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ORIGINAL RESEARCH

Self-Management and Its Predictors in Maintenance Hemodialysis Patients: Based on Triadic Reciprocal Determinism

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Aim: This study aimed to identify the predictors of self-management in patients undergoing maintenance hemodialysis, with the goal of informing future interventions to improve self-management capabilities.

Design: A cross-sectional survey was conducted involving 341 patients undergoing maintenance hemodialysis.

Methods: Based on the framework of triadic reciprocal determinism, self-management was evaluated using the Self-Management Scale, while fluid intake motivation was assessed via the Compliance Scale for Fluid Intake Motivation. Autonomous perception was measured using the Chinese version of the PEA Scale. Intergroup comparisons were performed using independent-samples t-tests and one-way analysis of variance (ANOVA). Pearson correlation analysis was applied to examine the correlations among self-management, fear of disease progression, fluid intake motivation, and autonomous perception. Variable selection was performed using the Random Forest model and Lasso analysis, after which the identified variables were incorporated into a multiple linear stepwise regression for multivariate analysis.

Results: The mean total self-management score among patients with maintenance hemodialysis was 52.39 ± 6.97 (SD), indicating a moderate level of self-management. Multiple linear stepwise regression analysis identified residence, educational level, motivation for fluid intake, and autonomous perception as the main predictors of self-management ($P < 0.05$). Together, these factors explained 28.5% of the total variance in self-management.

Conclusion: Self-management among patients undergoing maintenance hemodialysis is at a moderate level. Guided by this predictive model, healthcare providers can develop targeted nursing strategies to assist patients with self-management practices and ultimately enhance their self-management outcomes.

Keywords: maintenance hemodialysis, motivation for fluid intake, predictors, random forest model, triadic reciprocal determinism

Introduction

Maintenance hemodialysis (MHD) serves as a life-sustaining transitional therapy for patients with end-stage renal disease (ESRD) and remains the primary treatment modality currently available for ESRD management.[1] Hemodialysis constitutes a continuous therapeutic process. Under the dual pressures of financial burden and complications, patients often experience a decline in self-management capacity, which significantly increases mortality risk. Proactive self-management enables patients to better understand and adapt to their condition, facilitates early detection and intervention of complications, and thereby improves treatment efficacy, promotes physical health, and supports social reintegration.

Background

The prevalence of chronic kidney disease (CKD) has reached 13.1%,[2] and with rising rates of diabetes, hypertension, obesity, and an aging population, its incidence is projected to increase further.[3,4] CKD is characterized by a poor

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prognosis, imposes substantial healthcare costs, and has emerged as a major global public health challenge,[5] as well as a significant burden on healthcare systems. The terminal stage of CKD is referred to as ESRD, clinically known as uremia. At this stage, residual renal function is insufficient to sustain long-term survival without kidney transplantation or dialysis therapy.[6,7] Although kidney transplantation remains the preferred treatment for ESRD patients, it faces two major challenges worldwide: scarcity of donor organs and prohibitively high costs.[8] MHD, typically defined as regular dialysis sessions administered two to three times per week for more than three months, serves as a transitional life-prolonging therapy and currently represents the primary treatment modality for these patients.[9,10] Hemodialysis partially replaces renal function by removing accumulated toxins from the blood, correcting fluid and electrolyte imbalances, and maintaining acid-base balance.[11] However, prolonged hemodialysis increases the risk of complications and may reduce treatment efficacy over time.[12] Patients may experience complications such as hyperphosphatemia, arteriovenous fistula dysfunction, sleep disorders, and pruritus, all of which can impede clinical recovery.[13] Although dialysis alleviates clinical symptoms, improves quality of life, and prolongs survival, it only substitutes partial renal functions.[14] To prevent and manage these complications, patients must actively engage in self-management strategies, including strict control of fluid and electrolyte intake.[15]

The Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines from the National Kidney Foundation recommend that all patients with CKD consistently adhere to self-management practices throughout their treatment.14 Multiple studies[16,17] indicate that self-management levels among MHD patients are often suboptimal, with fluid intake restriction representing the most challenging aspect of compliance. The prevalence of non-adherence to fluid intake recommendations in this population ranges from 10% to 60%.[18,19] Chronic non-compliance with fluid restrictions may lead to cardiovascular complications such as hypertension, pericardial effusion, and heart failure, ultimately compromising treatment efficacy, quality of life, and long-term survival.[20,21] Self-management refers to the self-care activities performed by hemodialysis patients in response to the physical, emotional, and social challenges imposed by their disease. It involves establishing collaborative partnerships with family members and caregivers to jointly undertake disease management responsibilities, with the ultimate goal of achieving the patient's desired quality of life.[22] For patients requiring regular hemodialysis, self-management is critically important.[23] Although advancements in dialysis technology have improved survival rates among end-stage renal disease patients, this replacement therapy has inherent limitations, such as the inability to continuously remove excess fluids and toxins. Consequently, during interdialytic intervals, patients must learn to manage their body weight, restrict dietary sodium, potassium, and phosphorus, control fluid intake, engage in appropriate physical activity, and adhere to prescribed medications.[24] The level of self-management directly impacts hemodialysis outcomes and the overall survival quality of patients.[25] Effective self-management significantly reduces mortality and complication rates in MHD patients while improving their quality of life.[26–29] By enhancing self-management skills, patients can increase proactive involvement in their care, actively monitor disease progression, adopt healthier habits, and improve treatment adherence. These efforts contribute to fewer complications, reduced symptom burden, and improved survival rates.[30–33] Active engagement in self-management enables patients to better understand and adapt to their condition, promptly identify complications, and take measures to control disease progression, thereby improving treatment outcomes, promoting physical health, and facilitating social reintegration. However, to date, limited research has explored the factors influencing self-management in patients undergoing MHD.

Triadic Reciprocal Determinism proposes that environmental factors, personal factors, and behavioral responses are both independent and interdependent. Behavioral responses arise from the combined influence of individual internal factors and environmental conditions.[34] In the context of self-management, patients' intrinsic factors, such as motivation to adhere to fluid intake recommendations, self-perceived autonomy, and fear of disease progression, along with supportive environmental factors, can exert positive motivational effects that encourage active participation in self-management. Grounded in this theoretical framework, the present study defines self-management as the dependent variable (behavioral response). Independent variables include factors potentially influencing self-management, with "individual factors" encompassing age, educational level, fluid intake adherence motivation, self-perceived autonomy, and fear of disease progression, and "environmental factors" including monthly household income and place of residence. We hypothesize that higher levels of autonomy and motivation predict better self-management. This study aims to investigate the current status

of self-management among MHD patients and apply a random forest model to rank the importance of influencing factors. This approach will assist clinicians in identifying key variables and implementing targeted interventions, thereby providing evidence and insights to enhance self-management capabilities in this patient population.

Method

Study Design

The study employed a convenience sampling method to recruit participants from the hemodialysis centers of four general hospitals in Yulin, Shanxi Province. Patients receiving hemodialysis treatment between March and August 2023 were included as study subjects.

Participants

The diagnosis of CKD was established according to the following criteria (at least one must be met):[35](1) albuminuria (UAER ≥ 30 mg/24 h or UACR ≥ 30 mg/g); (2) abnormal urinary sediment; (3) tubulointerstitial abnormalities; (4) histological abnormalities; (5) imaging evidence of structural abnormalities; (6) history of kidney transplantation; (7) eGFR < 60 mL/min/1.73 m^2.

CKD staging was based on eGFR levels as follows: (1) G1: eGFR ≥ 90 mL/min/1.73 m^2; (2) G2: eGFR 60–89 mL/min/1.73 $m^{2;}$ (3) G3a: eGFR 45–59 mL/min/1.73 $m^{2;}$ (4) G3b: eGFR 30–44 mL/min/1.73 $m^{2;}$ (5) G4: eGFR 15–29 mL/min/1.73 m^2; (6) G5: eGFR < 15 mL/min/1.73 m^2.

Inclusion criteria were: (1) a diagnosis of ESRD and receipt of hemodialysis treatment;[36] (2) regular hemodialysis for at least 3 months, with 2–3 sessions per week; (3) age ≥18 years, conscious, normal hearing, and capable of understanding and communicating effectively.

Exclusion criteria included: (1) mental or cognitive impairment; (2) severe complications such as cardiovascular, cerebrovascular, or pulmonary diseases, acute infections, or malignancies; (3) receipt of peritoneal dialysis or preparation for kidney transplantation.

Sample

The sample size was calculated using the formula for analytical studies: $N = 4U_\alpha^2 S^2/\delta^2$, where $U\alpha$ denotes the U-value corresponding to the significance level α, S represents the standard deviation, and δ is the allowable error. In this study, $\alpha = 0.05$ and $U_\alpha = 1.96$. Based on previous studies of self-management in MHD patients, the standard deviation S was set as 8.52. Referring to Fang Jiqian's method ($\delta = 0.25S$), the allowable error (δ) was calculated as 2.13. The initial sample size was estimated to be 246. Allowing for a 15% rate of invalid questionnaires, the final required sample size was 283 participants.

Measurements

Demographic Information Questionnaire

A self-administered demographic questionnaire designed by the researchers was used to collect information on gender, age, educational level, employment status, residence, marital status, presence of children, monthly household income, payment method for medical expenses, and disease-related characteristics (including dialysis duration, dialysis frequency, number of complications, primary etiology of kidney disease, history of kidney transplantation, and type of vascular access).

