THE ASSOCIATION BETWEEN CREATININE SERUM LEVELS AND HEMOGLOBIN VALUES IN PATIENTS WITH CHRONIC KIDNEY DISEASE AT RSUD BULELENG

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ABSTRAK
Penyakit ginjal kronik (PGK) adalah kondisi kerusakan ginjal secara progresif yang kerap disertai anemia, sehingga pemeriksaan kadar kreatinin dan hemoglobin menjadi penting dalam evaluasi klinis. Tujuan penelitian ini, yaitu menganalisis hubungan antara kadar kreatinin dengan nilai hemoglobin pada pasien PGK di RSUD Kabupaten Buleleng tahun 2024. Desain dari penelitian ini, yaitu analitik korelasional melalui pendekatan *cross-sectional*. Sampel terdiri atas 44 pasien PGK rawat jalan yang diseleksi melalui teknik *purposive sampling*. Sumber data menggunakan rekam medis elektronik berupa usia, jenis kelamin, kadar kreatinin serum, serta nilai hemoglobin. Penelitian ini menunjukkan rata-rata kadar kreatinin pasien PGK di RSUD Kabupaten Buleleng pada tahun 2024 adalah sebesar 4,2 mg/dL dan rata-rata nilai hemoglobin sebesar 10,72 g/dL dengan variasi yang relatif luas. Mayoritas pasien memiliki kadar kreatinin di atas normal dan sebagian besar pasien menunjukkan nilai hemoglobin rendah. Uji normalitas Shapiro-Wilk menunjukkan variabel kreatinin tidak terdistribusi normal ($p < 0,001$). Oleh karena itu, analisis dilanjutkan dengan uji korelasi Rank-Spearman. Hasil uji korelasi memperlihatkan adanya hubungan negatif yang bermakna antara kadar kreatinin dengan nilai hemoglobin ($r = –0,557$; $p < 0,001$). Peningkatan kreatinin serum berkaitan dengan penurunan nilai hemoglobin pada pasien PGK sehingga pemeriksaan fungsi ginjal harus dimonitoring secara berkala untuk meminimalisir risiko komplikasi, termasuk anemia.

Kata kunci : kadar kreatinin, nilai hemoglobin, penyakit ginjal kronik

ABSTRACT
Chronic kidney disease (CKD) is a progressive condition often accompanied by anemia, making creatinine and hemoglobin levels crucial in clinical evaluation. The purpose of this research is to analyze the relationship between creatinine levels and hemoglobin values in CKD patients at RSUD Buleleng in 2024. The design of this research is correlational analytic through a cross-sectional approach. The sample used in this study was 44 outpatient CKD patients selected using purposive sampling technique. The data extracted from electronic medical records included patient age, gender, serum creatinine concentrations, and hemoglobin values. The study demonstrated that the average serum creatinine concentration in CKD patients at RSUD Buleleng in 2024 was 4.2 mg/dL and the average hemoglobin value was 10.72 g/dL with relatively wide variations. The majority of patients had creatinine levels above normal, and most patients showed low hemoglobin values. The Shapiro-Wilk normality test showed that the creatinine variable was not normally distributed ($p < 0.001$), so the analysis was continued with the Rank-Spearman correlation test. The correlation analysis revealed a significant negative association between serum creatinine and hemoglobin values ($r = –0.557$; $p < 0.001$). Increased creatinine serum levels are related with decreased hemoglobin values in individuals with CKD, so kidney function tests must be monitored continuously to minimize the risk of complications, such as anemia.

Keywords *: chronic kidney disease, creatinine level, hemoglobin value*

INTRODUCTION

Chronic Kidney Disease (CKD) is a non-communicable disease with a growing global health burden. In 2021, the number of CKD cases reached 674 million, with a mortality rate of 1.5 million (Ferrari et al., 2024). Based on the Indonesian *Survei Kesehatan Indonesia* (SKI), the prevalence of CKD in Indonesia is 1.8%, while the percentage in Bali is 1.9% (BKPK, 2023). CKD is defined as a clinical condition resulting from a gradual and permanent loss of renal function that persists for no less than three months. It is typically defined by a glomerular filtration rate below 60 mL/min/1.73 m^2, along with manifestations of kidney damage such as hematuria, abnormalities in urinary sediment, electrolyte disturbances, albuminuria, history of kidney transplantation, or kidney structural alterations (Ammirati, 2020).

