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Depression and Hemoglobin levels in patients undergoing maintenance hemodialysis

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Abstract

Background: Depression is prevalent in hemodialysis patients and may contribute to anemia, yet its impact on hemoglobin levels remains underexplored.
Purpose: To examined the association between depression severity and hemoglobin levels in Indonesian hemodialysis patients.
Method: A cross-sectional study was conducted at a single-site hemodialysis unit from October to December 2024. A total of 101 patients were selected using purposive sampling. Depression severity was assessed using the Beck Depression Inventory-II (BDI-II), and hemoglobin levels were measured via venous blood samples. Spearman's correlation and linear regression analysis were used to analyze the association.
Results: Depression severity was negatively correlated with hemoglobin levels ($r = -0.62$, $p < 0.01$). Patients with severe depression had hemoglobin levels nearly 3 g/dL lower than those with minimal depression. Regression analysis showed depression severity significantly predicted hemoglobin levels (Adjusted $R^2 = 0.38$, $p < 0.01$).
Conclusion: Higher depression severity is associated with lower hemoglobin levels in hemodialysis patients. Routine mental health screening should be integrated into nephrology care, with nurses playing a key role in early detection and intervention. Future multi-center studies are needed to enhance generalizability.

Keywords: Anemia; Chronic Kidney Disease; Depression; Hemodialysis; Hemoglobin; Indonesia.

INTRODUCTION

The number of hemodialysis patients is increasing globally and in Indonesia, with over 132,000 patients undergoing hemodialysis in Indonesia as of 2018 (Tanod, Nurbayati, Danisia, & Mayasari, 2022). This rise is attributed to the growing prevalence of chronic kidney disease (CKD), which increased from 0.2% in 2013 to 0.3% in 2018 in Indonesia (Hustrini, 2023). While comprehensive psychiatric epidemiology among Indonesian dialysis patients is still emerging, available studies indicate a high burden of depression (Al-Jabi, Sous, Jorf, Taqatqa, Allan, Sawalha, & Zyoud, 2021). A study in Indonesia found that depression is the most dominant factor associated with high symptom burden among hemodialysis patients (Limbong, Pahria, & Pratiwi, 2020). Depression significantly impacts quality of life, mortality, and treatment outcomes in dialysis patients (Elhadad, Ragab, & Atia, 2020). Early screening and continuous care models are recommended for managing depression in this population (Tian, Chen, & Li, 2021). Additionally, patients with diabetes in Indonesia face an increased risk of psychiatric disturbances, particularly when comorbidities are present. Approximately 18.29% of diabetic individuals displayed symptoms indicative of psychiatric disturbances, with the risk being significantly higher in those with concurrent conditions such as hypertension, heart disease, and cancer (Isfandari, Roosihermiatie, Tuminah, & Mihardja, 2023). Depression is widely recognized as a serious mental health disorder that affects millions globally and is

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linked to various physiological complications (Liu, He, Yang, Feng, Zhao, & Lyu, 2020). Studies have shown that depression is associated with chronic diseases, including cardiovascular disorders, metabolic syndrome, and immune dysfunction (Tonhajzerova, Sekaninova, Bona Olexova, & Visnovcova, 2020). Among hemodialysis patients, depression is particularly common due to the psychological burden of chronic kidney disease (CKD), lifestyle disruptions, and physical limitations imposed by treatment (Drew, 2020). Additionally, depression has been linked to alterations in hematological parameters, particularly hemoglobin levels, which play a crucial role in oxygen transport and overall physiological function (Vulser, Lemogne, Boutouyrie, Côté, Perier, Van Sloten, & Empana, 2020).

