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Quality of life of hemodialysis patients with anemia in Lombok, Indonesia

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ABSTRACT

Background: Anemia is a common complication of hemodialysis and is associated with substantial impairment of quality of life.

Objective: This study evaluated the relationship between anemia biomarkers (hemoglobin and hematocrit) and health-related quality of life among patients receiving maintenance hemodialysis.

Methods: A cross-sectional study was conducted at three hospitals on Lombok Island, Indonesia, involving 186 hemodialysis patients selected by purposive sampling. Quality of life was measured using the Indonesian-language KDQoL-SF36 questionnaire. Associations between hemoglobin, hematocrit, and quality-of-life scores were analyzed using Pearson's correlation and multiple linear regression (IBM SPSS version 29; $p<0.05$ considered significant).

Results: The mean KDQoL-SF36 score was 63.60 ± 9.37. Age was significantly associated with quality of life ($p = 0.024$). Both hemoglobin and hematocrit showed significant positive correlations with quality of life ($p<0.001$), remaining significant predictors after multivariable adjustment.

Conclusion: Hemoglobin and hematocrit levels are significant determinants of quality of life among hemodialysis patients. Optimizing anemia management, supported by active pharmacist involvement, may improve patient-reported outcomes in this population.

Keywords: hemodialysis, anemia, hemoglobin, hematocrit, quality of life

Introduction

Chronic kidney disease (CKD) affects approximately 10% of the world's population, or roughly 800 million people, and is the tenth leading cause of death worldwide, accounting for 1.3 million deaths in 2019 [1,2]. Mortality from CKD continues to rise, particularly in developing countries such as Indonesia [1]. The global prevalence of CKD reached 843.6 million people in 2017 [1]. In Indonesia, according to the 2018 National Basic Health Research Survey (RISKESDAS), CKD prevalence rose to 3.8% in 2018, compared with 0.2% in 2013 [3]. The prevalence of CKD in West Nusa Tenggara (NTB) Province rose to 5.1% in 2018, compared with 0.42% in 2013 [4]. To preserve kidney function in patients with CKD, specific therapy is required, comprising conservative therapy and renal replacement therapy, which includes kidney transplantation, peritoneal dialysis, and hemodialysis [5].

Hemodialysis (HD) is the most common therapy for patients with CKD, typically performed two to three times weekly to control uremia and excess fluid and electrolytes [5,6]. However, HD is frequently associated with complications such as cardiovascular problems, metabolic acidosis, mineral and bone disorders, and anemia, which occurs in up to 90% of patients with advanced-stage CKD, primarily as a result of

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erythropoietin deficiency [6,7]. Patients with severe, long-standing anemia experience mental and physical fatigue, reduced exercise capacity, impaired cognitive function, decreased libido and sexual function, and loss of appetite, all of which can affect their quality of life [8]. This anemia can further reduce quality of life through symptoms such as fatigue, dyspnea, insomnia, headache, and cognitive impairment, and it increases treatment costs [8]. Approximately 25% of patients with CKD require repeated blood transfusions, and only 3% maintain a normal hemoglobin level [8]. Anemia management with iron supplementation and erythropoiesis-stimulating agents (ESA) can improve quality of life in patients with CKD [9].

The anemia parameters most commonly used are hemoglobin (Hb) and hematocrit (Ht), with target levels of Hb 10–12 g/dL and Ht >30% [10,11]. Puspitasari et al. [12] reported a significant correlation between increasing Hb levels and quality of life among patients on routine hemodialysis for CKD, while Rahimi and Lakeh [13] found that lower quality of life in hemodialysis patients correlated with decreased Hb and Ht. Reduced Hb and Ht levels cause fatigue due to insufficient oxygen delivery to tissues [13]. Assessment of Hb and Ht is therefore important for predicting morbidity in patients with CKD undergoing hemodialysis. Beyond Hb level, the quality of life of patients with CKD is also influenced by individual characteristics such as age, sex, ethnicity, marital status, occupation, education, comorbidities, hemodialysis frequency, duration of hemodialysis, and frequency of erythropoietin administration [14,15]. Declining Hb in HD patients has been shown to reduce quality of life and increase mortality [8]. Studies conducted in Yogyakarta and Bengkulu found that Hb significantly affected the quality of life of HD patients, and that comorbidities, duration of HD, nutritional status, and sociodemographic factors also influenced HD patients' quality of life [12,14].