Serum levels of creatinine are a crucial indicator of renal function in CKD. An increase in creatinine clearance ≤ 30% or creatinine levels ≥ 3.5 mg/dL is often accompanied by anemia due to reduced erythropoietin production (Wayan et al., 2023). Anemia is a condition where hemoglobin levels in the blood decrease. In stage 1 CKD, the prevalence of anemia is reported to be 8.4%. Meanwhile, in stage 5 CKD patients, this percentage reaches 53.4% (Pan et al., 2022). Anemia can cause symptoms such as fatigue, muscle pain, orthostatic complaints, syncope, palpitations, difficulty sleeping and concentrating, and decreased appetite. Anemia also has the potential to worsen clinical symptoms, increase the risk of cardiovascular complications, and accelerate disease progression (Salwani et al., 2023). Preliminary study data from RSUD Buleleng showed an escalation in the number of CKD patients from 2023 to 2024. During this period, the majority of inpatients had anemia, and the number of repeat visits was quite high. The number of outpatients also increased from 275 patients in 2023 to 320 patients in 2024. Previous studies at various hospitals have shown varying results regarding the correlation between creatinine serum and hemoglobin values in individuals with CKD.

Considering these factors, examining the association between creatinine levels and hemoglobin values specifically at RSUD Buleleng is essential, as the hospital reflects the CKD burden in North Bali. This research provides a foundation for evaluating clinical services and guiding efforts to prevent complications in CKD patients. In addition, variations in population characteristics and study settings may influence research outcomes. Therefore, this study was conducted to assess the association between creatinine serum levels and hemoglobin values in CKD patients at RSUD Buleleng.

METHODS

This research used a correlational analytical design with a cross-sectional methodology and was conducted at RSUD Buleleng from July to September 2025. Data were obtained from serum creatinine and hemoglobin test results recorded in the medical records of first-visit CKD outpatients in 2024. All 320 individuals diagnosed with CKD in 2024 were included as the study population. The sample was selected using purposive sampling techniques according to the specified criteria. The inclusion criteria consisted of CKD outpatients aged 18 years and older with complete laboratory data. Exclusion criteria included patients with incomplete laboratory results, those undergoing outpatient hemodialysis, and patients with conditions such as thalassemia, hemoglobinopathies, malignancy, active bleeding, or HIV infection. All data were retrieved from electronic medical records, and patient identities were coded to ensure confidentiality. Serum creatinine levels served as the independent variable, while hemoglobin values were the dependent variable. Additional variables, such as age and sex, were included in the univariate analysis.

The data analysis process used included univariate analysis to describe sample characteristics and bivariate analysis to assess the relationship between the two variables. Data normality was examined using the Shapiro–Wilk test. If the data were not normally distributed, relationships were tested using the Rank-Spearman correlation. Data analysis was assisted by Microsoft Excel and SPSS 27 software.

RESULT

There were 320 CKD patients at RSUD Buleleng in 2024. After selection based on exclusion and inclusion criteria, 44 patients were selected as the study sample.

Table 1. Age Distribution of PGK Patients at RSUD Buleleng in 2024

Age (years old)	Frequency	Percentage (%)
25 – 34	1	2.3
35 – 44	6	13.6
45 – 54	12	27.3
55 – 64	9	20.5
65 – 74	14	31.8
≥75	2	4.5
Total	**44**	**100.0**

Based on table 1, the highest number of CKD patients was in the 65–74-year age group, totaling 14 individuals (31.8%). This was followed by the 45–54-year group with 12 patients (27.3%) and the 55–64-year group with 9 patients (20.5%). The 35–44-year group accounted for 6 patients (13.6%), while only 2 patients (4.5%) were aged 75 years or older. The smallest proportion was observed in the 25–34-year age group, with only 1 patient (2.3%).