Anemia is a well-documented complication in CKD patients, and nearly all Indonesian dialysis patients are anemic, with mean hemoglobin levels often well below normal (Carolina, Wibowo, & Prameswari, 2024). The pathophysiology of anemia in CKD is complex, involving factors such as erythropoietin deficiency, iron dysregulation, and chronic inflammation (Marthoenis, Syukri, Abdullah, Tandi, Putra, Laura, & Schouler-Ocak, 2021). Anemia in CKD is associated with decreased quality of life, increased healthcare utilization, and higher risks of CKD progression, cardiovascular events, and mortality (Hanna, Streja, & Kalantar-Zadeh, 2021). Iron deficiency, both absolute and functional, contributes significantly to anemia in CKD patients (Henry, Rudiansyah, Kurniaatmaja, & Wulandari, 2022). While several prior research have explored the effects of renal dysfunction on hemoglobin levels (Amalia, Nadjmir, & Azmi, 2015). Psychological stress and depression have been suggested to negatively impact hematopoiesis through inflammatory pathways and endocrine dysregulation (Anderson, Rodriguez, & Kathrein, 2020). However, specific data examining the direct link between depression severity and hemoglobin levels in Indonesian hemodialysis patients remain scarce. Additionally, cultural stigma surrounding mental illness in Asian societies may lead to underdiagnosis of depression, as symptoms such as fatigue, sleep disturbances, and appetite loss are often attributed to uremia rather than underlying psychological distress (Krendl & Pescosolido, 2020).

The gap in the literature lies in the limited understanding of how varying degrees of depression impact hemoglobin levels in this vulnerable population. Addressing this gap is critical, as both depression and anemia significantly affect the quality of life and clinical outcomes in hemodialysis patients. Identifying a potential correlation between depression severity and hemoglobin levels could help healthcare providers develop more comprehensive management strategies that integrate mental health support with routine anemia monitoring and treatment.

RESEARCH METHOD

This quantitative, cross-sectional study was conducted at the Hemodialysis Unit of Rumah Sakit Advent Bandung from October to December 2024 to examine the relationship between depression severity and hemoglobin levels. This study hypothesizes that higher depression severity is associated with lower hemoglobin levels, potentially affecting patients' quality of life and physical endurance. A total of 101 patients were selected from 130 registered hemodialysis patients using purposive sampling to ensure eligibility based on predefined criteria. Participants were 18 years or older and had undergone routine hemodialysis (HD) for at least six months. Patients with severe mental disorders (e.g., schizophrenia) or acute/chronic illnesses unrelated to renal disease (e.g., cancer, autoimmune diseases, chronic infections) were excluded to avoid confounding factors. Depression severity was assessed using the BDI-II, administered in Bahasa Indonesia for better comprehension. The 21-item self-report instrument evaluates depressive symptoms over the past two weeks, with each item scored from 0 to 3. Total scores classify depression as minimal (0–13), mild (14–19), moderate (20–28), and severe (29–63). The Indonesian version of the BDI-II has been validated, demonstrating strong reliability and validity (placeholder for citation and psychometric properties). Hemoglobin levels were measured using venous blood samples, collected under sterile conditions by trained medical personnel and analyzed with automated hematology analyzers in a certified clinical laboratory. The standard

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reference range for hemoglobin was 13.8–17.2 g/dL for males and 12.1–15.1 g/dL for females. This study hypothesizes that higher depression severity is associated with lower hemoglobin levels, potentially affecting patients' quality of life and physical endurance.

Statistical analyses were conducted using SPSS 29. Descriptive statistics (means, standard deviations, confidence intervals) were calculated for depression severity and hemoglobin levels. Spearman's rank correlation assessed the association between depression severity and hemoglobin levels, given the ordinal nature of depression scores. Linear regression analysis determined whether depression severity significantly predicted hemoglobin levels. Cohen's d measured effect sizes, and a p-value < 0.05 was considered statistically significant. 95% confidence intervals (CIs) were reported to enhance result reliability. Ethical approval was obtained from Komite Etik Penelitian Rumah Sakit Advent Bandung (No. 005/KEPK/RSAB/X/2024), ensuring compliance with research ethics standards. All participants provided written informed consent, with confidentiality and anonymity strictly maintained.

