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Associations of Mobility, Physical Activity, and Work Ability with Quality of Life among Hemodialysis Patients in Coastal and Wetland Communities: A Cross-Sectional Study

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Research Article

Keywords: Chronic kidney disease, Hemodialysis, Functional capacity, Health-related quality of life, Mobility, Rehabilitation

Posted Date: November 6th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11191272/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Patients undergoing hemodialysis experience various functional limitations that can reduce their quality of life. However, most studies still focus on the clinical aspects of the disease, while the contributions of functional capacity, including mobility, physical activity, and work ability, remain incompletely understood, particularly among populations living in geographically distinct settings such as coastal and wetland communities. This study aimed to analyze the independent associations of mobility, physical activity, and work ability with quality of life among hemodialysis patients living in coastal and wetland communities in Riau Province, Indonesia.

Methods

This cross-sectional study included 272 patients undergoing hemodialysis at three hemodialysis centers in Riau Province, Indonesia, from June to August 2026. Quality of life was measured using the Kidney Disease Quality of Life Short Form (KDQOL-SF); mobility was assessed using the Mobility Domain of the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0); physical activity was assessed using the International Physical Activity Questionnaire-Short Form (IPAQ-SF); and work ability was assessed using the Work Ability Index (WAI). Multivariable linear regression analysis was performed to evaluate the independent associations of these functional variables with quality-of-life domains (KDCS, PCS, and MCS) after adjusting for demographic and clinical factors.

Results

WAI showed consistent, independent associations with all quality-of-life domains. WAI was positively associated with KDCS (β = 0.470; $p < 0.001$), PCS (β = 0.202; $p = 0.002$), and MCS (β = 0.406; $p < 0.001$). Higher WHODAS Mobility Domain scores were negatively associated with KDCS (β = -0.380; $p < 0.001$) and PCS (β = -0.421; $p < 0.001$), but were not significantly associated with MCS. Physical activity showed no independent association with any quality-of-life domain after adjustment. The regression models explained 44.5% of the variance in KDCS, 36.2% of the variance in PCS, and 20.5% of the variance in MCS.

Conclusion

Work ability and mobility were independently associated with quality of life among hemodialysis patients in coastal and wetland communities in Riau Province. These findings underscore the importance of a function-centered care approach that incorporates functional capacity assessment and rehabilitation strategies while considering patients' individual conditions and environmental contexts.

Background

Chronic kidney disease (CKD) is a growing global health problem that contributes substantially to morbidity and mortality. In advanced stages, patients require kidney replacement therapy, such as hemodialysis, to sustain life. Although hemodialysis effectively prolongs survival, this long-term therapy is often accompanied by various physical, psychological, and social consequences that can reduce health-related quality of life [1]. In Indonesia, kidney failure is classified as a catastrophic disease that places a substantial burden on healthcare services and financing; therefore, the management of hemodialysis patients needs to extend beyond maintaining treatment continuity to preserving patients' functional capacity, independence, and quality of life [2] .

Among patients receiving hemodialysis, reduced quality of life is associated not only with disease progression but also with declines in functional capacity. Functional impairments such as fatigue, skeletal muscle loss, reduced aerobic capacity, physical weakness, and mobility limitations are common and may compromise independence and the ability to perform activities of daily living [3, 4]. These limitations may also reduce participation in social, occupational, and community activities, which are important components of health-related quality of life. Furthermore, physical inactivity is highly prevalent among hemodialysis patients, and higher levels of physical activity have been associated with better quality-of-life outcomes across multiple domains [5]. Given the substantial functional burden experienced by this population, assessment and management strategies should extend beyond traditional clinical indicators to include functional dimensions that reflect patients' ability to maintain independence, engage in meaningful activities, and participate in everyday life.

Mobility, physical activity, and work ability are important and distinct dimensions of functional capacity among individuals receiving hemodialysis. Physical function and mobility limitations have been recognized as important aspects of health among patients with kidney disease, while physical inactivity is prevalent among those receiving dialysis [5, 6]. Work ability represents another dimension of functioning that may be compromised among individuals with end-stage kidney disease receiving hemodialysis, as employment and occupational functioning may be affected by the burden of kidney disease and dialysis treatment [7]. Together, these dimensions capture different aspects of patients' ability to function physically, remain physically active, and sustain productive roles during long-term treatment.

