UNDERSTANDING THE DETERMINANTS OF WELL-BEING: SELF-MANAGEMENT AND QUALITY OF LIFE IN CHILDREN UNDERGOING HEMODIALYSIS

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Abstract

Background: Children undergoing hemodialysis face significant challenges that impair their health-related quality of life (HRQoL). Self-management is considered crucial for improving outcomes, but its specific relationship with HRQoL in this population remains underexplored.
Aim: This study aimed to assess the relationship between self-management practices and HRQoL in children undergoing maintenance hemodialysis.
Methods: A descriptive, cross-sectional correlation study was conducted with 51 pediatric hemodialysis patients. Data were collected using a structured interview questionnaire, a validated pediatric self-management scale, and the Parent Proxy version of the Pediatric Quality of Life Inventory 3.0 End-Stage Renal Disease module.
Results: The majority of children (98.1%) reported poor or fair self-management levels. Child-reported total self-management demonstrated a strong positive correlation with parent-reported total HRQoL ($r= 0.81$, $p<0.001$). In multiple linear regression analysis, controlling family income and dialysis frequency, the child's total self-management score was the strongest and most significant predictor of HRQoL ($\beta = 0.79$, $p<0.001$), explaining 71.3% of the variance.
Conclusion: Self-management practices, particularly in nutrition and stress management, are the principal determinant of HRQoL for children on hemodialysis. The findings strongly advocate for integrating structured, competency-based self-management support into routine nursing care to enhance the well-being of this vulnerable population.

Keywords: Hemodialysis, Pediatric Nursing, Health-Related Quality of life, Self-Management

BACKGROUND

Chronic kidney disease (CKD) in children represents a profound clinical and psychosocial challenge, distinct from its presentation in adults due to unique etiologies, such as congenital anomalies of the kidney and urinary tract, and the critical impact on growth and development (Harada et al., 2021; Stern-Zimmer et al., 2021). For those who progress to end-stage renal disease (ESRD), maintenance hemodialysis (HD) becomes a life-sustaining yet demanding regimen. This treatment imposes a significant burden, characterized by frequent hospitalizations, painful procedures, strict dietary and fluid restrictions, and substantial disruptions to school attendance and social activities (Clavé et al., 2019; Goldstein et al., 2008). Consequently, the ultimate goal of care extends beyond mere survival to optimize the overall well-being and developmental trajectory of the child, bringing the constructs of health-related quality of life (HRQoL) and self-management to the forefront of pediatric nephrology practice and research.

HRQoL is a multidimensional, patient-centered outcome that encompasses physical, emotional, social, and school functioning (World Health Organization, 2022). For children undergoing hemodialysis, studies consistently report significantly impaired HRQoL compared to healthy peers (Tavri et al., 2023). The relentless treatment schedule and its side-effects, such as fatigue, growth delays, and the psychological strain of chronic illness, compromise multiple domains of well-being (Aier et al., 2022). In pediatric populations, assessing HRQoL often involves proxy reports from parents, who provide a crucial external perspective on the child's observable functioning and behavior, especially valuable for younger children or in clinical contexts where self-report may be challenging (Wiemann & Zimmerman, 2023). Parental perceptions of their child's QoL are clinically significant, as they reflect the family's adaptive coping and often influence healthcare decisions and perceived treatment burden.

Parallel to QoL, self-management is recognized as a critical component of chronic disease care. In the context of pediatric hemodialysis, self-management refers to the child's ability, in partnership with family and healthcare providers, to perform tasks and adopt roles necessary for managing their treatment and daily life. This includes adherence to dialysis schedules, medication regimens, dietary and fluid restrictions, symptom monitoring, and effective communication with the healthcare team (Peruzzi & Coppo, 2020). Effective self-management is theorized to foster a sense of autonomy, improve clinical stability, and empower the child. However, the complexity and demanding nature of the HD regimen make mastering these skills exceptionally challenging (M. C. Lee et al., 2016). Assessing these practices directly from the child's perspective is vital, as it captures their own perception of involvement and competence, which may differ from caregiver or clinician assessments (Bravo et al., 2020).

Theoretically, a dynamic and reciprocal relationship likely exists between self-management and QoL in this population. Competent self-management may lead to better physiological control and a greater sense of mastery, thereby enhancing QoL. Conversely, better emotional and social well-being (components of QoL) may provide the psychological resources necessary to engage in effective self-management (Russo, 2022). While both are established as key outcome indicators, the specific nature of their association in children undergoing maintenance hemodialysis remains inadequately explored. Existing literature often examines these variables in isolation or within broader CKD or transplant populations, with fewer studies focusing explicitly on the hemodialysis subset (Mizerska-Wasiak et al., 2021). Crucially, there is a paucity of research that deliberately employs a dual-informant approach, correlating the child's own rating of their self-management practices with the parent's assessment of the child's QoL. This approach is methodologically sound as it minimizes single-reporter bias and provides a more nuanced, multi-perspective understanding of the child's lived experience (Varni et al., 2018).

Therefore, this study aims to address this gap by employing a descriptive, cross-sectional, correlational design. The primary objectives are: (1) to assess the level of self-management practices as reported by children undergoing hemodialysis, (2) to assess the level of HRQoL as reported by their parents, and (3) to examine the correlation between these two variables. By elucidating the strength and direction of this relationship, the study seeks to map a foundational understanding of how a child's perceived agency in managing their care is linked to their overall well-being as observed by their primary caregivers.

