determined to be 14.1%
Calculation:

$$n = \frac{78 \times 1.96^2 \times 0.5(1-0.5)}{(N-1) \times 0.141^2 + 196^2 \times 0.5(1-0.5)}$$

The result:

$$n = \frac{74.91}{1.531 + 0.9604}$$

$$n = \frac{74.91}{2.4914} \approx 30.07$$

From these calculations, the minimum sample size required is 30 patients with chronic kidney disease undergoing hemodialysis, plus 10% to account for dropouts, bringing the minimum sample size required to 33 people.

Results and Discussions

The research was conducted in November 2025 at the ODSK Provincial Hospital in North Sulawesi. The research sample consisted of chronic kidney disease patients undergoing hemodialysis with inclusion criteria of patients aged ≥18 years and willing to participate in the study. The exclusion criteria were patients who had undergone hemodialysis for less than 6 months.

The study used a cross-sectional approach using primary data, namely blood and urine samples taken from chronic kidney disease patients undergoing hemodialysis. The sampling method used in this study was simple random sampling with a sample size of 30 patients. Sampling was conducted on patients who had been informed about the purpose of the study and the sampling method. Blood sampling was performed by nurses, while urine sampling was performed by the patients themselves. Data processing was performed using software applications.

Univariate Analysis

The distribution of samples based on gender in chronic kidney disease patients can be seen in Table 8, where the research subjects consisted of 30 patients, with more males (18 samples, 60%) than females (12 samples, 40%).

Table 1. Sample distribution based on gender

Gender	n	Percentage (%)
Male	18	60
Female	12	40
Total	30	100

Sample distribution based on age is divided into 7 age categories according to SKI 2023. The 65-74 age group had the highest number of chronic kidney disease cases among all age groups, with 12 patients (40%). Meanwhile, the 45-54 age group had the lowest number of chronic kidney disease patients among all age groups, with 2 patients (6.7%), as shown in Table 2.

Table 2. Sample Distribution by Age Group

Age (Year)	n	Percentage (%)
19-24	0	0
25-34	0	0
35-44	0	0
45-54	2	6.7
55-64	10	33.3
65-74	12	40.0
≥75	6	20.0
Total	30	100

The distribution of samples based on high-density lipoprotein (HDL) levels in patients with chronic kidney disease can be seen in Table 10, where the largest number of samples were found in the male category with HDL levels ≥ 40 mg/dL, totaling 12 patients (40%). while the smallest number of samples was found in the female category with HDL levels ≥ 50 mg/dL, totaling 4 patients (13.3%).

Table 3. Sample Distribution based on High Density Lipoprotein Levels

	HDL level (mg/dL)	n	Peresentase (%)
Male	< 40	6	20
	≥ 40	12	40
Famele	< 50	8	26.7
	≥ 50	4	13.3
	Total	30	100

Sample distribution based on urinary albumin levels in patients with chronic kidney disease was grouped into several categories according to the 2024 KDIGO classification, as shown in Table 4. The largest number of samples was found in the albuminuria >300 mg/g category, with 29 samples (96.7%). These results indicate that the majority of chronic kidney disease patients at ODSK Provincial General Hospital in North Sulawesi have urine albumin levels >300 mg/g.

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Table 4. Sample Distribution based on Urine Albumin Levels

Urine albumin level (mg/g)	n	Percentage (%)
<30	0	0
30 – 300	1	3.3
>300	29	96.7
Total	**30**	**100**

The distribution of urinary albumin levels in patients with chronic kidney disease based on HDL levels can be seen in Table 5. The group with the largest number of samples was in the category of urinary albumin levels >300 mg/g and HDL levels ≥40 mg/dL in males, namely 12 samples. Meanwhile, the group with the smallest sample size was found in the category of urinary albumin levels of 30–300 mg/g and HDL levels <50 mg/dL among females, with 1 sample.

Table 5. Distribution of Urine Albumin Levels based on HDL Levels

Urine Albumin Level (mg/g)	High Density Lipoprotein Level (mg/dL)								Total
	Male				Female				
	<40	%	≥ 40	%	< 50	%	≥ 50	%	
< 30	0	0	0	0	0	0	0	0	0
30 – 300	0	0	0	0	1	12.5	0	0	1
> 300	6	100	12	100	7	87.5	4	100	29
Total	**6**	**100**	**12**	**100**	**8**	**100**	**4**	**100**	**30**

Based on the research conducted, the average HDL level was 48.33 mg/dL and the average urine albumin level in the sample was 1392.33 mg/g, as shown in Table 6.

Table 6. Univariate Descriptive Statistics

	Min	Max	Mean	Std. Deviation
Age	41	72	57.83	8.043
HDL Level	26	72	48.33	12.135
Urine Albumin Level	83.39	3915.69	1392.33	916.068

Bivariate Analysis

Based on the results of the Shapiro-Wilk normality test, the data was found to be normally distributed, so the Pearson correlation test was used. Based on the Pearson correlation test, a significance value of 0.237 (p-value) was obtained with a correlation coefficient of 0.207. From these results, it can be concluded that there is no significant relationship between HDL levels and urinary albumin levels. With a p-value > 0.05, the alternative hypothesis (H1) in the study is rejected.