The multidimensional nature of quality of life further supports the examination of these functional dimensions across distinct health domains. The Kidney Disease Quality of Life Short Form (KDQOL-SF) combines kidney disease-specific content with generic health measures, allowing quality of life to be assessed from multiple perspectives, including physical and mental health [8, 9]. Examining mobility, physical activity, and work ability together may therefore provide a more comprehensive understanding of the functional factors associated with quality of life and whether these dimensions show different patterns of association across kidney disease-specific, physical, and mental health-related quality-of-life domains.

Despite growing research on quality of life among patients receiving hemodialysis, evidence remains limited regarding the simultaneous associations of mobility, physical activity, and work ability with different quality-of-life domains. In particular, it remains unclear whether these functional dimensions are differentially associated with kidney disease-specific, physical, and mental health outcomes. Clarifying these relationships may support more comprehensive nursing assessments by identifying the functional dimensions most closely associated with specific aspects of patients' quality of life and may help inform the prioritization of supportive care. Therefore, this study aimed to analyze the associations of mobility, physical activity, and work ability with quality of life among patients receiving hemodialysis.

Methods

Study Design and Setting

This analytical cross-sectional study examined the associations of mobility, physical activity, and work ability with quality of life among patients undergoing hemodialysis in Riau Province, Indonesia. The study was conducted at three hemodialysis centers in Riau Province, namely Arifin Achmad Regional General Hospital, Dumai Regional General Hospital, and Duri Regional General Hospital. These three hospitals provide hemodialysis services to patients from various areas of Riau Province, including those living in coastal and wetland communities. Data were collected from June to August 2026. All primary variables and participant characteristics were measured during the same study period. Therefore, the findings were interpreted as associations rather than evidence of causal relationships.

Study Population and Sample

The target population in this study consisted of patients with chronic kidney disease undergoing hemodialysis who resided in coastal and/or wetland communities in Riau Province. The accessible population consisted of patients undergoing hemodialysis at Arifin Achmad Regional General Hospital, Dumai Regional General Hospital, and Duri Regional General Hospital during the data collection period. A total of 272 participants were recruited from the three hospitals, including 95 participants from Arifin Achmad Regional General Hospital, 100 participants from Dumai Regional General Hospital, and 77 participants from Duri Regional General Hospital. All participants who met the study criteria, agreed to participate, and had complete data required for the analysis were included in the final analysis.

Inclusion and Exclusion Criteria

Participants included in the study were patients with chronic kidney disease undergoing hemodialysis at the study hospitals, residing in coastal and/or wetland communities of Riau Province, able to communicate and complete the interview, and willing to participate after providing informed consent. Patients were excluded if they had impaired consciousness or physical or cognitive conditions that

prevented them from completing the study instruments. Patients who declined to participate were not enrolled in the study.

Participant Recruitment and Sampling Technique

Potential participants were identified among patients undergoing routine hemodialysis at the three hospitals during the data collection period. The researcher or enumerator conducted an initial assessment of each potential participant's eligibility based on the inclusion and exclusion criteria. Eligible patients were provided with information regarding the study objectives, data collection procedures, data confidentiality, the voluntary nature of participation, and the right to refuse or withdraw from the study without affecting the healthcare they received. Patients who agreed to participate provided informed consent before data collection. All eligible patients encountered consecutively during the study period were invited to participate; therefore, consecutive sampling was used.

Sample Size

The study sample size was determined by the number of eligible patients recruited from the three hemodialysis centers during the study period and included in the final analysis. A total of 272 patients participated in the study, comprising 95 patients from Arifin Achmad Regional General Hospital, 100 patients from Dumai Regional General Hospital, and 77 patients from Duri Regional General Hospital. This study was initially designed to include additional hemodialysis centers in Riau Province. However, the current analysis was limited to data from the three hospitals that completed data collection. Therefore, the reported sample size represents the actual number of participants recruited from these three centers rather than the initial sampling target for seven hospitals.

Study Variables

The dependent variable in this study was quality of life, measured using the KDQOL-SF, with outcomes represented by the KDCS, PCS, and MCS component summary scores. The main independent variables were work ability, mobility, and physical activity. The covariates included age, sex, education, marital status, employment status, living arrangement, and duration of hemodialysis. All main variables were analyzed as continuous variables in accordance with their scoring properties and the statistical models used.