The significance of this study lies in its potential to inform targeted, family-centered clinical interventions. Identifying specific domains of self-management that are strongly associated with better parent-reported QoL can guide healthcare teams, particularly nurses who are at the forefront of patient education, in tailoring supportive strategies (Catarino et al., 2021; Tharwat et al., 2023). The findings will underscore the importance of fostering developmentally appropriate self-management skills not solely for biomedical adherence, but as an integral component of promoting holistic well-being and resilience in children navigating the profound challenges of life on hemodialysis. Ultimately, this research contributes to the broader imperative of improving patient-centered outcomes in pediatric nephrology.

Aim of the Study

This study aimed to assess the relationship between self-management practices and health-related quality of life in children undergoing maintenance hemodialysis. Specifically, it seeks to:

1. Describe the level of self-management practices as reported by the children.
2. Describe the level of health-related quality of life as reported by their parents.
3. Examine the correlation between child-reported self-management practices and parent-reported health-related quality of life.

SUBJECTS AND METHOD

Study Design

This study employed a descriptive, cross-sectional correlational design.

Study Setting

Data collection was conducted between July 2024 and January 2025 across three pediatric hemodialysis units in Egypt.

Participants

A purposive sample of 51 pediatric patients undergoing maintenance hemodialysis (≥2 sessions per week) was recruited. Inclusion criteria were: (1) children aged 8 to 18 years; (2) a confirmed diagnosis of ESRD; and (3) receiving hemodialysis for a minimum of six months. Exclusion criteria included: (1) active evaluation for renal transplantation; (2) concurrent malignancy; (3) documented intellectual disability or severe sensory impairment precluding completion of self-report measures; or (4) acute hospitalization or a major medical complication within the preceding four weeks. Eligible children who provided assent, along with parent/guardian consent, were enrolled.

Tools for data collection

Data were collected using four instruments. To ensure comprehension, all child-facing tools were administered in Arabic.

Tool I: Structured Interview Sheet

This tool is a researcher-developed, semi-structured Socio-Demographic and Clinical Interview Schedule, designed to collect baseline information across three domains: (1) Child Characteristics (age, gender, educational level, birth order, residence); (2) Clinical Characteristics (presence of comorbid conditions, dialysis frequency, vascular access type, total dialysis duration); and (3) Family Characteristics (education, occupation; and household income).

Tool II: Pediatric Hemodialysis Self-Management Questionnaire (PHD-SMQ)

The second instrument was a researcher-developed 44-item questionnaire, administered in Arabic, designed to assess self-management practices specific to the pediatric hemodialysis context. The tool evaluates eight core domains: treatment adherence (5 items), nutrition and fluid control (15 items), exercise (2 items), vascular access (fistula) care (4 items), hemodialysis session management (7 items), general self-care (4 items), communication with healthcare providers (5 items), and stress management (2 items). Responses were recorded on a 3-point Likert scale ranging from 0 (*never*) to 2 (*always*), yielding a total possible score from 0 to 88, where higher scores indicate more frequent self-management practices. For clinical interpretability, total scores were categorized into three levels: Poor Self-Management (score <44, representing <50% of the total), Fair Self-Management (score 44–65, representing 50% to <75%), and Good Self-Management (score ≥66, representing ≥75%). The content validity of the questionnaire was established through a rigorous synthesis of relevant self-management

literature (Biagioli et al., 2022; Billany et al., 2023; Catarino et al., 2021; Riegel et al., 2021; Wee et al., 2022). The instrument demonstrated acceptable internal consistency for pediatric use, with a Cronbach's alpha of 0.83.

Tool III: Pediatric Quality of Life Inventory 3.0 End-Stage Renal Disease module (PedsQL 3.0 ESRD Module)

The third instrument was the PedsQL 3.0 ESRD Module, a disease-specific measure for assessing HRQoL in children and adolescents with ESRD (Goldstein et al., 2008). This 34-item instrument contains seven subscales: General Fatigue (4 items), Kidney Disease Symptoms (5 items), Treatment Problems (4 items), Family and Peer Interaction (3 items), Worry (10 items), Physical Appearance (3 items), and Communication (5 items). Parents rate the frequency of their children's problems over the past month using a 5-point Likert scale (0=*never a problem* to 4=*almost always a problem*). Raw item scores were linearly transformed to a 0–100 scale for each subscale and for a total score, where higher scores represent better HRQoL. The original English version of the PedsQL 3.0 ESRD Module has demonstrated strong internal consistency reliability, with previously reported coefficients exceeding the established minimum standard of 0.70 for group-level comparisons. For the purposes of this study, an Arabic version was utilized. This version was developed via a rigorous forward-backward translation process to ensure linguistic and conceptual equivalence. In the current sample, the Arabic version exhibited excellent internal consistency, with a Cronbach's alpha coefficient of 0.950 for the parent self-report total score, substantially surpassing the recommended threshold for clinical measures.

Pilot Study

Prior to the main data collection, a pilot study was conducted with eight pediatric hemodialysis patients who met the inclusion criteria. These participants were subsequently excluded from the main study sample. The pilot study aimed to evaluate the clarity and comprehensibility of the instruments, estimate the time required for administration, and identify any potential logistical challenges. Based on the feedback and observations from the pilot phase, minor refinements were made to the data collection procedures and the wording of several items in the interview schedule to enhance clarity and feasibility.

Ethical Consideration

The study protocol was reviewed and approved by the Research Ethics Committee at the Faculty of Nursing, Port Said University. Adhering to standard ethical guidelines, administrative approval was first obtained from the directors of the participating hemodialysis units. Subsequently, the researcher conducted detailed discussions with eligible children and their parents or legal guardians to explain the study's purpose, procedures, potential benefits, and the right to withdraw without consequence. Written informed consent was obtained from all guardians, and verbal assent was secured from all participating children. To ensure confidentiality, all collected data were anonymized using identification codes and stored securely in a password-protected environment, accessible only to the research team, in compliance with institutional data protection policies.

