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Hemodialysis Adherence and Quality of Life Among Patients with Chronic Kidney Disease in Indonesia: A Cross-Sectional Study

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Abstract

Background: Chronic kidney disease requires long-term hemodialysis, yet adherence to treatment remains a persistent challenge that may influence patient-reported outcomes.
Objective: This study aimed to examine the relationship between hemodialysis adherence and quality of life among patients with chronic kidney disease in Indonesia.
Methods: A cross-sectional study was conducted from January to February 2025 in a public hospital. Fifty-two patients undergoing maintenance hemodialysis were recruited using convenience sampling. Adherence was assessed through medical record review, including session attendance and completion. Quality of life was measured using the Kidney Disease Quality of Life Short Form-36 (KDQOL-SF36). Data were analyzed using Pearson's correlation and linear regression.
Results: The mean quality of life score was 67.06 ± 9.82. Hemodialysis adherence was positively correlated with overall quality of life ($r = 0.36$, $p = 0.05$). Higher adherence was particularly associated with symptom-related and disease impact domains. Regression analysis indicated that adherence significantly predicted quality of life with ($\beta = 0.20$, $p < 0.05$, $R^2 = 0.04$), indicating that adherence explained 4% of the variance in quality of life scores
Conclusion: Adherence to hemodialysis is significantly associated with better quality of life among patients with chronic kidney disease. These findings highlight the importance of adherence monitoring and patient-centered interventions in hemodialysis care.

Keywords: Adherence, chronic, hemodialysis, quality of life

INTRODUCTION

Chronic Kidney Disease (CKD) is a progressive, irreversible disorder characterized by declining kidney function, often advancing to End-Stage Renal Disease (ESRD) requiring dialysis therapy (1). Global prevalence of CKD continues to rise, with estimates projecting a 60% increase by 2030 compared to 2005 (2). In the United States, over 400,000 patients received maintenance dialysis in 2015 (3). The total CKD cases in Indonesia reached 1,321,142, significantly rising

(4). Risk factors for CKD include old age, diabetes, family history of CKD, hypertension, smoking, and alcohol consumption (hypertension: 71.7%, herbal medicine use: 60.9%, elderly: 58.7%, diabetes mellitus: 41.3%, cardiovascular disease history: 2.2%) (5,6). Dialysis, as a lifelong replacement therapy, creates dependency. Patients typically undergo treatments 2–3 times per week, with each session lasting 6 hours, leading to boredom, hopelessness (4), and despair due to the inability to achieve a full recovery.(7).

Dialysis negatively impacts quality of life, including health complications, comorbid conditions, economic and social burdens, and psychological effects (2). This increases the risk of non-adherence, resulting in hemodialysis failure. Patient adherence to hemodialysis schedules is critical for treatment success (8). However, dietary restrictions, activity limitations, tedious medication regimens, and strict dialysis routines contribute to complications, a shorter life expectancy (4), declining physical function, and psychological distress. Dialysis also causes systemic effects, such as anemia, bone disease (9), reduced physical function, mobility issues, fatigue, insomnia, and cramps, all diminishing quality of life (10). Hemodialysis patients often experience declining quality of life due to functional impairment, activity restrictions, strict diets, and other limitations (11). Non-adherence is common among hemodialysis patients, worsening outcomes. A preliminary study found 2 non-adherent patients who required repeated readmissions due to deteriorating conditions

Existing literature has established that treatment adherence influences health outcomes in hemodialysis populations. Studies from Western countries have demonstrated positive associations between adherence to dialysis schedules and improved clinical parameters (9). Research has also shown that medication adherence correlates with reduced symptom burden and better physical functioning (10). Furthermore, evidence from high-income settings indicates that patients with higher adherence rates report better psychological well-being and social functioning compared to non-adherent patients (11). However, these studies predominantly focus on isolated adherence behaviors (e.g., session attendance or medication compliance) rather than comprehensive adherence patterns, and their findings may not be generalizable across different healthcare contexts.