Research Instruments

This study used four instruments to measure quality of life, mobility, physical activity, and work ability. Quality of life was measured using the Indonesian version of the Kidney Disease Quality of Life Short Form (KDQOL-SF™ v1.3), which covers general health and kidney disease-specific aspects. Scores were transformed to a 0–100 scale, with higher scores indicating better quality of life. This instrument has

demonstrated good reliability among Indonesian hemodialysis patients (Cronbach's alpha = 0.776; inter-domain range = 0.716–0.883) [10]. Mobility was assessed using the Indonesian version of the WHODAS 2.0 Mobility Domain, which evaluates limitations in standing, moving around, changing locations, and walking. Higher scores indicate greater mobility limitations. This instrument has demonstrated good reliability (Cronbach's alpha = 0.853; test–retest reliability = 0.784) [11]. Physical activity was measured using the Indonesian version of the International Physical Activity Questionnaire-Short Form (IPAQ-SF) and expressed in MET-minutes/week. The total score was used as a continuous variable in the regression analysis [12]. Work ability was measured using the Work Ability Index (WAI), which assesses work ability based on health status, job demands, physical capacity, and mental capacity. WAI was analyzed as a continuous variable and has demonstrated adequate reliability in the Indonesian population (Cronbach's alpha = 0.746) [13]. Employment status was recorded as a participant characteristic to support the interpretation of WAI scores.

Data Analysis

Data were analyzed using IBM SPSS Statistics version 29. Participant characteristics were summarized descriptively using frequencies and percentages for categorical variables and means ± standard deviations or medians (IQRs) for numerical variables, according to the data distribution. Bivariate associations between the Work Ability Index (WAI), WHODAS Mobility Domain, physical activity, and quality of life were analyzed using Pearson or Spearman correlation tests, as appropriate for the data characteristics. The primary analysis was performed using multivariable linear regression to evaluate the independent associations of WAI, WHODAS Mobility Domain, and physical activity with the three KDQOL-SF domains (KDCS, PCS, and MCS) after adjusting for age, sex, education, marital status, employment status, living arrangement, and duration of hemodialysis. Linear regression assumptions, including multicollinearity, were assessed before the analysis. Regression results were reported as standardized beta coefficients (β), p-values, R^2, and adjusted R^2. All analyses used two-sided tests with a significance level of $p < 0.05$.

Ethical Considerations

This study received ethical approval from the Research Ethics Committee of the Faculty of Nursing, Universitas Riau (No. 005704/FKp Universitas Riau/2026). All participants were provided with information regarding the study objectives, procedures, benefits, data confidentiality, and their right to refuse or withdraw before providing informed consent. Respondent identities were kept confidential using identification codes, and only anonymized data were used for analysis and publication.

Results

The demographic and clinical characteristics of the participants are presented in Table 1.

Table 1. Demographic and Clinical Characteristics of Participants (N = 272)

Characteristic	Median (Min–Max)	
Age (years)	53 (18-83)	
Duration of hemodialysis (days)	560 (1-6,570)	
Characteristic	**Participants (n)**	**Percentage (%)**
Sex		
Female	145	53.3
Male	127	46.7
Educational attainment		
No formal education	6	2.2
Elementary school/equivalent	63	23.2
Junior High School/Equivalent	55	20.2
High School/equivalent	118	43.4
Bachelor’s degree	30	11
Current employment status		
Employees	36	13.2
Self-employed	20	7.4
Non-permanent employment	8	2.9
On leave	1	0.4
Unemployed	176	64.7
Retired	15	5.5
Other	16	5.9
Marital status		
Never married	22	8.1
Married	234	86.0
Divorced	6	2.2
Widowed	10	3.7
Living arrangement		
Living alone	4	1.5
Living with spouse	40	14.7

Characteristic	Median (Min–Max)	
Living with spouse and children	140	51.5
Living with children/other family members	75	27.6
Living with parents	13	4.8
Monthly family income		
< IDR 1,500,000	10	3.7
IDR 1,500,000–2,999,999	60	22.1
IDR 3,000,000–4,999,999	77	28.3
≥ IDR 5,000,000	6	2.2
Preferred not to answer	119	43.8