Table 7. Pearson Correlation Test

					High Density Lipoprotein Level		
Urine Albumin Level	**Min**	**Max**	**Mean**	**SD**	**n**	**r**	**p-value**
	83.39	3915.69	1392.33	916.068	30	0.207	0.237

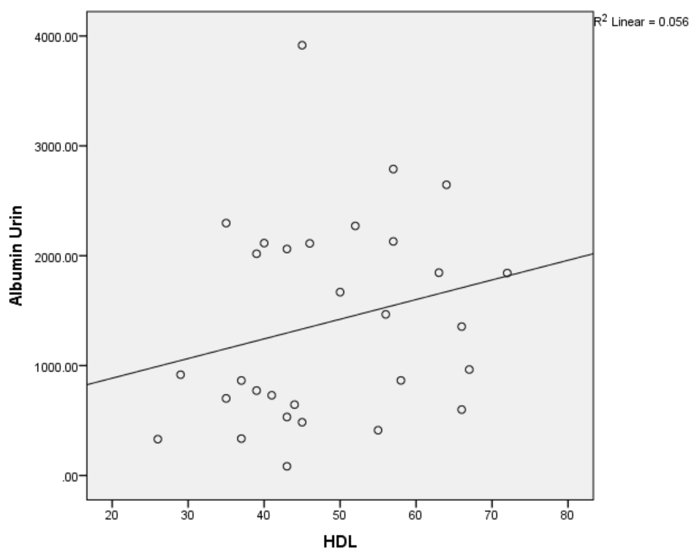

Figure 1. Graph of HDL Levels with Urine Albumin Levels

Discussion

Based on the results of the study using Pearson's correlation test, a p-value of 0.237 was obtained, leading to the conclusion that there is no significant relationship between HDL levels and urinary albumin levels in patients with chronic kidney disease at ODSK Provincial Hospital in North Sulawesi. These results are in line with a study conducted by Thamrin et al. (2019) on patients with DMT2, which found no significant relationship between albuminuria and low HDL levels.

The results of this study contradict previous research conducted by Hwang et al. (2024) using linear regression analysis and data from the Korean National Health and Nutrition Examination Survey (KNHANES), which found a negative relationship between HDL cholesterol levels and albuminuria levels. HDL levels gradually decreased with increasing urinary albumin from normal to severe albuminuria. The most pronounced decrease in HDL was observed in the group with high urinary albumin (>300 mg/g) in both men and women. Another study conducted by Wang and Li (2024) using data from the National Health and Nutrition Examination Survey (NHANES) 2001-2018 found that an increase in HDL levels reduced the risk of albuminuria in general, indicating a protective causal relationship between HDL and albuminuria.

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In a cross-sectional analysis of 490 CKD patients from the Seattle Kidney Study, targeted lipidomics of isolated HDL showed that increased urinary albumin, micro- and macroalbuminuria, was associated with a shift in HDL composition toward a more atherogenic profile (rich in ceramide and sphingomyelin). This change in HDL composition was weakly associated with traditional lipid parameters (HDL, LDL, total cholesterol), suggesting that standard lipid profiles are insufficient to capture HDL dysfunction in CKD with albuminuria (Marsche et al., 2020).

In this study, most PGK subjects were in the macroalbuminuria category (UACR ≥300 mg/g), while the proportion of patients with normo- or microalbuminuria was relatively small. The predominance of macroalbuminuria cases caused the distribution of urinary albumin levels to be uneven and narrowed the range of albuminuria degrees. This condition has the potential to reduce the ability of correlation tests to capture the linear relationship between HDL levels and albuminuria, so that relationships that may exist biologically do not appear statistically significant in this analysis. In addition, patient heterogeneity, including lifestyle, comorbidities, and medication use, can independently affect lipid profiles and albumin regulation. HDL regulation is primarily determined by lipid metabolism, ApoA-I activity, lipoprotein lipase, and the reverse cholesterol transport process (Morvaridzadeh et al., 2024). Conversely, albumin is influenced by hepatic synthesis, nutritional status, inflammation, and protein loss through the kidneys. Therefore, changes in HDL levels do not always correlate with changes in albumin (Benzing & Salant, 2021; Romero-González et al., 2024; Heyman et al., 2022).

The results of the study based on gender data show that more males suffer from CKD, namely 18 patients (60%), while females number 12 patients (40%). These results are in line with a study conducted by Rahman and Santika (2022), which found that male patients undergoing hemodialysis therapy for chronic kidney disease outnumbered female patients, with 216 (70.4%) males compared to 91 (29.6%) females. However, these findings contradict the 2023 SKI report, which shows that female CKD patients undergoing hemodialysis therapy outnumber male patients (23.1% vs. 19.9%) (SURVEI KESEHATAN INDONESIA 2023 DALAM ANGKA KEMENTERIAN KESEHATAN REPUBLIK INDONESIA, 2023).