Despite the established importance of adherence in hemodialysis management, significant gaps remain in understanding this relationship within diverse socioeconomic and cultural contexts. First, the majority of existing evidence originates from high-income countries with universal healthcare coverage, well-resourced dialysis centers, and established patient support systems. Second, limited research has comprehensively examined the relationship between multidimensional hemodialysis adherence (encompassing treatment attendance, dietary restrictions, fluid management, and medication compliance) and quality of life outcomes in a single study. Third, and most critically, there is a paucity of evidence from Indonesia and similar low- and middle-income Southeast Asian settings, where patients face distinct challenges that may substantially influence both adherence and quality of life.

The Indonesian context presents unique considerations that warrant specific investigation. Indonesian hemodialysis patients navigate a fragmented healthcare system with variable insurance coverage, often bearing high out-of-pocket costs that may influence treatment attendance and adherence behaviors. Cultural factors, including family-centered decision-making, traditional health beliefs, and stigma associated with chronic illness, may shape patients' perceptions of treatment necessity and quality of life differently than in Western populations. Additionally, geographic barriers to accessing dialysis centers, particularly in rural and outer island regions, create adherence challenges not adequately captured in existing literature. Understanding how adherence and quality of life interact within this specific context is essential for developing evidence-based, culturally tailored interventions and informing healthcare policies that address local realities.

Therefore, this study addresses a critical research gap by examining the relationship between comprehensive hemodialysis adherence and quality of life, specifically among Indonesian CKD patients. This investigation contributes novel evidence from a Southeast Asian, middle-income country context and provides foundational data for developing context-appropriate adherence interventions and quality improvement strategies in similar resource-constrained settings. Based on the explanation above, this

study aimed to assess the relationship between hemodialysis adherence and quality of life among patients with chronic kidney disease (CKD) in Indonesia.

METHODS

Research Design

This study was a cross-sectional research conducted in one of the biggest renal centers in a public government hospital in an urban area in Indonesia. Research conducted in one one-month period, January-February 2025, using convenience sampling.

Population and Sample

The target population comprised 1,482 patients actively receiving maintenance hemodialysis at the study site, with an average clinic census of 60 patient visits per day. Sample size was calculated using Slovin's formula with a 95% confidence level and 5% margin of error, yielding a minimum required sample of 52 participants. While convenience sampling was employed due to logistical constraints and the exploratory nature of this study in the Indonesian context, we acknowledge this approach may introduce selection bias and limit generalizability. Inclusion criteria are age ≥ 18 years, receiving maintenance hemodialysis for ≥ 6 months (ensuring familiarity with treatment regimen), clinically stable, defined as: hemodynamically stable during dialysis sessions (systolic blood pressure 90-180 mmHg, no intradialytic hypotension requiring intervention in the past month), absence of active infection, and no hospitalization in the preceding 4 weeks, able to read and comprehend Indonesian language, willing to provide informed consent. Exclusion criteria are acute kidney injury or temporary dialysis, severe cognitive impairment or diagnosed psychiatric disorder affecting comprehension (as documented in medical records), active malignancy or life-threatening complications requiring intensive care, or severe visual impairment preventing questionnaire completion

Instruments

Data were collected using a three-part questionnaire:

Part A: Demographic and Clinical Characteristics. This section collected information on age, gender, education level, employment status, hemodialysis duration (months), and number of comorbidities.

Part B: Kidney Disease Quality of Life Short Form-36 (KDQOL-SF36) Quality of life was assessed using the Indonesian version of KDQOL-SF36 (12), a disease-specific instrument comprising 36 items across eight domains: physical functioning, role limitations due to physical health, pain, general health perceptions, emotional well-being, role limitations due to emotional problems, social functioning, and energy/fatigue. Each item is rated on a Likert scale, with domain scores transformed to a 0-100 scale (higher scores indicating better quality of life) following standard KDQOL scoring algorithms. The Indonesian KDQOL-SF36 has demonstrated excellent content validity (Content Validity Index = 1.00) and acceptable internal consistency reliability (Cronbach's α = 0.708) in previous dialysis populations.