This study included 272 hemodialysis patients. The median age of the participants was 53 years, with an age range of 18-83 years. The median duration of hemodialysis was 560 days. The sex distribution showed that female participants outnumbered male participants, with 145 women (53.3%). Based on educational attainment, most participants had completed senior high school or equivalent (118 participants; 43.4%), followed by elementary school or equivalent (63 participants; 23.2%) and junior high school or equivalent (55 participants; 20.2%). Regarding employment status, the majority of participants were unemployed (176 participants; 64.7%), while other groups included employees (36 participants; 13.2%) and the self-employed (20 participants; 7.4%). By marital status, most participants were married (234; 86.0%). In terms of living arrangement, most participants lived with their spouse and children (140 participants; 51.5%), followed by those living with children or other family members (75 participants; 27.6%). Among participants who reported their monthly family income, the IDR 3,000,000–4,999,999 category was the most common (77 participants; 28.3%), while 119 participants (43.8%) preferred not to report their income. The descriptive statistics of the study variables are presented in Table 2.

Table 2. Descriptive Statistics of Study Variables (n = 272)

Study Variable	Median	Minimum–Maximum
Work Ability Index (WAI)	29	11-44.50
WHODAS Mobility Domain	4	0-20
Physical Activity (MET-min/week)	592.50	0-17,838
KDQOL-SF: Kidney Disease Component Summary (KDCS)	66.65	34.17-88.22
KDQOL-SF: Physical Component Summary (PCS)	33.62	17.44-57.47
KDQOL-SF: Mental Component Summary (MCS)	42.77	26.60-63.61

Descriptive analysis showed the distribution of scores across the study variables among 272 hemodialysis patients. The Work Ability Index (WAI) had a median score of 29, with a range of 11-44.50. The WHODAS Mobility Domain had a median score of 4 (range 0-20), while physical activity, measured in MET-min/week, had a median of 592.50 (range 0-17,838). For quality of life measured using the KDQOL-SF, the Kidney Disease Component Summary (KDCS) had a median score of 66.65 (range: 34.17-88.22). Meanwhile, the Physical Component Summary (PCS) and Mental Component Summary (MCS) had median scores of 33.62 (range: 17.44-57.47) and 42.77 (range: 26.60-63.61), respectively.

The correlation analysis between Work Ability Index, WHODAS Mobility Domain, physical activity, and quality of life is presented in Table 3.

Table 3. Spearman Correlation Analysis of Work Ability Index, WHODAS Mobility Domain, and Physical Activity with Quality of Life among Hemodialysis Participants (n = 272)

Independent Variable	Dependent Variable	Correlation Coefficient (r)	Direction of Association	*p-value*	Strength of Association
Work Ability Index (WAI)	KDCS	0.566	Positive	<0.001	Moderate-to-strong
Work Ability Index (WAI)	PCS	0.411	Positive	<0.001	Moderate
Work Ability Index (WAI)	MCS	0.410	Positive	<0.001	Moderate
WHODAS Mobility Domain	KDCS	-0.418	Negative	<0.001	Moderate
WHODAS Mobility Domain	PCS	-0.548	Negative	<0.001	Moderate-to-strong
WHODAS Mobility Domain	MCS	-0.218	Negative	<0.001	Weak
Physical Activity	KDCS	0.350	Positive	<0.001	Weak-to-moderate
Physical Activity	PCS	0.312	Positive	<0.001	Weak-to-moderate
Physical Activity	MCS	0.239	Positive	<0.001	Weak

Note: KDCS = Kidney Disease Component Summary; PCS = Physical Component Summary; MCS = Mental Component Summary; WAI = Work Ability Index; WHODAS = World Health Organization Disability Assessment Schedule; r_s = Spearman rank correlation coefficient

Correlation analysis showed that functional ability measures were significantly associated with quality of life among hemodialysis patients. The Work Ability Index (WAI) showed significant positive associations

with all quality-of-life domains, with the strongest association observed for the kidney disease-specific component (KDCS) (r_s = 0.566; p < 0.001). This finding indicates that higher work ability was associated with better kidney disease-related quality of life. In contrast, higher WHODAS Mobility Domain scores were negatively associated with quality of life. The strongest negative association was observed for the physical component (PCS) (r_s = −0.548; p < 0.001), indicating that greater mobility limitations were associated with poorer quality of life, particularly in the physical domain. Physical activity also showed positive associations with quality of life, although the associations were weaker than those observed for WAI. The strongest association for physical activity was observed with the KDCS domain (r_s = 0.350; p < 0.001). Overall, the correlation results showed that work ability and physical activity were positively associated with quality of life, whereas higher WHODAS Mobility Domain scores, indicating greater mobility limitations, were negatively associated with quality of life. The multivariable linear regression analysis of factors associated with quality-of-life outcomes is presented in Table 4, Panels A and B**.**

The multivariable linear regression analysis of factors associated with quality-of-life outcomes is presented in Table 4, Panels A and B.