RESEARCH RESULTS

Table 1. Demographic Characteristics of Respondents (N = 101)

Variable	Results
Age (Mean±SD)(Range)(Year)	(49.6±12.2)(17-65)
Age (n/%)	
17–25	2/2.0
26–34	9/8.9
35–43	21/20.8
44–52	23/22.8
53–61	21/20.8
>62	25/24.8
Education (n/%)	
Elementary School	12/11.9
Junior High School	12/11.9
Senior High School	42/41.6
Diploma	12/11.9
Bachelor's Degree	18/17.8
Master's Degree	5/5.0
Gender (n/%)	
Male	51/50.5
Female	50/49.5
Duration of Haemodialysis (n/%)	
6–24 months	39/38.6
25–36 months	16/15.8
37–48 months	10/9.9
49–60 months	11/10.9

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Based on the table above, it is known that the average age of respondents is 49.6 years with a standard deviation value of 12.2, the youngest age is 17 years and the oldest age is 65 years. The majority of respondents are >62 years old, as many as 25 respondents (24.8%). The majority of respondents have a senior high school education, as many as 42 respondents (41.6%). The majority of respondents are male, as many as 51 respondents (50.5%). The majority of respondents have a history of hemodialysis for 6-24 months, as many as 39 respondents (38.6%).

Table 2. Depression Severity and Corresponding Hemoglobin Levels (N=101)

Variable	n/%	Hemoglobin Level (Mean ± SD, g/dl)	95% Confidence Interval (CI)
Depression Severity			
Minimal Depression	27/27.0	10.5 ± 1.5	9.91 – 11.09
Mild Depression	35/35.0	9.8 ± 1.6	9.25 – 10.35
Moderate Depression	28/28.0	8.9 ± 1.7	8.24 – 9.56
Severe Depression	10/10.0	7.5 ± 1.8	6.21 – 8.79

Depression severity was classified using the BDI-II, and hemoglobin levels were assessed based on laboratory analysis. Among the 101 participants, the majority had mild or moderate depression, with only 10% classified as having severe depression. The mean hemoglobin levels varied across different depression severity groups, showing a downward trend as depression severity increased. Patients with severe depression exhibited the lowest mean hemoglobin levels, while those with minimal depression had the highest hemoglobin concentrations.

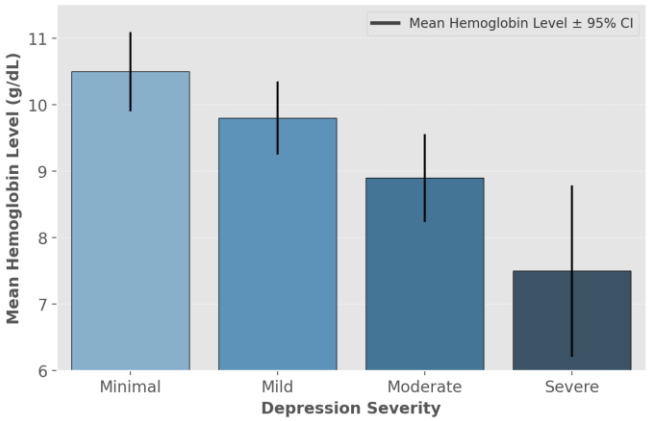


Figure Mean Hemoglobin Levels by Depression Severity

The results indicated a potential inverse relationship between depression severity and hemoglobin levels. Patients with severe depression exhibited hemoglobin levels nearly 3 g/dL lower than those with minimal depression. A Spearman correlation analysis revealed a significant negative correlation between depression severity (BDI-II scores) and hemoglobin levels, with a correlation coefficient of $r = -0.62$ ($p < 0.01$). According to Cohen (1988), this correlation represents a moderate to strong negative association.

Further linear regression analysis demonstrated that depression levels had a significant influence on hemoglobin concentration ($p < 0.01$), with depression severity accounted for 38% of the variation in hemoglobin levels (Adjusted $R^2 = 0.38$). The regression analysis revealed that for every one-unit increase in depression severity, hemoglobin

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decreases by an estimated β = X g/dL (95% CI: X-Y, $p < 0.01$). The effect size (Cohen's d) between severe and minimal depression groups was 1.90, indicating a large effect size.

DISCUSSION

The findings of this study revealed that depression severity varied among hemodialysis patients, with the majority experiencing mild to moderate depression, while a smaller proportion exhibited severe depression. Similarly, hemoglobin levels demonstrated a downward trend as depression severity increased, with patients experiencing severe depression showing the lowest hemoglobin concentrations. These findings provide further evidence of the psychological burden experienced by hemodialysis patients, reinforcing prior research on the high prevalence of depression in this population (Kurku, Gederet, Bor, Güney, Neşelioğlu, & Biyik, 2020).