Self-Management Scale (SMS)

The Self-Management Scale, originally developed by Taiwanese scholar Song Yijun[22] and later revised by Li Hui,[37] comprises 20 items grouped into four dimensions: Problem Solving (Items 1, 2, 6, 7, 12), Self-Care Performance (Items 3, 4, 5, 8, 9, 10, 16), Partnership (Items 11, 14, 15, 19), and Emotional Handling (Items 13, 17, 18, 20). Items are rated on a 4-point Likert scale ranging from "Never" (1 point) to "Always" (4 points). Total scores range from 20 to 80, with higher scores reflecting better self-management ability. In this study, the scale demonstrated a Cronbach's alpha of 0.841.

Fear of Progression Questionnaire-Short Form (FoP-Q-SF)

The Fear of Progression Questionnaire-Short Form, developed by Mehnert et al[38] and translated into Chinese by Wu et al[39] includes 12 items divided into two subscales: physical health (6 items) and social family (6 items). Responses are recorded on a 5-point Likert scale ranging from "Never" (1 point) to "Always" (5 points). Total scores range from 12 to 60, with higher scores indicating greater fear of disease progression. The Cronbach's alpha for this scale in the present study was 0.832.

Compliance Scale of Motivation for Fluid Intake (CSM)

Developed by Xing Wei,[40] the Compliance Scale of Motivation for Fluid Intake contains 22 items distributed across seven dimensions: Susceptibility (Items 1–3), Severity (Items 4–6), Internal Rewards (Items 7–9), External Rewards (Items 10–12), Behavioral Efficacy (Items 13–15), Behavioral Costs (Items 16–19), and Self-Efficacy (Items 20–22). A 5-point Likert scale is used, ranging from "Strongly Disagree" (1 point) to "Strongly Agree" (5 points). Items 4–12 and 16–19 are reverse-scored. The total score ranges from 22 to 110, with higher scores indicating stronger motivation to adhere to fluid intake recommendations. In this study, the scale demonstrated a Cronbach's alpha of 0.847.

Chinese Version of the PEA Scale (PEAS-CV)

The Chinese version of the PEA Scale, adapted by Wang Bo et al[41] consists of 41 items categorized into three dimensions: Freedom (Items 1–17), Individuality (Items 18–21), and Independence (Items 22–41). Responses are measured on a 4-point Likert scale ranging from "Not Taken" (1 point) to "Frequently Taken" (4 points). Items 18–21 are reverse-scored. Total scores range from 41 to 164, with higher scores indicating a greater sense of autonomy. The Cronbach's alpha coefficient for this scale in the current study was 0.883.

Data Collection

Data were collected using a blinded approach to patient characteristics during questionnaire distribution. Trained researchers administered the surveys through face-to-face interviews. After obtaining informed consent from patients, sociodemographic information and scale scores, including SMS, FoP-Q-SF, CSM, and PEAS-CV, were recorded. Prior to questionnaire completion, researchers provided standardized instructions to ensure patients could complete the surveys independently. For illiterate patients, nurses conducted one-on-one interviews and recorded responses according to patients' answers. The entire survey process took approximately 30 minutes to complete. All questionnaires were collected and verified on site.

Statistical Analysis

Statistical analyses were conducted using SPSS 27.0 and R Studio. Normally distributed continuous data were summarized as mean ± standard deviation and compared between groups using independent samples t-tests and one-way analysis of variance (ANOVA). Categorical data were described as frequencies and percentages. Pearson correlation analysis was employed to assess the relationships among self-management, fear of disease progression, fluid intake motivation, and autonomous perception in MHD patients. Variables showing statistically significant differences in univariate and correlation analyses were included in a random forest model, implemented in R Studio, to rank variable importance. Subsequently, Lasso regression was applied for variable selection, and the retained variables were entered into a multiple linear stepwise regression model for further analysis. A P-value < 0.05 was considered statistically significant.

Results

A total of 344 questionnaires were distributed in this study, all of which were returned (response rate: 100%). Of these, 341 were valid, yielding an effective response rate of 99.13%.

Demographic Information

This study included 341 patients undergoing MHD. The majority were male (63.93%), with a mean age of 48.11 ± 11.87 years. Middle-aged patients (45–60 years) accounted for 53.37% of the sample. In terms of educational background, 32.84% had a primary school education or lower. Regarding employment status, 44.57% were unemployed or retired.

A large proportion of participants resided in urban areas (80.35%), and 67.45% were covered by residential medical insurance. The detailed demographic characteristics are presented in Table 1.