Table 4. Adjusted Multivariable Linear Regression Analysis of Factors Associated with KDQOL-SF Domains

Panel A. Regression Coefficients for Factors Associated with KDQOL-SF Domains

Predictor	**KDCS β (*p-value*)**	**PCS β (*p-value*)**	**MCS β (*p-value*)**
Main variables			
Work Ability Index (WAI)	0.470 (<0.001)	0.202 (0.002)	0.406 (<0.001)
WHODAS Mobility Domain	-0.380 (<0.001)	-0.421 (<0.001)	-0.102 (0.123)
Physical Activity	-0.011 (0.834)	-0.081 (0.164)	0.044 (0.496)
Covariates			
Age	0.226 (<0.001)	0.022 (0.711)	0.081 (0.221)
Education	-0.064 (0.177)	-0.038 (0.457)	0.111 (0.048)
Marital status	-0.033 (0.586)	-0.130 (0.047)	-0.046 (0.530)
Employment status	-0.007 (0.893)	0.083 (0.184)	-0.087 (0.212)
Living arrangement	-0.018 (0.759)	0.168 (0.007)	-0.017 (0.802)
Sex	-0.002 (0.965)	0.079 (0.132)	0.006 (0.914)
Duration of hemodialysis	0.005 (0.920)	-0.001 (0.990)	0.031 (0.585)

Panel B. Model Fit

Outcome	R^2	Adjusted R^2	F-statistic	*p-value*
KDCS	0.445	0.424	20.952	<0.001
PCS	0.362	0.338	14.833	<0.001
MCS	0.205	0.175	6.735	<0.001

Note: β = standardized regression coefficient; KDCS = Kidney Disease Component Summary; PCS = Physical Component Summary; MCS = Mental Component Summary; WAI = Work Ability Index; WHODAS = World Health Organization Disability Assessment Schedule. Multivariable linear regression models were adjusted for age, sex, education, marital status, employment status, living arrangement, and duration of hemodialysis. Statistical significance was defined as $p < 0.05$.

Multivariable linear regression analysis was performed to evaluate the independent associations of the Work Ability Index (WAI), WHODAS Mobility Domain, physical activity, and sociodemographic and clinical factors with the quality-of-life domains assessed by the KDQOL-SF. All models were statistically significant, with $p < 0.001$. For the Kidney Disease Component Summary (KDCS) domain, the regression model explained 44.5% of the variance in KDCS scores ($R^2 = 0.445$; adjusted $R^2 = 0.424$), with an F statistic of 20.952 ($p < 0.001$). After adjustment for all covariates, WAI showed a significant positive association with KDCS (β = 0.471; $p < 0.001$), whereas higher WHODAS Mobility Domain scores showed a significant negative association with KDCS (β = −0.380; $p < 0.001$). Physical activity showed no independent association with KDCS (β = −0.011; $p = 0.834$). Duration of hemodialysis was not significantly associated with KDCS (β = 0.005; $p = 0.920$).

For the Physical Component Summary (PCS) domain, the regression model explained 36.2% of the variance in PCS scores ($R^2 = 0.362$; adjusted $R^2 = 0.338$), with an F statistic of 14.833 ($p < 0.001$). WAI was significantly and positively associated with PCS (β = 0.202; p = 0.002), whereas higher WHODAS Mobility Domain scores were significantly and negatively associated with PCS (β = −0.421; $p < 0.001$). Physical activity showed no independent association with PCS (β = −0.081; $p = 0.164$). Among the covariates, marital status (β = −0.130; $p = 0.047$) and living arrangement (β = 0.168; $p = 0.007$) were significantly associated with PCS. Duration of hemodialysis was not significantly associated with PCS (β = −0.001; $p = 0.990$).