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics software (Version 29). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the socio-demographic and clinical characteristics of the participants. The bivariate relationships between the primary study variables, namely, child-reported self-management and parent-reported HRQoL, were analyzed using Pearson's correlation coefficient. To further explore the predictive value of specific self-management domains on QoL outcomes, a multiple linear regression analysis was conducted, entering the self-management subscale scores as independent variables. For all inferential analyses, the threshold for statistical significance was set at $p<0.05$.

Results

Table 1 reveals that the sample comprised 51 pediatric hemodialysis patients, with a near-equal gender distribution (52.9% male, 47.1% female). The mean age of participants was 12.25 years (SD = 2.72), with the largest proportion (47.1%) falling in the 12 to 16-year age bracket. Most children resided in rural areas (66.7%). In terms of birth order, the sample was relatively evenly distributed, with first, second, and third children representing 27.5%, 25.5%, and 31.4% of the sample, respectively. Educational attainment ranged from illiteracy (7.8%) to secondary education (7.8%), with the majority (84.3%) enrolled in primary or preparatory school. Clinically, a high proportion of children (74.5%) had at least one comorbid condition. The hemodialysis regimen for most children (80.4%) consisted of three sessions per week, with a three-hour session being the most common duration (43.1%). The duration on hemodialysis varied, with 45.1% of children undergoing treatment for 1-3 years.

Table 2 shows that nearly one-fifth of mothers (17.6%) were illiterate, while 29.4% of fathers had attained higher education. A majority of mothers were not employed outside the home (56.9% housewives), whereas most fathers were employed (72.5%). Household income was perceived as insufficient by 41.2% of families, while 21.6% reported their income was enough to allow for savings.

Figure 1 illustrates the distribution of self-management levels as reported by the children in the study (N=51). The data reveal a concerning trend, with the majority of children (66.7%, n=34) categorized as having "poor" self-management practices. A further 31.4% (n=16) were rated as having "fair" self-management. Notably, only a single participant (2.0%) was classified as having "good" self-management. This distribution indicates that, from the children's own perspectives, nearly all participants (98.0%) demonstrated self-management capabilities that were either suboptimal or poor, highlighting a significant area of need in the clinical care of this population.

Table 3 displays that the mean total self-management score for the sample was 38.39 (SD= 12.66) on a 0-88 scale, placing the cohort's overall practices below the midpoint and indicating room for improvement. The Nutrition (Mean= 12.35/21) and Hemodialysis Session Management (Mean = 7.86/13) subscales received the highest average scores, suggesting these are areas where children feel most competent or engaged. In contrast, the Exercise (Mean= 1.33/4), Stress Management (Mean= 1.37/4), and Communication (Mean= 3.96/10) subscales yielded the lowest means, highlighting these as critical domains of potential deficit in the children's self-management repertoire.

As presented in **table 4**, parents reported a mean total HRQoL score of 42.85 (SD= 18.87) on a 0-100 scale, indicating a moderate overall impact of the disease and its treatment on their child's HRQoL. The Kidney Disease Symptoms (Mean= 45.88) and Family and Peer Interaction (Mean = 45.75) subscales were rated as the least problematic domains (i.e., higher scores). Conversely, the General Fatigue (Mean= 40.20), Treatment Problems (Mean= 40.56), Perceived Physical Appearance (Mean= 41.67), and Communication (Mean= 42.65) subscales received the lowest scores, signifying that parents perceive these as the areas most adversely affecting their child's life.

As shown in table 5, the correlation analysis reveals a clear and strong relationship between a child's self-management practices and their HRQoL as perceived by parents. The most significant finding is the strong positive correlation between the Total Self-Management score and the Total HRQoL score ($r= 0.81$, $p<0.001$). The domain of Nutrition emerged as the strongest and most consistent correlate across nearly all QoL dimensions, showing particularly strong associations with Total QoL ($r= 0.83$), Communication ($r= 0.78$), and Social Support ($r= 0.76$). This underscores the foundational role of dietary adherence in a child's daily functioning and social life. Similarly, Total SM and subscales like Self-Care, Communication, and Exercise showed moderate to strong positive correlations with multiple QoL domains, suggesting that holistic self-care competence contributes broadly to better physical and psychosocial outcomes. Notably, one domain showed an inverse relationship. Hemodialysis Process knowledge/skills were negatively correlated with the QoL domains of Fatigue ($r= -0.30$, $p= 0.030$) and Treatment Problems ($r= -0.34$, $p= 0.015$).

Table 6 reveals that the multiple linear regression model retained only statistically significant predictors, resulting in a parsimonious and robust solution. The final model, comprising Family Income, Dialysis Frequency, and Child Total Self-Management, was statistically significant and explained a substantial 71.3% of the variance in HRQoL scores ($F(3, 47) = 41.96$, $p<0.001$; Adjusted $R^2 = 0.713$). Examination of the individual predictors confirmed the primary hypothesis. Child Total Self-Management emerged as the strongest and most significant predictor, with a large, standardized effect ($\beta = 0.791$, $p<0.001$). The positive unstandardized coefficient ($B = 1.18$) indicates that for every one-point increase in a child's self-management score, their parent-reported HRQoL score increases by approximately 1.18 points, controlling for other factors. Family Income was also a significant positive predictor ($\beta = 0.215$, $p = 0.013$), suggesting that better financial resources are associated with higher perceived QoL. Conversely, Dialysis Frequency was a significant negative predictor ($\beta = -0.208$, $p = 0.007$), meaning that undergoing hemodialysis three times per week, compared to twice, is associated with a nearly 10-point decrease in HRQoL scores, holding self-management and income constant. Collinearity statistics (all VIFs < 1.1) confirmed no issues with multicollinearity.