Table 2. Gender Distribution of PGK Patients at RSUD Buleleng in 2024

Gender	Frequency	Percentage (%)
Female	21	47.7
Male	23	52.3
Total	**44**	**100.0**

Based on table 2, the majority of CKD patients undergoing outpatient treatment at RSUD Buleleng in 2024 were male, with a total of 23 patients (52.3%). Meanwhile, the number of female CKD patients was 21 patients (47.7%).

Table 3. Distribution of Serum Creatinine Levels in CKD Patients at RSUD Buleleng in 2024

	Frequency	Minimum (mg/dL)	Maximum (mg/dL)	Mean (mg/dL)	Std. Deviation
All sample	44	0,39	25,40	4,2	6,05
Female	21	0,39	25,40	3,27	5,57
Male	23	0,61	21,87	5,06	6,46

Based on table 3, creatinine levels among the 44 patients ranged from 0.39 to 25.40 mg/dL, with a mean value of 4.2 mg/dL and a standard deviation of 6.05. Male patients had a higher average creatinine level (5.06 mg/dL) compared to female patients (3.27 mg/dL). The wide range of creatinine values in both groups reflects substantial variation in the degree of kidney function impairment among CKD patients.

Table 4. Distribution of Hemoglobin Values in CKD Patients at RSUD Buleleng in 2024

	Frequency	Minimum	Maximum	Mean (g/dL)	Std. Deviation

		(g/dL)	(g/dL)		
All Sample	44	3,70	15,40	10,72	3,13
Female	21	3,70	14,40	10,26	2,96
Male	23	3,90	15,40	11,14	3,28

Based on table 4, hemoglobin values among the 44 patients ranged from 3.70 to 15.40 g/dL, with a mean value of 10.72 g/dL and a standard deviation of 3.13. The average hemoglobin level in male patients was 11.14 g/dL, which was slightly higher than that of female patients, who had a mean value of 10.26 g/dL.

Table 5. *Shapiro-Wilk* Normality Test Result

	Shapiro-Wilk Tests of Normality		
	Statistics	**Frequency**	**Significance**
Creatinine	.623	44	<,001
Hemoglobin	.955	44	.087

Based on table 5, this study used the Shapiro–Wilk test to determine data normality. In this method, data will be declared normally distributed if the significance value is (p>0.05). The results of the normality test analysis in this study indicate that creatinine levels are not normally distributed (p <0.001), while hemoglobin values are normally distributed (p = 0.087). The creatinine variable did not meet the normality criteria, so the analysis of relationship between these two variables was carried out using the *Rank–Spearman* correlation test.

Table 6. *Spearman Rank* Correlation Test Result

Correlation between Creatinine Levels and Hemoglobin Values in CKD Patients			
		Creatinine Levels	**Hemoglobin**
Creatinine Levels	Correlation Coefficient (r)	1.000	-.557
	Sig. (2-Tailed)		<,001
	Frequency (n)	44	44
Hemoglobin	Correlation Coefficient (r)	-.557	1.000
	Sig. (2-Tailed)	<,001	
	Frequency (n)	44	44

Based on table 6, the *Rank-Spearman* correlation test show a significant negative correlation between creatinine levels and hemoglobin values (r = – 0.557; p < 0.001). This result suggests that an escalation of serum creatinine is linked to a corresponding decrease in patients' hemoglobin levels. The correlation strength is in the moderate category, providing a clinically relevant illustration of the relationship between kidney function impairment and anemia among CKD patients at RSUD Buleleng.

DISCUSSION

Creatinine is formed as the final product of creatine catabolism in muscle tissue. During muscle contraction, creatine is degraded into phosphate and creatinine, which are subsequently eliminated via urinary excretion (Yuniarti, 2021). Creatinine is used as an ideal indicator of kidney function because it is constantly formed and after undergoing filtration in the kidneys, is not reabsorbed by the body (Hessels et al., 2018). Hemoglobin is a four-subunit protein within red blood cells that essential for the transport of oxygen (O_2) and carbon dioxide (CO_2) from the lungs to body tissues (Made & Saraswati, 2021). This study

shows that the majority of CKD patients at RSUD Buleleng in 2024 were in the elderly age group, particularly those aged 65–74 years. This aligns with findings reported by Yanti AKE et al. (2022), which stated that the majority of CKD patients at Ibnu Sina Hospital Makassar from January 2019 to December 2021 were in the 55–64 age group. Research by Delima & Tjitra (2017) also showed that the 61–86 age group had a 4.51 times higher risk of developing CKD.