Most of the existing Indonesian evidence on Hb/Ht and hemodialysis-related quality of life originates from single-center studies in Java, such as Yogyakarta [12], and Sumatra [14], while comparable data from the eastern Indonesian archipelago, including Lombok Island and West Nusa Tenggara Province, a region with disproportionately high and rapidly rising CKD prevalence [4], remain scarce. Furthermore, few of these prior studies applied multivariable regression to simultaneously adjust for sociodemographic and clinical characteristics alongside anemia biomarkers. This study therefore aimed to evaluate the relationship between anemia-related biomarkers (Hb and Ht) and health-related quality of life among hemodialysis patients across three hospitals on Lombok Island, West Nusa Tenggara Province, Indonesia, using multivariable analysis to account for potential sociodemographic and clinical confounders. The findings are expected to inform improvements in the management and pharmaceutical care of patients with CKD-related anemia in this underrepresented region.

Methods

Research design

This study was an analytical observational study with a cross-sectional design, conducted at three hospitals on Lombok Island, each operating a hemodialysis unit with more than ten hemodialysis machines, between November 2023 and April 2024. Ethical approval was obtained from the Health Research Ethics Committee of RSUD Provinsi NTB (Ethics Approval No. 00.9.1/04/KEP/2023).

Population and sample

Sampling was performed using a non-probability, purposive sampling technique, in which subjects were selected based on predefined inclusion and exclusion criteria. Inclusion criteria were patients with CKD and anemia who had undergone hemodialysis therapy for at least the preceding three months, were aged ⩾18 years, and had complete medical record data. Patients were excluded if they had a history of surgery, kidney transplantation, or blood transfusion within the preceding three months; if they had cancer, tumors, HIV/AIDS, hepatitis B/C, coronary heart disease, dementia, stroke, and/or paralysis; or if they had a history of heart failure or severe infection, conditions that can alter perceptions of fatigue and depression and thereby confound quality-of-life assessment. Of 398 hemodialysis patients screened across the three participating hospitals, 186 met the eligibility criteria and were enrolled, while 212 were excluded (see Results). All eligible patients provided written informed consent prior to data collection, and study procedures were conducted in accordance with the ethical approval described above.

Instrument

Data were obtained from medical records and through direct interviews using the KDQoL-SF36

questionnaire, covering patients' sociodemographic characteristics and quality-of-life scores. This study used the Indonesian-language version of the KDQoL-SF36, which has previously been validated and shown to be reliable in hemodialysis patients. Construct validity was established by correlating each item score with the total questionnaire score, yielding significant correlations [12]. Quality of life was measured using the KDQoL-SF36 questionnaire developed by the University of Arizona Research and Development (RAND) Corporation, comprising four domains and 36 items. The scoring procedure followed the RAND protocol, with scores ranging from 0 to 100; higher scores indicate better quality of life.

Analysis

The anemia markers assessed were hemoglobin (Hb) and hematocrit (Ht). To evaluate the influence of these two markers on quality of life among patients with CKD, Pearson's correlation and multiple linear regression analyses were performed using IBM SPSS Statistics version 29. A p-value <0.05 was considered statistically significant.

Results

Patient characteristics

A total of 398 hemodialysis patients across the three participating hospitals were screened for eligibility. Of these, 186 patients met the inclusion criteria and were enrolled in the study, while 212 were excluded because of HIV/AIDS, hepatitis B/C, heart failure, blood transfusion within the preceding three months, or hemodialysis therapy of less than three months' duration. Medical record data and KDQoL-SF36 interview data were analyzed and categorized according to patient characteristics, summarized in Table 1.