Table 1. Demographic and Clinical Characteristics of Pediatric Hemodialysis Patients (N = 51)

Variable	Category	n	%
Gender	Male	27	52.9
	Female	24	47.1
Age (in Years)	8 - (<12)	20	39.2
Mean= 12.25	12 – (<16)	24	47.1
SD= 2.72	16 - 18	7	13.7
Residence	Rural	34	66.7
	Urban	17	33.3
Birth Order	First	14	27.5
	Second	13	25.5
	Third	16	31.4
	Fourth or more	8	15.7
Education Level	Illiterate	4	7.8
	Primary	22	43.1
	Preparatory	21	41.2
	Secondary	4	7.8
Presence of comorbid conditions	Present	38	74.5
	Absent	13	25.5
Dialysis Sessions	2 sessions/week	10	19.6
	3 sessions/week	41	80.4
Dialysis Frequency	2 hours	19	37.3
	3 hours	22	43.1
	4 hours	10	19.6
Hemodialysis Duration	<1 year	12	23.5
	1-3 years	23	45.1
	>3 years	16	31.4

Note. SD= Standard Deviation.

Table 2. Family Characteristics of Pediatric Hemodialysis Participants (N = 51)

Variable	Category	n	%
Mother's Education	Illiterate	9	17.6
	Basic Education	12	23.5
	Intermediate Education	22	34.1
	Higher Education	8	15.7
Father's Education	Illiterate	4	7.8
	Basic Education	11	21.6
	Intermediate Education	21	41.2
	Higher Education	15	29.4
Mother's Occupation	Housewife	29	56.9
	Employed	22	43.1
Father's Occupation	Unemployed	14	27.5
	Employed	37	72.5
Household Income	Not Enough	21	41.2
	Enough	19	37.3
	Enough and save	11	21.6

Figure 1. Distribution of Self-Management Levels Among Children Undergoing Hemodialysis (N=51)

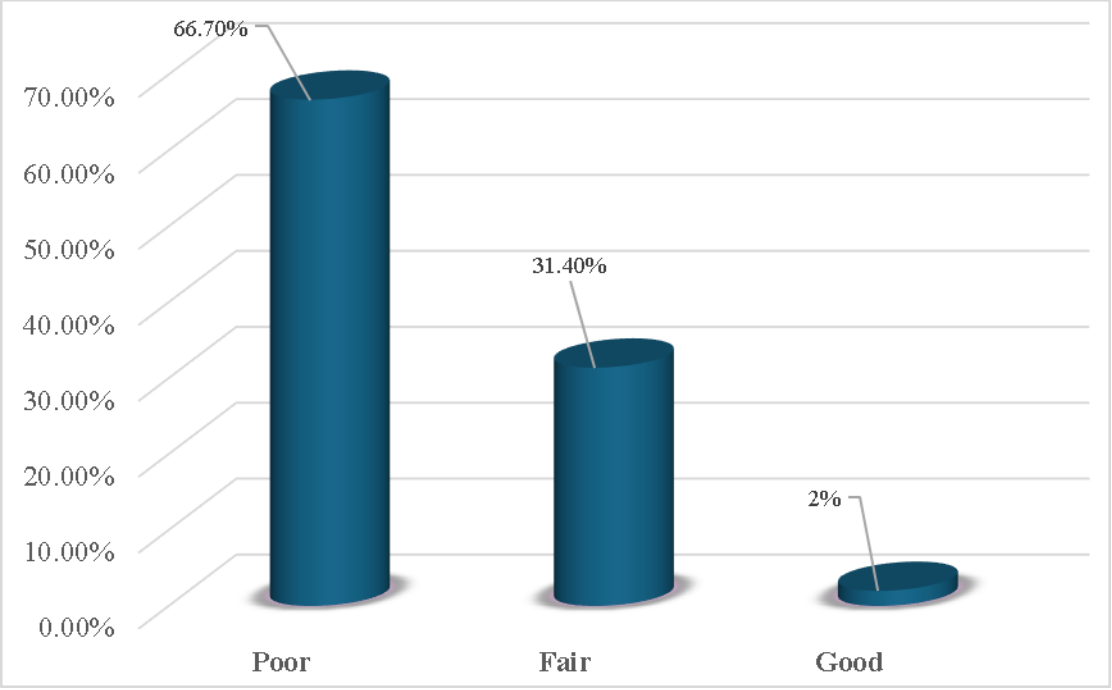

Table 3. Descriptive Statistics for Self-Management (SM) Practices and Subscales (N = 51)

SM Domain / Scale	Minimum	Maximum	Mean	Std. Deviation
Prevention / Treatment	1.00	10.00	4.45	1.84
Nutrition	0.00	21.00	12.35	5.49
Exercise	0.00	4.00	1.33	1.26
Fistula Care	0.00	7.00	3.57	2.00
Hemodialysis Session Mgmt.	0.00	13.00	7.86	2.62
Self-Care	0.00	8.00	3.49	2.37
Communication	0.00	10.00	3.96	3.00
Stress Management	0.00	4.00	1.37	1.40
Total Self-Management	6.00	70.00	38.39	12.66

Note. SM= Self-mangement.