For the Mental Component Summary (MCS) domain, the regression model explained 20.5% of the variance in MCS scores ($R^2 = 0.205$; adjusted $R^2 = 0.175$), with an F statistic of 6.735 ($p < 0.001$). WAI was the main predictor and showed a significant positive association with MCS (β = 0.406; $p < 0.001$). In contrast, higher WHODAS Mobility Domain scores (β = −0.102; $p = 0.123$) and physical activity (β = 0.044; $p = 0.496$) showed no independent associations with MCS. Education showed a significant positive association with MCS (β = 0.112; $p = 0.048$), whereas duration of hemodialysis was not significantly associated with MCS (β = 0.031; $p = 0.585$).

Discussion

This study showed that functional capacity, particularly work ability and mobility, was significantly associated with quality of life among patients receiving hemodialysis in coastal and wetland communities in Riau, Indonesia. Rather than focusing solely on clinical characteristics, the findings indicate that functional dimensions are also relevant to patients' experiences of quality of life. The Work Ability Index (WAI) showed consistent positive associations across the KDCS, PCS, and MCS domains, whereas higher WHODAS Mobility Domain scores, indicating greater mobility limitations, were primarily associated with lower kidney disease-specific and physical quality-of-life scores. These findings suggest that functional capacity is not a single construct in hemodialysis care, as different functional dimensions may relate to different aspects of quality of life. This supports a function-centered approach that complements disease management by considering patients' ability to maintain physical function, independence, productivity, and participation in daily life [14, 15] .

The characteristics of the study population should be considered contextual factors when interpreting these associations. The median age of 53 years indicates that the study population included many patients in late working age and early older adulthood, a period in which chronic disease and long-term dialysis may affect physical capacity and daily functioning. Increasing age among patients receiving hemodialysis has been associated with greater frailty, reduced physical function, and limitations in activities of daily living [16]. However, age was not a dominant factor after multivariable adjustment. This finding suggests that chronological age alone may not adequately capture the functional burden experienced by patients receiving hemodialysis. Instead, functional dimensions such as work ability and mobility may provide more direct information about how patients function in everyday life. This distinction is clinically relevant because patients of similar ages may experience substantially different levels of functional limitation and quality of life.

The main finding of this study was the positive association between WAI and all quality-of-life domains. Patients with higher work ability had higher KDCS, PCS, and MCS scores after accounting for demographic and social factors. In the context of hemodialysis, work ability encompasses the capacity to meet work demands in relation to an individual's health and available resources and may reflect broader aspects of physical and psychosocial functioning. Reduced work ability among individuals with end-stage kidney disease may be related to fatigue, physical limitations, and the burden of long-term dialysis treatment [7, 17]. The consistent association of WAI with all three quality-of-life domains may therefore indicate that work ability captures a broader dimension of functioning than physical performance alone. Maintaining the capacity to undertake productive roles may be closely connected not only to physical functioning but also to patients' perceptions of their illness and psychological well-being.

The relationship between work ability and quality of life should nevertheless be interpreted cautiously. Although previous studies have reported better quality of life among dialysis patients who remain able to work, employment itself may represent only one component of the broader relationship between

functioning and quality of life [17, 18]. Work ability may also be influenced by health status, functional limitations, adaptation to illness, and social circumstances. Because this study used a cross-sectional design, the direction of the association cannot be established. Thus, the findings do not indicate that higher work ability causes better quality of life; rather, they suggest that work ability is an important functional marker associated with multiple dimensions of quality of life. This distinction is important for nursing practice because the assessment of work ability may identify functional and psychosocial concerns that may not be apparent from routine clinical indicators alone.

In addition to work ability, greater mobility limitations, as indicated by higher WHODAS Mobility Domain scores, were associated with lower KDCS and PCS scores. This finding reinforces the relevance of mobility as a functional indicator among patients receiving hemodialysis. Mobility limitations can restrict activities of daily living, increase dependence on family members, and limit participation in social activities [16, 19]. Mobility impairment among patients receiving hemodialysis may also be related to musculoskeletal dysfunction and the systemic burden of chronic kidney disease, including muscle weakness, metabolic disturbances, and dialysis-related deconditioning [20, 21]. The stronger association with PCS is clinically plausible because mobility is closely related to physical functioning. The association with KDCS further suggests that mobility limitations may affect patients' perceptions of how kidney disease and its treatment interfere with everyday functioning and well-being. In contrast, the absence of an independent association with MCS may indicate that mental quality of life is influenced by additional psychological and social factors that are not captured by mobility alone.