Among the 186 enrolled patients, 108 (58.06%) were male and 78 (41.94%) were female. The mean age was 49.92 ± 12.43 years (median 50; range 24–77). Most patients were married (84.41%), of Sasak ethnicity (80.10%), and had completed senior high school (34.41%) or tertiary education (24.20%). Regarding occupation, 41.94% were unemployed or homemakers, 23.12% were self-employed, 19.35% were civil servants, 15.05% worked in the private sector, and 0.54% were students. Most patients (55.38%) had undergone hemodialysis for 1–5 years, 32.26% for less than one year, and 12.36% for more than five years. The most common comorbidity was hypertension (41.94%), followed by no comorbidity (29.03%), combined hypertension and diabetes mellitus (18.28%), and diabetes mellitus alone (10.75%). Regarding hemodialysis frequency, 127 patients (68.28%) underwent hemodialysis twice weekly and 59 patients (31.72%) underwent it once weekly.

Quality of life scores

The overall mean KDQoL-SF36 score was 63.60 ± 9.37. Among the four domains, patient satisfaction had the highest mean score (84.44 ± 12.68), followed by the kidney disease domain (57.99 ± 14.41) and the physical health domain (56.02 ± 13.34); the mental health domain had the lowest mean score (55.96 ± 14.22). At the parameter level, the lowest-scoring parameters were role-physical (22.78 ± 27.57) within the physical health domain, quality of social interaction (40.37 ± 40.52) within the mental health domain, and sexual function (27.30 ± 42.00) within the kidney disease domain, while dialysis staff encouragement scored highest among all individual parameters (95.39 ± 12.07). Full domain and parameter scores are presented in Table 2.

Regression analysis of individual characteristics

Multiple linear regression analysis of individual characteristics and the total KDQoL-SF36 score showed that age was the only sociodemographic/clinical characteristic significantly associated with quality of life (B = -0.12; p = 0.024), indicating that each one-year increase in age was associated with a 0.12-point decrease in quality-of-life score. Sex, marital status, ethnicity, education level, occupation, duration of HD therapy, comorbidity, and EPO therapy frequency were not significantly associated with quality of life (p>0.05 for all). Full results are presented in Table 3.

Hemoglobin and hematocrit levels

The mean hemoglobin level among the 186 patients was 8.96 ± 1.26 g/dL (median 8.9; range 6–12.7), and the mean hematocrit level was 27.60 ± 4.1% (median 27.2; range 19.5–40.9), indicating that most patients had Hb and Ht levels below the normal range, consistent with anemia.

Table 1. Sociodemographic and clinical characteristics of hemodialysis patients (N = 186)

Characteristic	n	%	Mean ± SD / Median (range)
Sex			
Male	108	58.06	
Female	78	41.94	
Age (years)			49.92 ± 12.43; 50 (24–77)
Marital status			
Unmarried	18	9.68	
Married	157	84.41	
Divorced	11	5.91	
Ethnicity			
Sasak	149	80.10	
Non-Sasak	37	19.90	
Education level			
No formal education	15	8.06	
Elementary school	32	17.20	
Junior high school	30	16.13	
Senior high school	64	34.41	
Tertiary education	45	24.20	
Occupation			
Unemployed / homemaker	78	41.94	
Civil servant	36	19.35	
Private employee	28	15.05	
Self-employed	43	23.12	
Student	1	0.54	
Duration of HD therapy (years)			
<1	60	32.26	
1–5	103	55.38	
>5	23	12.36	
Comorbidity			
None	54	29.03	
Hypertension	78	41.94	
Diabetes mellitus	20	10.75	
Hypertension & diabetes mellitus	34	18.28	
HD frequency			
Once weekly	59	31.72	
Twice weekly	127	68.28	