Table 4. Descriptive Statistics for Parent-Reported Health-Related Quality of Life (N = 51)

HRQoL Subscale	Minimum	Maximum	Mean	Std. Deviation
General Fatigue	0.00	75.00	40.20	24.50
Kidney Disease Symptoms	5.00	75.00	45.88	18.59
Treatment Problems	0.00	75.00	40.56	22.89
Family and Peer Interaction	0.00	83.33	45.75	23.12
Worry	0.00	72.50	42.89	20.53
Perceived Physical Appearance	0.00	100.00	41.67	26.09
Communication	0.00	75.00	42.65	23.84
Total HRQoL Score	1.47	63.97	42.85	18.87

Note. Subscale and total scores are on a 0–100 scale.
Higher scores indicate better health-related quality of life, HRQoL= Health-Related Quality of Life

Table 5. Correlations Between Child-Reported Self-Management (SM) and Parent-Reported Quality of Life (QoL) Variables (N=51)

SM Variable	Fatigue	CKD Symptoms	Treatment Problems	Social Support	Anxiety	Appearance	Communication	**Total QoL**
Total SM	0.68** (<0.001)	0.81** (<0.001)	0.65** (<0.001)	0.77** (<0.001)	0.64** (<0.001)	0.50** (<0.001)	0.78** (<0.001)	.81** (<0.001)
Treatment & Prevention	0.07 (0.641)	0.20 (0.168)	-0.08 (0.558)	0.14 (0.313)	-.006 (0.660)	-0.08 (0.593)	0.11 (0.455)	0.03 (0.821)
Nutrition	0.70** (<0.001)	0.74** (<0.001)	0.69** (<0.001)	0.76** (<0.001)	0.70** (<0.001)	0.53** (<0.001)	0.78** (<0.001)	0.83** (<0.001)
Exercise	0.49** (<0.001)	0.49** (<0.001)	0.60** (<0.001)	0.66** (<0.001)	0.49** (<0.001)	0.42** (0.002)	0.36* (0.010)	0.58** (<0.001)
Fluid & Sodium Care	0.53** (<0.001)	0.68** (<0.001)	0.64** (<0.001)	0.61** (<0.001)	0.53** (<0.001)	0.33* (0.017)	0.64** (<0.001)	0.66** (<0.001)
Hemodialysis Process	-0.30* (0.030)	-0.09 (0.521)	-0.34* (0.015)	-0.27 (0.059)	-0.17 (0.232)	-0.16 (0.251)	-0.02 (0.908)	-0.21 (0.131)
Self-Care	0.50** (<0.001)	0.64** (<0.001)	0.53** (<0.001)	0.54** (<0.001)	0.48** (<0.001)	0.43** (0.001)	0.55** (<0.001)	0.61** (<0.001)
Communication	0.58** (<0.001)	0.70** (<0.001)	0.50** (<0.001)	0.63** (<0.001)	0.40** (0.003)	0.29* (0.036)	0.58** (<0.001)	0.60** (<0.001)
Stress Management	0.56** (<0.001)	0.31* (0.025)	0.48** (<0.001)	0.53** (<0.001)	0.57** (<0.001)	0.64** (<0.001)	0.42** (0.002)	0.60** (<0.001)

Notes. SM = Self-Management; QoL = Quality of Life; CKD = Chronic Kidney Disease.
Values represent Pearson's correlation coefficient (r) followed by p-value in parentheses.
*Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 6. Multiple Linear Regression Analysis Predicting Parent-Reported Health-Related Quality of Life

Predictor	B	SE	β	t	p	95% CI for B	Tolerance	VIF
(Constant)	8.84	7.80		1.13	0.263	[-6.83, 24.51]		
Family Income	5.23	2.04	0.215	2.57	0.013	[1.13, 9.32]	0.911	1.10
Dialysis Frequency	-9.87	3.47	-0.208	-2.84	0.007	[-16.85, -2.89]	0.976	1.02
Total Self-Management	1.18	0.114	0.791	10.37	<0.001	[.95, 1.41]	0.925	1.08

Notes. $R^2 = 0.729$, Adjusted $R^2 = 0.713$, $F(3, 47) = 41.96$, $p<0.001$. CI = Confidence Interval; VIF = Variance Inflation Factor. Other sociodemographic and clinical variables were initially included but

removed from the final model as they were not significant predictors ($p>0.05$), thereby improving model parsimony without a meaningful reduction in explained variance.

DISCUSSION

This cross-sectional study provides a critical examination of the determinants of well-being in a vulnerable population, children undergoing maintenance hemodialysis. By focusing on the relationship between child-reported self-management practices and parent-reported HRQoL, the findings illuminate a powerful pathway for clinical intervention. The central revelation is that a child's engagement in self-management is not merely a clinical target but the principal driver of their perceived HRQoL, outweighing the influence of several demographic and treatment-related factors.

The Predominance of Poor Self-Management and Its Implications

A foremost and concerning finding is that the vast majority of children (98%) reported self-management levels that were either "poor" or "fair," with only 2% achieving a "good" level. This widespread deficit, particularly in domains like exercise, stress management, and communication, underscores a significant gap in current pediatric nephrology care. While children scored relatively higher in concrete, procedure-oriented tasks like nutrition and hemodialysis session management, they struggled with the psychosocial and behavioral components of self-care. This aligns with the broader literature suggesting that pediatric self-management extends beyond medical adherence to include emotional regulation and social participation, areas often neglected in traditional patient education (S. Y. Lee & Shin, 2018; Thompson et al., 2023; Town et al., 2023). The low scores in stress management and communication are especially telling, indicating that children may lack the coping strategies and communicative tools to navigate the anxiety of their condition and effectively express their needs to caregivers and peers, a challenge documented in other studies of chronic pediatric illness (Dryjańska & Kiliś-Pstrusińska, 2023).