This study also found a significant negative correlation between depression severity and hemoglobin levels in hemodialysis patients, indicating that those with higher depression severity had lower hemoglobin concentrations. These findings align with previous research suggesting that psychological distress may influence hematological function through inflammatory and neuroendocrine pathways (Qawaqzeh, Masa'deh, Hamaideh, Alkhawaldeh, & ALBashtawy, 2023). Studies on CKD and cardiovascular patients have reported similar trends, reinforcing the association between depression severity and hematological dysregulation (Avdal, Ayvaz, Uran, Yildirim, Sofulu, & Pamuk, 2020). Similar trends have been observed in studies examining depression and anemia in chronic disease populations, including CKD and cardiovascular patients (Wakhid, Kamsidi, & Widodo, 2019). Half of hemodialysis patients exhibited depressive symptoms, with significant differences in thiol-disulfide homeostasis linked to depression severity (Wu, Hsu, & Tzeng, 2022). This supports the hypothesis that depression is associated with physiological changes that could impact erythropoiesis. A negative correlation between depression and quality of life, emphasizing the role of self-care self-efficacy in mitigating depressive symptoms and improving overall health outcomes in hemodialysis patients. Patients with multiple comorbidities were more likely to experience severe depression, while those engaging in higher physical activity had reduced depression severity (Sahathevan, Khor, Ng, Abdul Gafor, Mat Daud, Mafra, & Karupaiah, 2020).

A 1 g/dL reduction in hemoglobin is clinically significant in hemodialysis patients, as even small decreases in hemoglobin levels are associated with increased fatigue, reduced exercise tolerance, and diminished quality of life (Orzechowski, Buczek, Szczerba, Gellert, Rydzewski, Fiderkiewicz, & Kokoszka, 2021). Several biological mechanisms may explain the association between depression and lower hemoglobin levels. Chronic stress and depression have been linked to increased inflammatory markers such as interleukin-6 (IL-6) and C-reactive protein (CRP), which are known to inhibit erythropoiesis and contribute to anemia (Tannous, Godlewska, Tirumalaraju, Soares, Cowen, & Selvaraj, 2020). Additionally, depression can lead to poor appetite and nutritional deficiencies, further exacerbating anemia in hemodialysis patients (Li, Zhu, Shen, & Miao, 2023). Given that anemia is a well-established risk factor for worsened clinical outcomes in CKD, addressing depression could have broader implications for improving overall patient health and quality of life (Pretto, Rosa, Dezordi, Benetti, Colet, & Stumm, 2020).

While this study provides insights into the relationship between depression and hemoglobin levels, several limitations should be acknowledged. The data were collected from a single site, which may limit the generalizability of the findings, as patient characteristics and healthcare practices may differ across regions and institutions. The data were collected from a single site, which may limit the generalizability of the findings to broader populations of hemodialysis patients across different healthcare settings. Future studies should consider multi-center approaches to enhance external validity (Kim, Lee, & Park, 2022). The cross-sectional design prevents causal inference, meaning it is unclear whether depression contributes to anemia or vice versa. Additionally, the study did not control for potential confounders such as nutritional status, inflammation levels, or erythropoietin therapy, which could have influenced the results (Nguyen, Liang, Liu, & Chien,

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2022). Future research should employ longitudinal designs and incorporate biochemical markers to further elucidate the causal pathways linking depression and hemoglobin levels (Zhao, Zhu, & Yang, 2023).

CONCLUSION

Managing depression in hemodialysis patients is crucial not only for mental well-being but also for addressing physiological health challenges such as anemia. This study suggests that higher depression severity is associated with lower hemoglobin levels, reinforcing the need for an integrated approach to care. Nurses play a key role in recognizing depressive symptoms, providing psychosocial support, and advocating for holistic interventions that address both mental and physical health. Incorporating mental health screening into routine nephrology care can enhance patient outcomes, improve quality of life, and contribute to better anemia management. Strengthening nursing interventions through education, counseling, and interdisciplinary collaboration will be essential in mitigating the burden of depression and its physiological consequences in hemodialysis patients.

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