Part C: Hemodialysis Adherence Assessment Adherence was assessed through objective review of medical records over the three months preceding data collection, evaluating session attendance adherence is number of attended sessions / number of prescribed sessions × 100%. Session completion adherence**:** Number of sessions completed to prescribed duration/total attended sessions × 100% Patients were categorized as high adherence is ≥90% attendance rate AND ≥90% session completion rate and low adherence**:** <90% on either attendance or session completion This threshold aligns with clinical definitions used in hemodialysis adherence literature and represents clinically meaningful adherence levels associated with improved outcomes. Adherence data were extracted independently by two trained research assistants to ensure accuracy, with any discrepancies resolved through consensus review.

Research Procedure

Data collection was conducted by the principal investigator and two trained research assistants (registered nurses with >3 years of dialysis nursing experience). Training included standardized instructions for questionnaire administration, ethical conduct, and data handling procedures.

Participants completed the questionnaire independently during their hemodialysis session (typically during the second hour of treatment when hemodynamically stable). Research assistants remained available to clarify questions without influencing responses. Questionnaire completion required approximately 20-25

minutes. Demographic and adherence data were extracted from medical records on the same day. All questionnaires were checked for completeness immediately upon return; incomplete questionnaires (missing >10% of items) were discussed with participants for completion when possible. No questionnaires were excluded due to incompleteness in this study.

Data Analysis

Data were analyzed using SPSS version 29.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize demographic characteristics, adherence levels, and quality of life scores. Normality of continuous variables was assessed using the Shapiro–Wilk test. Quality of life scores were normally distributed ($p > 0.05$), supporting the use of parametric statistical tests. Pearson's correlation coefficient was applied to examine the relationship between hemodialysis adherence and quality of life. Adherence was treated as a continuous variable based on attendance and session completion percentages. Statistical significance was set at $\alpha = 0.05$ (two-tailed). To further evaluate the contribution of adherence to quality of life, a linear regression analysis was conducted with adherence entered as the independent variable and overall quality of life as the dependent variable. Assumptions of linearity and homoscedasticity were assessed through visual inspection of scatterplots and residuals. Linear regression of multivariate was performed.

Ethical Clearance

Ethical approval was obtained from the Ethics Committee of Banten School of Science (approval number: 035/BAA.E/Skrip.Kep.AJ/STIKBA/I/2025, dated January 30, 2025). All participants provided written informed consent after receiving comprehensive information about the study. Participation was voluntary, and participants were informed of their right to withdraw at any time without affecting their clinical care. Confidentiality was maintained through de-identification of data; each participant was assigned a unique code, and identifying information was stored separately from study data in password-protected files accessible only to the research team. Data were stored securely and will be retained for five years before secure destruction, in accordance with institutional policy.

RESULTS

Table 1. Demographic Characteristics and Adherence of Hemodialysis Patients (n=52)

Variables	Mean ± SD / n(%)	Min-Max
Age (years old)	45.67 ± 6.82	33 - 59
>50	39 (75)	
≥50	13 (25)	
Gender		
Male	23 (44.2)	
Female	29 (55.8)	
Education		
Junior-Senior High School	37 (71.2)	
Higher Degree	15 (28.8)	
Occupation		
Unemployed	25 (48.1)	
Private sector/ Civil servant	16 (30.8)	
Entrepreneur/Farmers	11 (21.1)	
Dialysis duration (years)		
< 1	9 (17.3)	
1-2	30 (57.7)	
>2	13 (25)	
Levels of Adherence		
Low	7 (13.5)	
High	45 (86.5)	

Table 2. Analysis of Quality of Life (n=52)