The aging process contributes to a higher risk of CKD through progressive structural and functional alterations in the kidneys, including nephrosclerosis, reduced cortical volume, increased medullary volume, and the development of larger and more numerous renal cysts (Zhang, 2019). Furthermore, the aging process contributes to functional alterations in the kidneys, including a decline in glomerular filtration rate (GFR), reduced renal perfusion, and an increase in glomerular permeability (Sobamowo & Prabhakar, 2017). Gender distribution in this study shows that the number of male CKD patients is slightly higher than female CKD patients. This finding is supported by previous research from Yuwono et al. (2023) that the majority of CKD patients at RSUD Abdoel Wahab Sjahranie in Samarinda in 2022 were male, with a total of 54 people. *Survei Kesehatan Indonesia* in 2023 also stated that the number of CKD patients diagnosed by doctors was higher in men, namely 321,060 people (BKPK, 2023).

CKD progresses more rapidly in men than in women. This is due to differences in lifestyle and hormonal factors. Women are known to have estrogen, which can protect the kidneys by acting as an antioxidant, antifibrotic, and anti-inflammatory (Carrero et al., 2018). The normal creatinine level limit for women is 0.6-1.1 mg/dL, while the normal range for men is 0.7 – 1.3 mg/dL (Verdiansah, 2016). In this study, the average serum creatinine level in all CKD patients was quite high, namely 4.2 mg/dL, with a wide variation in values. This finding is consistent with the study of Alfonso et al. (2016) who reported an average creatinine level of 6.9 mg/dL among 35 CKD patients at RSUD Prof. Dr. R. D. Kandou Manado and Manado Advent Hospital. Another study by Putra & Islamiah (2023) conducted at Muara Teweh Hospital, Central Kalimantan, found an average serum creatinine level of 9.17 mg/dL in CKD patients. Increased creatinine levels in CKD patients are due to decreased GFR, which leads to creatinine accumulation in the blood. This is a clinical marker of decreased renal excretory function (Dalal et al., 2023). Creatinine variability is influenced by muscle mass, age, gender, comorbidities, and nutritional status (Groothof et al., 2024).

For individuals older than 15 years, normal hemoglobin levels exceed 12.0 g/dL in females and 13.0 g/dL in males (Norsiah, 2015). In this study, CKD patients generally showed reduced hemoglobin levels, with a mean value of 10.72 g/dL Previous research has shown comparable findings, indicating that hemoglobin levels tend to decline progressively as CKD severity advances. Research by Tamsil et al. (2019) at RSUD Prof. Dr. R. D. Kandou reported that the average hemoglobin level in stage 4 CKD patients was 11.51 g/dL, which further declined to 8.72 g/dL in stage 5 patients. These findings reinforce that anemia is a frequent complication of CKD, arising from reduced erythropoietin production, chronic inflammation, disturbances in iron metabolism, and additional factors such as nutritional status and comorbid conditions (Portolés et al., 2021).

In this study, the Rank–Spearman correlation analysis demonstrated a significant negative association between serum creatinine levels and hemoglobin values ($r = –0.557$; $p < 0.001$). This indicates that elevated creatinine serum levels are associated with reduced hemoglobin values in CKD patients. This result is consistent with earlier studies that have shown a similiar pattern at various health facilities. A study by Falah et al. (2024) conducted at RSUD Undata, Central Sulawesi in 2022 demonstrated a significant association between creatinine levels and hemoglobin values, with weak strength. This study has several limitations, primarily the use of secondary data from medical records and small sample size,

which limited access to other information that potentially affected the results. Despite these constraints, the study still offers valuable insight into the association between creatinine levels and hemoglobin values among CKD patients.