The correlation and regression analyses powerfully delineate which specific self-management competencies matter most for HRQoL. Nutrition emerged as the single most consistent and strongly correlated with nearly every QoL domain. This is highly plausible, as dietary management in hemodialysis is a constant, daily struggle with direct physical consequences (fatigue, symptoms) and profound social implications (inability to share meals, feeling different). Effective nutritional self-management may therefore confer a sense of control and normalcy that directly enhances overall well-being. This finding is supported by recent work emphasizing the psychosocial burden of renal diets and their impact on a child's social life and family interactions (Morris & Lycett, 2021).

Equally critical was the domain of stress management, which was a leading independent predictor in the final regression model. The chronic, life-threatening nature of ESRD and the invasiveness of hemodialysis are inherently stressful. Children who can employ effective stress-management techniques are likely to experience lower levels of anxiety and worry, which parents directly observe as improved emotional well-being and better overall QoL. This underscores a shift in understanding: managing the illness experience is as crucial as managing the *illness itself*. Research by Pungchompoo et al. (2020) similarly found that aiding adolescents with CKD in developing self-management behaviors helped relieve anxiety and depression, thereby improving HRQoL.

From Correlation to Causation: Self-Management as the Key Predictor

The hierarchical progression of our analysis solidifies the argument for causation. The strong bivariate correlations (e.g., Total SM and Total HRQoL, $r= 0.81$) established a compelling link. The multiple linear regression model then isolated the unique contribution of self-management while controlling for confounding variables. The result was definitive: the child's total self-management score was the strongest predictor of their HRQoL ($\beta = 0.79$), accounting for the lion's share of the explained variance.

This finding has profound implications. It suggests that interventions aimed broadly at improving a child's overall self-management capability, their sense of ownership and skill in handling their

treatment, diet, emotions, and communication, are likely to yield the greatest benefit for their HRQoL. This supports and extends the work of (Sezer et al., 2021), who demonstrated that self-management training in adolescents with CKD led to significant improvements in both knowledge and QoL. Our study quantifies the magnitude of this relationship, positioning self-management as the primary modifiable determinant of well-being in this population.

The regression model also identified two critical contextual factors that modify this primary relationship. First, dialysis frequency was a significant negative predictor of HRQoL. Children undergoing treatment three times per week, compared to twice, showed a clinically meaningful decrease in QoL scores, even after accounting for their self-management skills. This quantifies the inescapable "treatment burden", the disruption, fatigue, and time commitment inherent to more intensive therapy, which directly diminishes life quality irrespective of how well a child copes (Flythe et al., 2020). It is a sobering reminder of the disease's inherent impact.

Second, family income was a significant positive predictor. This highlights the undeniable role of socioeconomic resources in managing a chronic childhood illness. Higher income may facilitate better access to nutritious food, transportation to dialysis centers, educational resources, and reduce overall family stress, creating an environment more conducive to both effective self-management and better HRQoL. This aligns with global health disparities observed in pediatric CKD outcomes, where socioeconomic status is a key determinant of health (Kamath et al., 2019).

An intriguing and counterintuitive finding was the negative correlation between knowledge of the hemodialysis *process* and QoL domains like fatigue and treatment problems. This may represent a "burden of knowledge" phenomenon. Children who are more acutely aware of the technical details, risks, and complexities of their dialysis may experience greater anxiety, hyper-vigilance to symptoms, and a heightened sense of being medically fragile. This finding cautions against an educational approach that over-emphasizes mechanistic details at the expense of empowering, skills-based, and emotionally supportive learning. It suggests that knowledge must be delivered in a context that builds confidence and control, not fear.

Collectively, these results can be framed within Modi et al. (2012) pediatric self-management model. The child's self-management behaviors (the core action) are influenced by contextual domains: the healthcare system (represented by treatment burden/dialysis frequency), the family system (represented by socioeconomic status/income), and individual factors (the child's own skills in nutrition, stress management, etc.). Our study shows that the child's individual behavioral competencies within this ecology exert the most powerful direct effect on the outcome of interest: HRQoL. This provides empirical validation for a family-centered, skills-based clinical approach that empowers the child while actively addressing contextual barriers like treatment logistics and financial strain.

In conclusion, this study moves beyond documenting the low QoL of children on hemodialysis to identify its most potent determinants. It argues compellingly that the path to enhancing the well-being of these children lies fundamentally in strengthening their self-management capabilities, with particular emphasis on nutritional competence and stress-coping strategies. Simultaneously, it calls for systemic efforts to mitigate treatment burden and address socioeconomic disparities. By elevating self-management from a clinical checklist to the centerpiece of holistic care, healthcare providers can directly target the most significant lever for improving the daily lives of children facing the immense challenge of long-term hemodialysis.

Strengths and Limitations

This study possesses notable methodological strengths that bolster the credibility of its findings. The cross-sectional design provides a clear snapshot of the relationship between self-management and QoL at a critical point in the disease trajectory. A key strength is the use of multi-informant data, capturing both the child's internal perception of their self-management practices and the parent's external observation of their child's HRQoL, which offers a more holistic view of the child's experience.

Furthermore, the use of a well-validated statistical approach (hierarchical regression) to control for key confounding variables, such as treatment frequency and socioeconomic status, allows for a more precise estimation of the unique contribution of self-management.

However, several limitations must be acknowledged. The cross-sectional nature precludes any causal inference; while we can state self-management is strongly associated with HRQoL, we cannot definitively conclude that improving self-management will cause an increase in QoL. The use of convenience sampling from a single setting, along with a modest sample size (N=51), may limit the generalizability of the findings to other pediatric hemodialysis populations in different cultural or healthcare contexts. Finally, reliance on self-report measures, though appropriate for subjective constructs, carries the risk of social desirability bias and shared method variance, which may inflate the observed correlations.