Table 2. Mean scores for each KDQoL-SF36 domain and parameter

Domain / Parameter	Mean score ± SD
Physical Health	**56.02 ± 13.34**
Work status	48.72 ± 20.78
Physical function	52.64 ± 25.49
Role-physical	22.78 ± 27.57
Pain perception	56.65 ± 25.18
General health	57.65 ± 16.66
Social function	74.47 ± 22.92
Energy/fatigue	66.83 ± 16.23
Mental Health	**55.96 ± 14.22**
Burden of kidney disease	48.01 ± 26.17
Quality of social interaction	40.37 ± 40.52
Social support	76.92 ± 33.02
Emotional well-being	71.21 ± 17.91
Role-emotional	43.32 ± 40.70
Kidney Disease	**57.99 ± 14.41**
Symptoms/problems	62.77 ± 21.03
Effects of kidney disease	72.92 ± 21.62
Cognitive function	47.09 ± 31.22
Sexual function	27.30 ± 42.00
Sleep quality	56.34 ± 23.59
Patient Satisfaction	**84.44 ± 12.68**
Dialysis staff encouragement	95.39 ± 12.07
Patient satisfaction	69.40 ± 16.81
Total KDQoL-SF36 score	**63.60 ± 9.37**

Table 3. Multiple regression analysis of individual characteristics associated with KDQoL-SF36 score

Variable	B	p-value
Sex	-1.74	0.211
Age	-0.12	0.024*
Marital status	-0.02	0.986
Ethnicity	-0.85	0.624
Education level	0.73	0.186
Occupation	0.13	0.816
Duration of HD therapy	1.62	0.159
Comorbidity	-0.90	0.170
EPO therapy frequency	2.69	0.068

Note: significance level $p<0.05$; B = unstandardized regression coefficient; *significant.

Table 4. Descriptive statistics of hemoglobin and hematocrit levels

Parameter	Mean ± SD	Median (range)
Hemoglobin (g/dL)	8.96 ± 1.26	8.9 (6–12.7)
Hematocrit (%)	27.60 ± 4.1	27.2 (19.5–40.9)

Table 5. Regression analysis of hemoglobin and hematocrit with each KDQoL-SF36 domain

Hemoglobin (Hb) category					
	Physical health	**Mental health**	**Kidney disease**	**Patient satisfaction**	**Total KDQoL-SF36**
Constant	31.768 (p<0.001)	40.747 (p<0.001)	41.200 (p<0.001)	78.669 (p<0.001)	48.097 (p<0.001)
Hb	2.715 (p<0.001*)	1.707 (p=0.039*)	1.873 (p=0.026*)	0.649 (p=0.380)	1.736 (p<0.001*)
Hematocrit (Ht) category					
	Physical health	**Mental health**	**Kidney disease**	**Patient satisfaction**	**Total KDQoL-SF36**
Constant	33.101 (p<0.001)	40.582 (p<0.001)	34.995 (p<0.001)	78.214 (p<0.001)	46.725 (p<0.001)
Ht	0.833 (p<0.001*)	0.560 (p=0.029*)	0.832 (p<0.001*)	0.224 (p=0.322)	0.613 (p<0.001*)

Note: values shown as regression coefficient B (p-value); * significant at p<0.05.

Relationship between hemoglobin, hematocrit, and quality of life

Both hemoglobin and hematocrit levels showed a statistically significant positive relationship with the total KDQoL-SF36 score (p<0.001 for both). Multiple linear regression yielded a regression coefficient of 1.736 (constant = 48.097) for Hb, corresponding to the equation y = 48.097 + 1.736x, indicating that each 1 g/dL increase in Hb was associated with a 1.736-point increase in quality-of-life score. For Ht, the regression coefficient was 0.613 (constant = 46.725), corresponding to the equation y = 46.725 + 0.613x, indicating that each 1% increase in Ht was associated with a 0.613-point increase in quality-of-life score.

At the domain level (Table 5), higher Hb was significantly associated with better scores in the physical health domain (B = 2.715; p<0.001), mental health domain (B = 1.707; p = 0.039), and kidney disease domain (B = 1.873; p = 0.026), but not with the patient satisfaction domain (B = 0.649; p = 0.380). Similarly, higher Ht was significantly associated with better scores in the physical health domain (B = 0.833; p<0.001) and kidney disease domain (B = 0.832; p<0.001), and with the mental health domain (B = 0.560; p = 0.029), but not with the patient satisfaction domain (B = 0.224; p = 0.322).