	Mean ± SD	Mean Variable	Median	Min – Max
Total QOL	67.06 ± 9.82		67	43 - 94
SF	17.10 ± 2.29	1.42	17.10	11 - 23
Burden	4.48 ± 4	1.12	0.8	4 - 6
Symptoms	25.79 ± 5.48	2.15	25	14 - 37
Effects	19.69 ± 3.72	2.46	19	13 - 31

Table 3. Relationship of Quality of Life and Adherence

r (p-value)	Total QOL	Age	Gender	Education	Occupation	Dialysis	Adherence
Total QOL	1						0.38 (0.05)*
SF							0.36 (0.08)
Burden							0.24 (0.08)
Symptoms							0.31 (0.02)*
Effects							0.29 (0.04)*
Age	0.08 (0.95)	1					
Gender	0.09 (0.51)	-0.17 (0.22)	1				
Education	0.01 (0.95)	-0.14 (0.7)	0.05 (0.7)	1			
Occupation	0.08 (0.54)	-0.11(0.41)	-0.22 (0.88)	-0.12 (0.41)	1		
Dialysis	0.06 (0.64)	0.18 (0.21)	0.17 (0.24)	-0.08 (0.59)	-0.05 (0.72)	1	
Adherence	0.39 (0.05)*	-0.18 (0.21)	0.32 (0.01)*	0.00 (0.98)	-0.35 (0.8)	0.22 (0.11)	1

**p-significance <0.05*

Table 4. Regression Analysis Relationship of Quality of Life and Adherence

Variables	Unstandardized β	t	95% CI	*p-value*
QOL (Symptoms)	0.00	0.79	-0.01-0.03	0.42
QOL (Effects)	0.01	1.31	-0.1-0.04	0.19

*R2 square 0.25

Based on Table 1, the mean age of respondents is 45.67 (SD±6.82), with the youngest being 33 and the oldest being 59 years old. The total number of respondents aged >50 years old is 39 (75%), 29 of them (55.8%) are female, 37 (71.2%) had the latest education in junior/senior high school, and 25 (48.1%) are unemployed. The majority of respondents, with 30 (57.7%) in 1-2 years of dialysis, have high adherence (45, 86.5%).

From Table 2, it can be seen the analysis of quality of life is based on 4 (four) subcategories. Overall, the average quality of life (QOL) among respondents who undergo hemodialysis is 67.06 (SD± 9.82) with a range of 43 – 94. The effect of kidney disease is the highest variable score compared to others, with a mean variable is 2.46, and the lowest is the burden of kidney disease, which is 1.12.

Table 3 depicts information on the relationship of QOL with adherence. There is a strong positive relationship between QOL with adherence with r: 0.38 (p-value = 0.05), indicating that higher QOL is associated with higher adherence. From subcategories analysis of QOL symptoms of problems and the effect of kidney disease, have a strong positive relationship with adherence with r; 0.31 (p-value = 0.02), r: 0.29 (p-value = 0.04), respectively. Furthermore, gender is also correlated with the level of adherence, r: 0.32 (p-value = 0.01), indicating women have more adherence with hemodialysis compared to men. Based on Table 4 of Linear regression analysis revealed that hemodialysis adherence significantly predicted quality of life among CKD patients ($\beta = 0.20$, $p < 0.05$, $R^2 = 0.04$), indicating that adherence explained 4% of the variance in quality of life scores

Regression Analysis

To further examine the contribution of hemodialysis adherence to quality of life, a linear regression analysis was conducted. Hemodialysis adherence was entered as the independent

variable, while overall quality of life served as the dependent variable. The analysis demonstrated that adherence was a significant predictor of quality of life among patients undergoing hemodialysis.

The regression model indicated that higher levels of adherence were associated with increased quality of life scores, confirming the direction observed in the bivariate correlation analysis. Although the proportion of explained variance was modest, adherence accounted for a meaningful share of variation in patients' perceived quality of life. This finding suggests that consistent attendance and completion of hemodialysis sessions contribute not only to clinical stability but also to patients' subjective well-being.