Conclusion

In conclusion, this study demonstrates that for children undergoing hemodialysis, their self-reported self-management practices are the most powerful determinant of their parent-reported HRQoL, overshadowing the influence of several clinical and demographic factors. The domains of nutrition and stress management emerged as particularly vital. While the inherent burden of frequent treatment sessions and socioeconomic constraints negatively impact well-being, a child's sense of competence and active engagement in their own care appears to be the central pathway to a better life. These findings shift the clinical focus from viewing self-management as merely a set of adherence tasks to recognizing it as the cornerstone of holistic, patient-centered care aimed at optimizing overall well-being in this vulnerable population.

Clinical and Research Implications

For nursing clinical practice, these findings mandate a paradigm shift toward structured, routine assessment of self-management, moving beyond knowledge checks to evaluate a child's confidence and skills in key areas like dietary management and emotional coping. Nurses should develop and implement targeted, family-centered educational interventions that build practical competencies in these domains, empowering children rather than simply instructing them. Concurrently, nurses must advocate for system-level changes to mitigate modifiable burdens, such as optimizing dialysis schedules, and providing resources or referrals to support families facing socioeconomic challenges.

Future research should prioritize longitudinal or interventional designs to establish causality and examine how improvements in specific self-management skills lead to changes in HRQoL over time. Qualitative studies are needed to explore the lived experience behind statistical relationships, particularly to understand the "burden of knowledge" phenomenon. Furthermore, research should test the efficacy of tailored nursing-led self-management programs that prioritize nutrition and stress-coping skills and investigate their effectiveness across diverse cultural and healthcare settings to develop globally relevant best practices.

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Competing interests

The authors declare no competing interests.

Discussion

The first hypothesis, which stated that diagnostic assessment would significantly affect students' interest in Economics, was accepted. The ANCOVA results revealed a significant main effect of the group (diagnostic vs. non-diagnostic) on students' interest, $F(1,147) = 14.72$, $p < 0.001$, partial $\eta^2 = 0.091$. This implies that students taught using diagnostic assessment strategies demonstrated significantly higher levels of interest in Economics than those taught without such assessments.

This result suggests that diagnostic assessment enhances learners' engagement by providing clear, personalized feedback and helping students understand their progress. When learners are aware of their learning gaps and strengths, they can regulate their own learning more effectively, which boosts motivation and curiosity. This finding aligns with Budiman et al. (2024) and Díaz-García et al. (2025), who reported that diagnostic and formative assessments increase student motivation and self-regulation through feedback and active engagement. Similarly, Ghafarpour and Feryok (2022) found that formative diagnostic practices foster students' intrinsic interest by reducing assessment anxiety and emphasizing learning improvement rather than judgment. From a theoretical standpoint, Vygotsky's Social Constructivist Theory provides a strong explanation for this finding. Diagnostic assessment acts as a form of scaffolding within the learner's Zone of Proximal Development (ZPD), giving guidance that promotes deeper understanding and sustained interest. As learners engage with feedback and reflection, they co-construct knowledge with their teachers, which enhances both motivation and conceptual growth.

The second hypothesis, which posited that diagnostic assessment would significantly affect students' academic achievement in Economics, was accepted. The ANCOVA results showed that the effect of group was significant, $F(1,147) = 28.55$, $p < 00.001$, partial $\eta^2 = 0.163$, indicating that students exposed to diagnostic assessment performed significantly better than those assessed without it. This finding suggests that diagnostic assessment plays a crucial role in improving learning outcomes by identifying individual weaknesses and providing feedback for remediation. Through this process, students can correct misconceptions and strengthen understanding. The result is consistent with Esomonu and Eleje (2020), who found that secondary school students who received diagnostic testing and feedback achieved higher academic performance than control groups. Similarly, Egan et al. (2023) and Sharma (2024) emphasized that diagnostic and formative assessments promote metacognitive reflection and reduce test anxiety, thereby improving achievement. The result is also well-explained by Vygotsky's Social Constructivist Theory, which highlights that learning occurs through guided interaction and scaffolding. Diagnostic assessment provides such scaffolding by clarifying learners' needs and structuring support accordingly. Bandura's Social Cognitive Theory further complements this explanation through the construct of self-efficacy: students who receive clear, constructive feedback build confidence in their ability to learn and perform, which leads to improved academic outcomes.

The third hypothesis, which proposed that there would be a significant difference between male and female students' interest in Economics when assessed using diagnostic assessment and when assessed without it, was rejected. The ANCOVA results indicated that gender had no significant main effect on interest, $F(1,146) = 1.25$, $p = 0.266$, partial $\eta^2 = 0.009$.

This finding suggests that diagnostic assessment influences both male and female students similarly in terms of developing interest. The result may be due to the personalized and supportive nature of diagnostic feedback, which reduces anxiety and enhances engagement across genders. These findings resonate with Macher et al. (2023), who reported that diagnostic feedback alleviates test-related stress and supports self-efficacy in both genders. From a theoretical lens, Vygotsky's Social Constructivist Theory emphasized the universality of scaffolding and collaborative learning. Since diagnostic assessment provides individualized guidance for all learners, both male and female students benefit equally in interest development. Bandura's Social Cognitive Theory also helps explain the outcome: by improving self-efficacy through constructive feedback, diagnostic assessment enhances intrinsic motivation regardless of gender.