Discussion

The main finding of this study is that hemoglobin and hematocrit levels, together with patient age, were significant determinants of health-related quality of life among hemodialysis patients on Lombok Island (p<0.05 for all), while other sociodemographic and clinical characteristics were not significant predictors. Both Hb and Ht showed a positive linear relationship with the total KDQoL-SF36 score (p<0.001), consistent with previous Indonesian studies reporting that higher hemoglobin levels correlate with better quality of life among hemodialysis patients [12,16] and that lower quality of life correlates with decreased Hb and Ht [13]. These findings reinforce the central role of anemia correction in improving patient-reported outcomes among patients with CKD undergoing long-term hemodialysis.

Anemia is a condition in which the red blood cell count or hemoglobin (Hb) concentration in the blood falls below the normal range. This condition produces symptoms such as fatigue, weakness, headache, and dyspnea, which negatively affect patients' quality of life [8]. In this study, the mean Hb level was low (8.96 g/dL), reflecting the anemic status of the study population. Higher Hb levels were significantly associated with better scores in the physical health, mental health,

and kidney disease domains (p<0.05 for all), but not with the patient satisfaction domain, consistent with the regression findings reported above (p<0.001; B = 1.736). Hemoglobin level has also been directly linked to fatigue severity in patients with CKD [17], further supporting the observed association with the physical health domain in this study. This suggests that hemoglobin levels approaching the normal range are associated with improvements in the physical, social, and psychological functioning of hemodialysis patients [16].

Hematocrit is another key parameter used to assess anemia. In this study, patients on Lombok Island had a mean hematocrit level of 27.60%. Higher Ht levels were positively associated with the physical health, mental health, and kidney disease domains (Table 5), consistent with Rahimi and Lakeh, who reported that improved quality of life correlated significantly with increasing hematocrit levels [13]. The multiple regression analysis showed a significant relationship between Ht and quality-of-life score (p<0.001; B = 0.613), indicating that each 1% increase in hematocrit was associated with a 0.613-point increase in quality-of-life score.

Age was the only sociodemographic or clinical characteristic, besides Hb and Ht, that was significantly associated with quality of life in this study (B = -0.12; p = 0.024), indicating that quality of life tends to decline with advancing age. This is consistent with the tendency of older patients to experience greater limitations in physical activity, leading to an overall decline in physical function [18]. Assessing the relationship between individual characteristics and quality of life is necessary to determine whether observed effects reflect genuine underlying influences rather than subjective bias [15]. Sex, marital status, ethnicity, education level, occupation, duration of HD therapy, comorbidities, and EPO therapy frequency were not significant predictors of quality of life in this study, although these characteristics have been reported to influence quality of life among patients with CKD in other settings [14,15].

In this study, the number of male patients (58.06%) exceeded that of female patients (41.94%). Men generally have greater muscle mass and higher protein intake than women, which can increase blood creatinine levels and potentially reduce kidney function [19]. The mean patient age in this study was 49.92 ± 12.43 years. The 2017 Indonesian Renal Registry reported that CKD incidence increases within the 45–64-year age range [20]. Age-related nephron loss, together with a consequent decline in glomerular filtration rate, is a well-recognized contributor to the development of CKD [21]. According to 2018 Indonesian Renal Registry data, the most common comorbidity among hemodialysis patients nationally was hypertension (51.00%), followed by diabetes mellitus (21.00%) and cardiovascular disease (7.00%) [22]. Patients with a history of hypertension have a 3.2-fold higher risk of developing CKD compared with those without such a history [23]. Prolonged hypertension causes structural changes in the arterioles, marked by fibrosis of the vessel wall that leads to vascular narrowing and subsequently triggers glomerulosclerosis, tubular atrophy, and interstitial fibrosis [21]. The proportion of patients with hypertension as a comorbidity in this study was 41.94%. Most patients (68.28%) underwent hemodialysis twice weekly, while the remainder (31.72%) underwent it once weekly; this frequency varies according to patients' clinical condition and residual kidney function [6]. Hemodialysis is ideally performed three times weekly for 4–5 hours per session, although in Indonesia it is commonly performed two to three times weekly [10].