CONCLUSION

Based on research conducted on 44 medical records of outpatients with CKD at RSUD Buleleng in 2024, it was found that the majority of patients were aged 65–74 years and were predominantly male. Serum creatinine levels averaged 4.2 mg/dL, with the majority of patients, both male and female, having creatinine levels above the normal range. The mean hemoglobin level was 10.72 g/dL, with hemoglobin values generally low, especially among female patients. The Rank–Spearman correlation analysis demonstrated a significant negative association between serum creatinine and hemoglobin levels ($r = –0.557$; $p < 0.001$), indicating that elevated creatinine levels are linked to reduced hemoglobin values in CKD patients. This suggests that creatinine may serve as an important marker for identifying patients at risk of anemia. These findings highlight the need for concurrent monitoring of creatinine and hemoglobin as part of the routine clinical assessment in CKD management.

ACKNOWLEDGMENT

The researcher extends his sincere gratitude to RSUD Buleleng, particularly the medical records unit, for their support and cooperation in providing the data required for this study. Appreciation is also conveyed to the Faculty of Medicine, Universitas Pendidikan Ganesha, as well as to the academic supervisors for their valuable guidance throughout the research process. The researcher further expresses heartfelt thanks to family and all individuals who contributed their support, enabling the successful completion of this study.

REFERENCES

Alfonso, A. A., Mongan, A. E., & Memah, M. F. (2016). Gambaran kadar kreatinin serum pada pasien penyakit ginjal kronik stadium 5 non dialisis. *In Jurnal e-Biomedik (eBm)* (Vol. 4, Issue 1).

Ammirati, A. L. (2020). *Chronic kidney disease. In Revista da Associacao Medica Brasileira* (Vol. 66, pp. 3–9). *Associacao Medica Brasileira.* https://doi.org/10.1590/1806-9282.66.S1.3

BKPK. (2023). Survei Kesehatan Indonesia 2023 Dalam Angka. Kementerian Kesehatan Republik Indonesia. https://www.badankebijakan.kemkes.go.id/ski-2023-dalam-angka/

Carrero, J. J., Hecking, M., Chesnaye, N. C., & Jager, K. J. (2018). *Sex and gender disparities in the epidemiology and outcomes of chronic kidney disease*. *Nature Reviews Nephrology*, *14*(3), 151–164. https://doi.org/10.1038/nrneph.2017.181

Dalal, R., Bruss, Z. S., & Sehdev, J. S. (2023). *Physiology, Renal Blood Flow and Filtration*. *StatPearls Publishing*. https://www.ncbi.nlm.nih.gov/books/NBK482248/

Delima, D., & Tjitra, E. (2017). Faktor Risiko Penyakit Ginjal Kronik : Studi Kasus Kontrol di Empat Rumah Sakit di Jakarta Tahun 2014. Buletin Penelitian Kesehatan, 45(1), 17–26. https://doi.org/10.22435/bpk.v45i1.7328.17-26

Falah, M. H., Setyawati, T., Walanda, R. M., & Putrie, I. R. (2024). Hubungan Kadar Kreatinin Dengan Hemoglobin Pasien GGK di RSUD Undata. *Medika Tadulako (Jurnal Ilmiah Kedokteran)*, *9*(1), 40–46.

Groothof, D., Shehab, N. B. N., Erler, N. S., Post, A., Kremer, D., Polinder-bos, H. A., Gansevoort, R. T., Groen, H., Pol, R. A., Gans, R. O. B., & Bakker, S. J. L. (2024).

Creatinine , cystatin C , muscle mass , and mortality : Findings from a primary and replication population- based cohort. *Journal of Cachexia, Sarcopenia and Muscle*, *June*, 1528–1538. https://doi.org/10.1002/jcsm.13511

Hessels, L., Koopmans, N., Gomes Neto, A. W., Volbeda, M., Koeze, J., Lansink-Hartgring, A. O., Bakker, S. J., Oudemans-van Straaten, H. M., & Nijsten, M. W. (2018). *Urinary creatinine excretion is related to short-term and long-term mortality in critically ill patients*. *Intensive Care Medicine*, *44*(10), 1699–1708. https://doi.org/10.1007/s00134-018-5359-6