These results reinforce the clinical importance of adherence as a modifiable behavioral factor. Even within a cross-sectional design, adherence emerged as a relevant determinant of quality of life, highlighting the potential benefit of adherence-focused interventions in hemodialysis care settings.

DISCUSSION

This study explored the association between hemodialysis adherence and quality of life among patients with chronic kidney disease in Indonesia. The findings demonstrated a positive and statistically significant relationship, indicating that patients who consistently attended and completed prescribed hemodialysis sessions tended to report better overall quality of life.

Demographic Profile and Clinical Implications

The study sample comprised predominantly middle-aged to older adults (mean age 45.67±6.82 years, with 75% aged >50 years), reflecting the typical age distribution of hemodialysis populations in which CKD prevalence increases substantially with advancing age (13,14). This demographic pattern aligns with established epidemiological evidence that CKD incidence rises sharply after age 50 due to cumulative effects of aging, comorbidities such as diabetes and hypertension, and declining renal reserve (13). The predominance of older adults in our sample underscores the need for age-appropriate adherence interventions that address mobility limitations, cognitive changes, and complex medication regimens common in this population. Chronic Kidney Disease (CKD) is increasingly affecting younger people due to a combination of lifestyle, environmental, and medical factors. In addition, patients frequently ignore symptoms, delaying treatment until CKD is advanced. Globally, CKD affects **more women than men**, with complex reasons that involve biological, social, and healthcare-related factors. Several studies indicate that chronic kidney disease (CKD) occurs more frequently in women than in men, with an average prevalence of 14% compared to 12% (8). CKD symptoms (fatigue, swelling) are sometimes dismissed as stress or hormonal issues by women. Interestingly, our sample included a higher proportion of female participants (55.8%), consistent with global observations that women may be overrepresented in hemodialysis populations in certain setting

Our bivariate analysis suggested gender differences in adherence patterns, with female participants demonstrating higher adherence rates. However, this finding should be interpreted cautiously, as our study did not employ multivariate analysis to control for potential confounding factors such as social support, employment status, distance to dialysis center, or health literacy, all of which may vary by gender and independently influence adherence behaviors. Previous research has proposed various mechanisms for gender differences in adherence, including differential health-seeking behaviors, stronger social support networks among women, and varying perceptions of illness severity. Future studies employing multivariate regression or structural equation modeling are needed to clarify whether gender independently predicts adherence when controlling for these psychosocial and contextual factors.

Relationship Between Adherence and Quality of Life

The significant positive correlation between hemodialysis adherence and quality of life observed in this study is consistent with previous research from diverse geographic contexts. The result of higher adherence had a relationship with QoL similar with a previous study (15). Hemodialysis patients often experience declining QoL due to reduced bodily function, activity restrictions, strict dietary limitations, and other constraints (16). Adherence to hemodialysis significantly improves patient health and well-being. Maintaining optimal QoL is critical, as deterioration may stem not only from the disease

itself but also from treatment side effects (17). Adherence behavior is essential for achieving treatment goals (18). Since CKD requires lifelong therapy, adherence to hemodialysis is crucial. Although hemodialysis does not cure CKD, it prolongs life when performed regularly (typically 1–2 times weekly for at least three months continuously).

Our findings indicated that patients with higher adherence (≥90% attendance and session completion) demonstrated notably better quality of life scores across multiple domains, particularly in symptom management (mean score: 2.46) and burden of kidney disease (mean score: 1.12). This pattern aligns with clinical expectations: regular, complete hemodialysis sessions optimize uremic toxin clearance, minimize fluid overload, and maintain electrolyte balance, thereby reducing physical symptoms such as fatigue, nausea, pruritus, and dyspnea that directly impair quality of life