The fourth hypothesis, which stated that there would be a significant difference between male and female students' academic achievement in Economics when assessed using diagnostic assessment and when assessed without it, was rejected. The ANCOVA result showed no significant main effect of gender, $F(1,146) = 2.04$, $p = 0.156$, partial $\eta^2 = 0.014$. This finding indicates that diagnostic assessment benefits students' achievement in a gender-neutral manner. Both male and female students achieved similarly when exposed to diagnostic feedback and guidance. This result supports prior studies such as Ghazvini and Khajehpour (2021) and Voyer and Voyer (2024), who found minimal gender differences in academic performance when teaching and assessment practices are equitable. According to Vygotsky's Social Constructivist Theory, diagnostic assessment provides equal scaffolding opportunities to all learners, enabling both genders to progress within their ZPD.

The fifth hypothesis, which proposed that there would be a significant interaction effect of diagnostic assessment and gender on students' interest in Economics, was rejected. The ANCOVA results showed no significant interaction effect, $F(1,145) = 0.84$, $p = 0.361$, partial $\eta^2 = 0.006$. This means that diagnostic assessment enhanced students' interest in Economics equally for both male and female students. The finding can be explained by the inherently inclusive nature of diagnostic assessment, which promotes engagement and motivation for all learners. Studies by Yan and Cheng (2022) and Alruwaili (2023) similarly reported that diagnostic and formative assessment strategies enhance motivation and self-regulated learning without gender differences. From a theoretical standpoint, Vygotsky's Social Constructivist Theory supports this outcome by emphasizing that scaffolding and feedback stimulate engagement across genders. Likewise, Bandura's Social Cognitive Theory highlights that diagnostic assessment strengthens self-efficacy through mastery experiences and feedback, processes that are gender-independent. Thus, the equal benefits observed across genders reflect the universal motivational effects of diagnostic assessment.

The sixth hypothesis, which stated that there would be a significant interaction effect of diagnostic assessment and gender on students' academic achievement in Economics, was also rejected. The ANCOVA revealed that the interaction effect was not significant, $F(1,145) = 1.12$, $p = 0.293$, partial $\eta^2 = 0.008$. This indicated that diagnostic assessment improved students' academic achievement in Economics consistently across both male and female groups. These findings are consistent with prior research by Esomonu and Eleje (2020) and Arai et al. (2021), who found that diagnostic feedback enhances achievement for all learners without favouring a particular gender. The result can be interpreted through Vygotsky's Social Constructivist Theory, which posited that effective scaffolding supports learning across individual differences. Bandura's Social Cognitive Theory further explains that diagnostic feedback enhances self-efficacy and academic persistence, mechanisms equally relevant to both male and female learners. Consequently, diagnostic assessment can be viewed as a gender-inclusive instructional strategy that supports equitable achievement outcomes.

Conclusion

Diagnostic assessment significantly enhances students' interest in Economics. Students exposed to diagnostic assessment strategies demonstrated greater curiosity, engagement, and motivation toward the subject, as the process provided meaningful feedback and a clearer understanding of their learning progress. Diagnostic assessment improves students' academic achievement in Economics. By identifying prior knowledge, misconceptions, and individual learning needs, diagnostic assessment allowed for more targeted instruction and timely remediation, leading to higher performance outcomes. Gender does not significantly influence the effect of diagnostic assessment on students' interest and achievement. Both male and female students benefited equally from diagnostic feedback and guidance, indicating that the approach is inclusive and equitable in promoting learning and motivation. The interaction between diagnostic assessment and gender has no significant effect on students' interest and achievement in Economics. This suggests that diagnostic assessment nurtures a supportive learning environment that benefits all learners, regardless of gender differences. Overall, diagnostic assessment serves as an effective instructional strategy that combines cognitive and motivational benefits. It not only enhances students' conceptual understanding and performance but also nurtures positive attitudes

toward learning Economics. Therefore, integrating diagnostic assessment into classroom instruction is recommended for improving both achievement and sustained interest in the subject.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Education authorities and curriculum planners should promote the integration of diagnostic assessment into the teaching and learning of Economics at the secondary school level. Workshops and professional development programs should be organized to train teachers on how to design, administer, and interpret diagnostic assessments effectively.
2. Teachers of Economics should adopt diagnostic assessment strategies to identify students' prior knowledge, learning gaps, and misconceptions before instruction begins. This will enable them to plan lessons that meet learners' specific needs and enhance both interest and achievement.
3. School administrators should provide institutional support by allocating time within the school timetable for diagnostic activities and follow-up feedback sessions. Adequate resources, such as assessment guides and digital tools for analysis, should also be made available to facilitate effective implementation.
4. Teacher education programs in universities and colleges of education should include diagnostic assessment as a core component of instructional methods courses. This will ensure that pre-service teachers acquire the knowledge and skills necessary to apply diagnostic strategies in real classroom contexts.
5. Assessment policies and frameworks at the state and national levels should emphasize continuous and diagnostic evaluation rather than focusing solely on summative examinations. Incorporating diagnostic assessment into the official evaluation system will help promote more meaningful learning outcomes.
6. Further research should be conducted to explore the long-term impact of diagnostic assessment on students' self-regulation, motivation, and performance across other subjects and educational levels. This will contribute to the growing body of evidence supporting learner-centered assessment practices in Nigerian education.

Limitations of the Study

This study was subject to certain limitations that do not undermine its overall validity but should be considered when interpreting the findings. The research was conducted within selected secondary schools in the Onitsha Education Zone of Anambra State, which may limit the extent to which the results can be generalized to other regions with different educational contexts. However, the use of multiple schools and a gender-balanced sample helped enhance representativeness. In addition, while the quasi-experimental design used intact classes rather than randomly assigned groups, this approach ensured ecological validity by preserving the natural classroom setting. The use of ANCOVA further controlled for pre-existing differences among participants. Future studies could expand the sample size and include other geographical zones to strengthen the external validity and broader applicability of the findings.

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