Data from the Indonesian Renal Registry and hemodialysis unit research found that 57--70% of PGSA patients undergoing hemodialysis are male. Overall, in Japan, China, and Indonesia, women tend to contribute more cases of PGK in the general population, but men are more prevalent in the PGSA group that already requires dialysis or transplantation. Gender disparities such as physiological differences, the protective effects of estrogen, the harmful effects of testosterone, smoking habits that are more common among men, and socioeconomic factors between women and men are the reasons why the prevalence of PGK is generally higher in women, but PGSA cases are more common in men (Selby & Taal, 2024; Harris & Zhang, 2020; Liyanage et al., 2022; Hockham et al., 2022; Kovesdy, 2022; Sullivan et al., 2024; Badan Peneliatian dan Pengembangan Kesehatan, 2018).

The results of the study based on age group data according to the 2023 SKI classification show that the highest number of PGK patients were in the 65--74 age group, with 12 patients (40%).

These results are in line with a study conducted by Rahman and Santika (2022), which showed that most PGK patients were in the >45 age group (72%).

With increasing age, the kidneys are unable to form new nephrons and senescent cells accumulate in the kidneys, causing fibrosis and even glomerulosclerosis. Older adults are also susceptible to kidney damage due to other chronic diseases such as hypertension, diabetes, and renal tubulointerstitial disease (Mallamaci & Tripepi, 2024; Rahman & Santika, 2022).

The results of the study based on HDL level distribution found that most CKD patients were men with HDL levels ≥ 40 mg/dL, totaling 12 patients (40%). This study found that the average HDL level was 48.33, indicating that most patients had HDL levels within the normal range. Research conducted by Patel et al. (2025) also showed similar results, namely that most stage 5 CKD patients who had not undergone dialysis had HDL levels within the normal range with an average of 40.34. However, these results contradict the study conducted by Ahmad Praramadhan et al. (2017), which found that most CKD patients (55.5%) had low HDL levels.

The results of the study based on the distribution of urinary albumin levels found that PGK patients had urinary albumin levels > 300 mg/g, namely 29 patients (96.7%) with an average of 1392.33. These results show that almost all PGK patients are in the macroalbumin category. These results are in line with the study conducted by Tomayahu et al. (2024), which found that most PGK patients had high urinary albumin levels with an average of 3032.39, which also falls into the macroalbumin category.

GFB damage causes the loss of glomerular filtration selectivity so that albumin can pass through the barrier and enter the tubules. Albumin that passes through can still be reabsorbed in the tubules under normal conditions, but in PGK, the amount of albumin that passes through is usually large, causing albumin to accumulate in the tubules, triggering the release of cytokines and oxidative stress, causing tubular inflammation, resulting in no reabsorption and albumin passing into the urine (Gburek et al., 2021; Romero-González et al., 2024).

The results of the sample distribution study based on urinary albumin levels and serum HDL levels found that the number of PGK patients was higher in the male category with urinary albumin levels >300 mg/g and HDL levels ≥ 40 mg/dL, totaling 12 (40%). PGK patients with severe albuminuria (>300 mg/g) showed structural damage to the glomerulus, causing increased GFB permeability. This process is localized in the kidneys and does not directly affect the HDL metabolism pathway controlled by the liver and peripheral tissues, so HDL levels can remain normal. Additionally, albuminuria releases pro-inflammatory cytokines that can trigger HDL oxidation, causing a decrease in HDL RCT function, but HDL levels remain normal (Pavanello & Ossoli, 2023; Xu et al., 2024).

This study used primary data from blood and urine samples of PGK patients undergoing hemodialysis at the Hemodialysis Unit of ODSK Provincial Hospital in North Sulawesi. The study had limitations, namely the collection of urine samples using random urine samples (or after dialysis) and performed by the patients themselves, which could lead to errors in sample collection.

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Conclusion

The research concluded no significant relationship between serum HDL levels and urinary albumin levels in chronic kidney disease (CKD) patients at ODSK Provincial Hospital in North Sulawesi ($p > 0.05$), despite mean HDL levels of 48.33 mg/dL falling within the normal range and most patients exhibiting high urinary albumin (A3 category, >300 mg/g). Recommendations include regular kidney function screening (e.g., urine albumin checks) and healthy lifestyle promotion for high-risk groups like those with diabetes, hypertension, or family history of kidney failure; exploration by researchers of advanced HDL function metrics like cholesterol efflux capacity in progressive CKD; and government expansion of CKD screening at primary health facilities with eGFR/creatinine tests, blood pressure monitoring, and strengthened national surveillance of CKD burden and cardiovascular risks. For future research, a larger prospective cohort study could investigate HDL functional assays alongside inflammatory markers (e.g., CRP) and longer-term outcomes in diverse CKD stages to uncover potential associations missed by cross-sectional HDL quantification.

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