The coastal and wetland community context provides additional context for interpreting the mobility findings. However, these contextual factors should not be interpreted as direct explanations for the observed associations because environmental barriers were not directly measured in this study. In geographically challenging areas, transportation and distance may impose additional practical demands on accessing dialysis facilities and maintaining social or economic activities. Transportation burden has been recognized as an important consideration in the experience of dialysis care [22]. Accordingly, mobility assessment in geographically dispersed communities may have practical relevance beyond physical movement itself, particularly when patients must travel regularly for dialysis. However, further studies incorporating direct measures of transportation access, travel burden, and environmental accessibility are needed to determine whether these factors modify the relationship between mobility and quality of life.

Physical activity showed no independent association with quality of life after adjustment for work ability, mobility, and other covariates. This finding differs from several studies reporting positive associations between physical activity and quality of life among patients receiving hemodialysis [23, 24]. One possible explanation is that physical activity and functional capacity represent related but distinct constructs. Physical activity reflects the amount and intensity of activity performed, whereas functional capacity concerns the ability to perform physical tasks and maintain functioning. Consequently, patients may report some level of physical activity while still experiencing limitations in strength, endurance, energy, or mobility that are more closely associated with their quality of life. Another possibility is that the

association between physical activity and quality of life overlaps with mobility or work ability, such that its independent contribution becomes less apparent when these related functional dimensions are considered simultaneously. This interpretation should be regarded as a possible explanation rather than a causal mechanism, as the cross-sectional design does not permit temporal or mediation analyses. From a clinical perspective, the finding suggests that assessing physical activity alone may not adequately characterize the functional burden of patients receiving hemodialysis. Supportive care may therefore benefit from considering physical activity together with mobility and broader functional capacity.

Duration of hemodialysis showed no independent association with quality of life in this study. This finding suggests that dialysis vintage alone may not adequately explain differences in patients' quality of life after other relevant factors are considered. The long-term experience of dialysis may be accompanied by adaptation, changes in functional status, social support, and disease-related complications, which may differ substantially among individuals. Previous literature has also reported inconsistent findings regarding the association between dialysis duration and quality of life, with some studies identifying significant associations and others finding no association after adjustment for other factors [25]. Therefore, dialysis duration may be more appropriately viewed as an indicator of exposure to long-term dialysis rather than as a standalone marker of quality of life. This finding also reinforces the importance of assessing patients' current functional status rather than assuming that a longer duration of dialysis necessarily corresponds to poorer quality of life.

Taken together, the findings indicate that mobility, physical activity, and work ability should not be treated as interchangeable indicators of functional status. Mobility was primarily associated with kidney disease-specific and physical quality-of-life domains, whereas work ability showed associations across kidney disease-specific, physical, and mental domains. In contrast, physical activity did not show an independent association in the present multivariable analysis despite its reported association with quality of life in previous studies [23, 24]. The different patterns observed across these dimensions suggest that functional status among patients receiving hemodialysis is multidimensional and that a single measure may not fully capture how patients function in daily life. This distinction has practical relevance for nursing assessment because identifying the specific functional dimension associated with a patient's quality-of-life concern may allow assessment and supportive care to be directed toward the most relevant functional needs.

These findings have implications for nursing practice. Routine dialysis assessment could incorporate brief evaluations of mobility and work ability alongside physical activity and conventional clinical indicators. This approach is consistent with evidence that symptom and functional burden in hemodialysis may not be fully recognized by clinicians and that patient-reported assessments can provide important information about problems such as poor mobility and their relationship with quality of life [26]. Patients with mobility limitations may benefit from further assessment of activities of daily living, dependence, and physical functioning, while patients with reduced work ability may require consideration of fatigue, role functioning, and psychosocial concerns, which are relevant to their ability

to participate in everyday and productive activities [27, 28]. In geographically dispersed communities, including coastal and wetland areas, consideration of practical barriers to accessing dialysis and maintaining daily activities may also be relevant when developing individualized care plans, although these environmental factors were not directly assessed in the present study. Such an approach would complement disease-centered management with function-centered assessment and may help nurses identify the specific functional needs most relevant to individual patients' quality of life.