The mean quality-of-life score among hemodialysis patients in this study was 63.60 ± 9.37, indicating a good overall level of quality of life, consistent with findings from other Indonesian hemodialysis cohorts [24]. The domain with the lowest mean score was mental health (55.96 ± 14.22), while the highest was patient satisfaction (84.44 ± 12.68); this pattern is consistent with systematic-review evidence showing that physical and mental health domains are typically more affected by dialysis-related burden than satisfaction with care [15]. Within the physical health domain, the role-physical parameter had the lowest mean score (22.78 ± 27.57), reflecting patients' difficulty completing work or daily activities because of their physical health. Hemodialysis patients with anemia tend to have reduced muscle strength, which contributes to decreased and restricted physical activity, consistent with evidence linking anemia to reduced handgrip strength in hemodialysis patients [25]. Within the mental health domain, quality of social interaction (40.37 ± 40.52) was the lowest-scoring parameter, reflecting how often patients felt isolated or irritable toward those around them. Within the kidney disease domain, sexual function (27.30 ± 42.00) had the lowest score; most patients reported reluctance to engage

in sexual activity following hemodialysis therapy. Reduced sexual activity among hemodialysis patients is thought to result from neurohormonal disturbances that reduce blood flow to the genital organs, leading to sexual dysfunction, consistent with reports describing impaired sexual function and psychological distress in this population [26].

This study has several limitations that should be considered when interpreting the findings. First, its cross-sectional design does not allow causal inference between anemia biomarkers (Hb and Ht) and quality of life; the observed associations should be interpreted as correlational rather than causal. Second, because Hb and Ht are physiologically closely correlated, their inclusion in related regression models may be subject to collinearity, which was not formally assessed in this analysis (e.g., via variance inflation factor) and should be examined in future studies. Third, quality-of-life data were collected through direct interviews using the KDQoL-SF36 questionnaire, which may be subject to recall and social desirability bias. Finally, because participants were recruited from only three hospitals on Lombok Island, the findings may not be fully generalizable to hemodialysis populations in other regions of Indonesia with different demographic, clinical, or healthcare-access characteristics.

These findings carry several implications for pharmaceutical care in patients undergoing hemodialysis. Given the significant association between Hb/Ht levels and quality of life, pharmacists play an important role in optimizing anemia management through regular monitoring of iron status and erythropoiesis-stimulating agent (ESA) therapy, ensuring appropriate dosing to reach target Hb (10–12 g/dL) and Ht (>30%) levels while avoiding the risks associated with overcorrection. Pharmacists can also contribute through medication therapy management, patient education on adherence to iron and ESA therapy, and monitoring for adverse effects, all of which may help translate improved anemia control into measurable gains in patients' physical, mental, and disease-specific quality of life. Furthermore, because age was independently associated with lower quality of life, pharmacists working within multidisciplinary hemodialysis teams should consider age-tailored counseling and closer monitoring for older patients.

Conclusion

This study demonstrates a significant relationship between the anemia markers hemoglobin and hematocrit, as well as the individual characteristic of age, and quality of life ($p<0.05$). These findings indicate that anemia status and patient characteristics influence the quality of life of hemodialysis patients on Lombok Island. Optimizing anemia management, supported by active pharmacist involvement, may contribute to improved patient-reported outcomes in this population.

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Conflict of interest

The authors declare no conflict of interest throughout the research process and the preparation of this manuscript.

Author contributions

CEP: writing, data analysis, and principal investigator. MPZ: writing, data collection, and data analysis. NLASW: writing, data collection, and data analysis. IBPE: writing, data collection, and data analysis. SA: writing and data collection. WW: writing and data collection. KAW: writing and data collection. NMARD: writing and data analysis.

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