Made, P., & Saraswati, I. (2021). Hubungan Kadar Hemoglobin (Hb) Dengan Prestasi Pada Siswa Menengah Atas (SMA) Atau Sederajat. Jurnal Medika Hutama, 02(04), 1187–1191. http://jurnalmedikahutama.com

Norsiah, W. (2015). Perbedaan Kadar Hemoglobin Metode Sianmethemoglobin Dengan Dan Tanpa Sentrifugasi Pada Sampel Leukositosis. *Medical Laboratory Technology Journal*, *1*(2), 72–83. http://ejurnal-analiskesehatan.web.id

Pan, W., Han, Y., Hu, H., & He, Y. (2022). *Association between hemoglobin and chronic kidney disease progression: a secondary analysis of a prospective cohort study in Japanese patients. BMC Nephrology*, *23*(1). https://doi.org/10.1186/s12882-022-02920-6

Portolés, J., Martín, L., Broseta, J. J., & Cases, A. (2021). *Anemia in Chronic Kidney Disease: From Pathophysiology and Current Treatments, to Future Agents. In Frontiers in Medicine* (Vol. 8). Frontiers Media S.A. https://doi.org/10.3389/fmed.2021.642296

Putra, I. G. S. S., & Islamiah, A. (2023). Gambaran klinis dan laboratoris penderita penyakit ginjal kronis yang menjalani hemodialisis di RSUD Muara Teweh, Barito Utara, Kalimantan Tengah. Intisari Sains Medis, 14(1), 538–542. https://doi.org/10.15562/ism.v14i1.1602

Salwani, D., Syukri, M., & Abdullah, A. (2023). Anemia pada Penyakit Ginjal Kronik. Jurnal Kedokteran Nanggroe Medika, 6(2), 31–38. https://doi.org/10.55981/brin.906.c802

Sobamowo, H., & Prabhakar, S. S. (2017). T*he Kidney in Aging: Physiological Changes and Pathological Implications. In Progress in Molecular Biology and Translational Science* (1st ed., Vol. 146). Elsevier Inc. https://doi.org/10.1016/bs.pmbts.2016.12.018

Tamsil, Y., Moeis, E. S., & Wantania, F. (2019). Gambaran Anemia pada Subjek Penyakit Ginjal Kronik Stadium 4 dan 5 di Poliklinik Ginjal-Hipertensi RSUP Prof. Dr. R. D. Kandou. *E-CliniC*, *8*(1), 60–66. https://doi.org/10.35790/ecl.v8i1.27097

Verdiansah. (2016). Pemeriksaan Fungsi Ginjal. *CDK-237*, *43*(2), 148–154.

Wayan, N., Dewi, A. M., Gede, L., Yenny, S., & Cahyawati, P. N. (2023). Hubungan Kadar Kreatinin dan Ureum dengan Derajat Anemia pada Pasien Penyakit Ginjal Kronik di RSUD Sanjiwani Gianyar. *Aesculapius Medical Journal*, *3*(1), 74–80.

Yanti AKE, Mamile R, Hidayati PH, Dwimartyono F, & Sanna AT. (2022). Karakteristik Pasien Penyakit Ginjal Kronis di Rumah Sakit Ibnu Sina Makassar Tahun 2019-2021. *Wal'afiat Hospital Journal*, *3*(02), 126–138.

Yuniarti, W. (2021). Anemia Pada Pasien Gagal Ginjal Kronik Anemia *In Chronic Kidney Disease Patients. Journal Health And Science ; Gorontalo Journal Health & Science Community*, *5*, 341–347.

Yuwono, D. N. A., Danial, & Rajibsman. (2023). Gambaran Pasien Penyakit Ginjal Kronik di RSUD Abdoel Wahab Sjahranie Samarinda pada Tahun 2022. Jurnal Medika Karya Ilmiah Kesehatan. https://jurnal.itkeswhs.ac.id/index.php/medika/article/view/1265

Zhang, T. (2019). *Aging and Chronic Kidney Disease. Chronic Kidney Disease: Diagnosis and Treatment*, 71–82. https://doi.org/10.1007/978-981-32-9131-7_6