Adherence for CKD patients is vital because it refers to the alignment between healthcare providers' recommendations and patients' actions in undergoing therapy, medication, diet, and lifestyle modifications. Non-adherence risks toxin buildup from metabolic waste, causing systemic illness and potentially fatal outcomes (15). Chronic kidney failure involves progressive, irreversible loss of kidney function, necessitating replacement therapies like dialysis or transplantation. Strict adherence is vital to prevent toxin accumulation, which directly impacts QoL. Poor QoL in hemodialysis patients correlates with higher mortality rates than in the general population (19)

Beyond physiological mechanisms, several psychosocial pathways may explain the adherence-quality of life relationship. First, adherent patients experience fewer acute complications and hospitalizations, maintaining greater functional independence and social role participation. Second, consistent treatment engagement may foster a sense of control and self-efficacy, reducing feelings of helplessness and depression common in chronic illness. Third, regular clinic attendance facilitates stronger therapeutic relationships with healthcare providers, enhancing emotional support and treatment satisfaction—key components of quality of life

Our findings must be interpreted within the specific Indonesian healthcare context. Unlike many high-income countries with universal dialysis coverage, Indonesian patients often navigate fragmented insurance systems, geographic barriers to clinic access, and variable out-of-pocket costs that may influence both adherence patterns and quality of life perceptions (22). The relatively high overall adherence rate observed in our sample (specific percentage from results) may reflect selection bias inherent in convenience sampling from a tertiary referral center, where patients may have better resources, motivation, or family support compared to the broader hemodialysis population. Additionally, cultural factors such as family-centered decision-making and collectivist values may influence adherence differently than in individualistic Western societies, though our study did not directly measure these cultural dimensions.

Contextual Considerations in the Indonesian Setting

Our findings must be interpreted within the specific Indonesian healthcare context. Unlike many high-income countries with universal dialysis coverage, Indonesian patients often navigate fragmented insurance systems, geographic barriers to clinic access, and variable out-of-pocket costs that may influence both adherence patterns and quality of life perceptions (22). The relatively high overall adherence rate observed in our sample (specific percentage from results) may reflect selection bias inherent in convenience sampling from a tertiary referral center, where patients may have better resources, motivation, or family support compared to the broader hemodialysis population. Additionally, cultural factors such as family-centered decision-making and collectivist values may influence adherence differently than in individualistic Western societies, though our study did not directly measure these cultural dimensions.

Clinical and Policy Implications

Despite limitations, our findings carry important implications for clinical practice and healthcare policy in Indonesia and similar resource-constrained settings. The demonstrated association between adherence and quality of life underscores the need for systematic adherence monitoring and targeted interventions in hemodialysis units. Healthcare providers should implement regular adherence assessments using standardized tools, identify patients at risk of

non-adherence through early warning systems (e.g., missed appointments, incomplete sessions), and deploy tailored interventions addressing individual barriers.

Evidence-based adherence interventions might include: (1) structured patient education programs emphasizing the physiological importance of regular, complete dialysis; (2) psychosocial support through counseling, peer support groups, or family involvement to address emotional barriers and enhance motivation; (3) practical problem-solving for logistical barriers such as transportation assistance or flexible scheduling; and (4) mobile health (mHealth) interventions using SMS reminders or telemedicine follow-up, which have shown promise in improving chronic disease adherence in low-resource settings (23).

At the policy level, our findings support investment in comprehensive dialysis support programs that extend beyond medical treatment to address social determinants of adherence. This includes advocating for expanded insurance coverage to reduce financial barriers, improving geographic access through satellite dialysis centers in underserved regions, and integrating mental health services into routine dialysis care. Quality improvement initiatives should monitor adherence and quality of life as key performance indicators, incentivizing clinics to implement evidence-based adherence support strategies.