Overall, this study highlights the relevance of functional capacity as a multidimensional component of quality of life among patients receiving hemodialysis. Work ability was associated with kidney disease-specific, physical, and mental quality-of-life domains, whereas mobility was primarily associated with kidney disease-specific and physical domains. The absence of an independent association between physical activity and quality of life after adjustment for related functional dimensions further indicates that these constructs should not be considered interchangeable. A multidimensional functional assessment that includes mobility, physical activity, and work ability may therefore provide nurses with a broader understanding of patients' functional needs and inform more targeted supportive care.

Strengths and limitations

This study has several strengths. It examined mobility, physical activity, and work ability simultaneously as distinct functional dimensions and evaluated their independent associations with multiple quality-of-life domains among patients receiving hemodialysis. The use of validated instruments, including the KDQOL-SF, WHODAS 2.0 Mobility Domain, IPAQ-SF, and Work Ability Index, allowed different aspects of functional status and quality of life to be assessed systematically. In addition, the multivariable analyses adjusted for relevant demographic and clinical factors, providing a more comprehensive assessment of the independent associations between functional dimensions and quality of life. The inclusion of patients from three hemodialysis centers also provided data from populations living in coastal and wetland communities with different geographical characteristics. Several limitations should also be considered when interpreting the findings. First, the cross-sectional design limits the ability to determine causal relationships among work ability, mobility, physical activity, and quality of life. The observed associations need to be confirmed through longitudinal studies to evaluate changes in functional capacity and quality of life over time. Second, most of the main variables were measured using self-report instruments, which may introduce recall or reporting bias, particularly in the assessment of physical activity and work ability. Third, the study was conducted at three hemodialysis centers in Riau Province; therefore, the generalizability of the findings to other regions should be interpreted with caution, particularly for populations with different geographical characteristics and healthcare systems. Finally, this study did not comprehensively evaluate clinical factors such as nutritional status, inflammation, anemia, comorbidities, and dialysis adequacy parameters, which may also be associated with patients' quality of life.

Conclusion

Based on the findings of this study, work ability and mobility limitations were independently associated with quality of life among hemodialysis patients in coastal and wetland communities in Riau Province. The Work Ability Index (WAI) showed consistent positive associations with all KDQOL-SF component summary scores (KDCS, PCS, and MCS), whereas greater mobility limitations were associated with lower KDCS and PCS scores. In contrast, physical activity showed no independent association after adjustment for other factors. These findings indicate that efforts to improve quality of life among hemodialysis patients should adopt a function-centered care approach that supports work ability, mobility, and patient independence while accounting for geographical and environmental factors.

Abbreviations

CKD
Chronic Kidney Disease
KDQOL-SF
Kidney Disease Quality of Life Short Form
KDCS
Kidney Disease Component Summary
PCS
Physical Component Summary
MCS
Mental Component Summary
WHODAS 2.0
World Health Organization Disability Assessment Schedule 2.0
IPAQ-SF
International Physical Activity Questionnaire-Short Form
WAI
Work Ability Index
MET
Metabolic Equivalent of Task
SPSS
Statistical Package for the Social Sciences

Declarations

Funding

This study was funded by the Institute for Research and Community Service (Lembaga Penelitian dan Pengabdian kepada Masyarakat, LPPM), Universitas Riau, through the 2026 Excellent Research Grant (Penelitian Unggulan), Contract No. 657/UN19.5.1.3/AL.04.03/2026. The funder had no role in the study design, data collection, data analysis, data interpretation, manuscript preparation, or the decision to submit the manuscript for publication.

Acknowledgements:

The authors would like to express their gratitude to all patients who participated in this study and to the healthcare professionals at the participating hemodialysis centres for their assistance during the data collection process.

Author Contributions

BB conceptualized the study, designed the methodology, supervised the research, secured funding, and revised the manuscript. JE and APD contributed to data analysis, interpretation of findings, and critical revision of the manuscript. All authors read and approved the final manuscript.

Availability of data and materials

The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request.

Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of the Faculty of Nursing, Universitas Riau (No. 005704/FKp Universitas Riau/2026). All participants received information about the study objectives, procedures, potential benefits, data confidentiality, the voluntary nature of participation, and their right to refuse or withdraw from the study without affecting the healthcare they received. Written informed consent was obtained from all participants before data collection.

Consent for publication

Not applicable.

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Competing interests

The authors declare that they have no competing interests.

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