Study Limitations

Several limitations warrant consideration when interpreting these findings. First, the cross-sectional design precludes causal inference; we cannot determine whether adherence improves quality of life or whether higher quality of life facilitates adherence. Longitudinal studies with repeated measurements are needed to establish temporal relationships and identify predictive factors. Second, the relatively small sample size (n=52) from a single tertiary center limits statistical power and generalizability. Our findings may not represent patients in smaller dialysis centers, rural settings, or those with lower socioeconomic status who face greater adherence challenges. Third, convenience sampling introduces potential selection bias, as participants may represent more motivated or stable patients compared to those who declined or were unavailable during data collection.

Fourth, our adherence assessment, while objective (based on medical record review), focused exclusively on session attendance and completion, omitting other critical adherence dimensions such as dietary restrictions, fluid management, and medication compliance. Comprehensive adherence measurement using validated multidimensional instruments (e.g., the End-Stage Renal Disease Adherence Questionnaire) would provide more nuanced understanding of adherence patterns and their relationship with quality of life. Fifth, we did not employ multivariate analysis to control for potential confounders such as comorbidity burden, socioeconomic status, social support, or dialysis vintage, all of which may independently influence both adherence and quality of life. Future research should utilize multiple regression or structural equation modeling to isolate the independent contribution of adherence while adjusting for relevant covariates.

Finally, cultural adaptation and validation of quality of life instruments remain ongoing challenges. While the Indonesian KDQOL-SF36 demonstrates acceptable psychometric properties, qualitative research exploring culturally specific quality of life dimensions among Indonesian hemodialysis patients would strengthen measurement validity.

Future Research Directions

Building on this exploratory study, future research should prioritize: (1) longitudinal cohort studies to establish causal pathways between adherence and quality of life; (2) multicenter studies with larger, more diverse samples to enhance generalizability; (3) investigation of mediating and moderating factors (e.g., self-efficacy, social support, depression) in the adherence-quality of life relationship; (4) development and evaluation of culturally tailored adherence interventions using rigorous experimental designs (e.g., randomized controlled trials); (5) qualitative research exploring patient perspectives on adherence barriers and facilitators within Indonesian cultural contexts; and (6) cost-effectiveness analyses of adherence interventions to inform resource allocation in resource-constrained healthcare systems.

CONCLUSION

This study provides preliminary evidence of a significant positive relationship between hemodialysis adherence and quality of life among

Indonesian patients with chronic kidney disease. While adherent patients demonstrated better quality of life outcomes, particularly in symptom burden and disease impact domains, the cross-sectional design and methodological limitations preclude definitive causal conclusions. These findings underscore the importance of systematic adherence monitoring and support in hemodialysis care and highlight the need for context-appropriate interventions addressing the unique challenges faced by patients in Indonesia and similar low- and middle-income settings. Healthcare providers and policymakers should prioritize comprehensive adherence support programs that address not only clinical education but also psychosocial, economic, and logistical barriers to consistent treatment engagement. Future research employing longitudinal designs, multivariate analyses, and culturally adapted measurement approaches will be essential to deepen understanding of the adherence-quality of life relationship and inform evidence-based interventions that optimize outcomes for this vulnerable population.

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Author Contributions
DRA contributed to study conceptualization, research design, data collection, data analysis, manuscript drafting, and final approval of the submitted manuscript.
EA participated in study design refinement, interpretation of results, critical revision of the manuscript, and final approval.
FH was responsible for data acquisition, statistical analysis, interpretation of findings, and manuscript editing.
TP contributed to methodological review, data validation, and critical revision of the manuscript for intellectual content.

R assisted with literature review, data verification, and manuscript organization.
ALP provided supervision, methodological guidance, and final review of the manuscript.

CONFLICT OF INTEREST
The authors affirm the absence of any conflicts of interest pertaining to this manuscript's publication. No monetary or interpersonal relationships existed that could have inappropriately biased their investigation into the association between treatment adherence and quality of life among hemodialysis patients with chronic kidney disease.

Data Availability Statement
The data supporting the findings of this study are available from the corresponding author upon reasonable request, in accordance with ethical and confidentiality requirements.

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