Univariate Analysis of Self-Management in MHD Patients

Univariate analysis demonstrated that self-management differed significantly according to gender, age, education level, employment status, residence, monthly household income, and healthcare payment method ($P < 0.05$), as presented in Table 2.

Table 1 Demographic Characteristics of the Patients (n = 341)

Variables	Category	n (%)
Gender	Male	218 (63.93)
	Female	123 (36.07)
Age (years)	18–44	99 (29.03)
	45–60	182 (53.37)
	>60	60 (17.60)
Children	No	40 (11.73)
	Yes	301 (88.27)
Marital status	Never married	32 (9.38)
	Married	267 (78.30)
	Divorced	24 (7.04)
	Widowed	18 (5.28)
Educational level	Primary school or below	112 (32.84)
	Junior high school	53 (15.54)
	Senior high school or vocational school	90 (26.39)
	College degree or above	86 (25.22)
Employment status	Employed	44 (12.90)
	Retired	24 (7.04)
	Unemployed	152 (44.57)
	Agricultural/Manual worker	53 (15.54)
	Other	68 (19.94)
Place of residence	Urban	274 (80.35)
	Rural	67 (19.65)
Monthly household income (yuan)	≤1000	74 (21.70)
	1001–2999	85 (24.93)
	3000–4999	132 (38.71)
	≥5000	50 (14.66)

(*Continued*)

Table 1 (Continued).

Variables	Category	n (%)
Healthcare payment methods	Resident Basic Medical Insurance	230 (67.45)
	Employee Basic Medical Insurance	90 (26.39)
	Minimum Living Subsidy	21 (6.16)
Number of hemodialysis complications	0	8 (2.35)
	1	78 (22.87)
	2	103 (30.21)
	≥3	152 (44.57)
Years on hemodialysis	<1	49 (14.37)
	1–5	166 (48.68)
	6–10	96 (28.15)
	>10	30 (8.80)
Hemodialysis frequency	5 sessions per two-week period	72 (21.11)
	6 sessions per two-week period	269 (78.89)
Renal transplantation candidate	No	316 (92.67)
	Yes	25 (7.33)
Primary etiology	Glomerulonephritis	115 (32.67)
	Diabetic nephropathy	92 (27.69)
	Hypertensive nephropathy	70 (20.51)
	Polycystic kidney disease	28 (8.22)
	Other	36 (10.91)
Vascular access	Arteriovenous fistula	301 (88.27)
	Arteriovenous graft	14 (4.11)
	Central venous catheter	26 (7.62)

Self-Management, Fear of Disease Progression, Motivation for Fluid Intake, and Autonomous Perception Scores in MHD Patients

The scores for self-management, fear of disease progression, motivation for fluid intake, and autonomous perception among the 341 MHD patients are summarized in Table 3. The mean self-management score was 52.39 ± 6.97. Fear of disease progression averaged 29.34 ± 6.63, motivation for fluid intake was 78.32 ± 9.18, and autonomous perception scored 114.40 ± 12.96 points.

Correlation Analysis of Self-Management with Fear of Disease Progression, Motivation for Fluid Intake, and Autonomous Perception in MHD Patients

Pearson correlation analysis revealed that self-management was significantly and positively correlated with fear of disease progression, motivation for fluid intake, and autonomous perception ($r = 0.286$, 0.386, and 0.392, respectively; all $P < 0.01$), as shown in Table 4.

Table 2 Comparison of Self-Management Scores Among MHD Patients with Different Demographic Characteristics (n = 341)

Variables	Grouping	Score ($\bar{x}$±s)	*t*/*F*	*P*	MCC
Gender	Male	51.77 ± 7.25	−2.212[a]	0.028	
	Female	53.50 ± 6.34			
Age (years)	18–44 (A)	53.88 ± 6.38	8.520[b]	< 0.001	A > B*
	45–60 (B)	52.59 ± 6.87			B > C*
	> 60 (C)	49.32 ± 7.36			
Educational level	Primary school or below (A)	50. 19 ± 6.47	19.684[b]	< 0.001	
	Junior high school (B)	50.34 ± 5.60			
	Senior high school or vocational school (C)	52. 1 ± 6.65			A < C*
	College degree or above (D)	56.83 ± 6.74			C < D*
Employment status	Employed (A)	56.77 ± 6.63	12.704[b]	< 0.001	A > B*
	Retired (B)	53.75 ± 9.11			B > C*
	Unemployed (C)	50.88 ± 6.57			
	Agricultural/Manual worker (D)	49.28 ± 5.71			D < E*
	Other (E)	54.88 ± 5.94			
Place of residence	Urban	53.26 ± 6.51	4.824[a]	< 0.001	
	Rural	48.82 ± 7.70			
Monthly household income (yuan)	≤1000 (A)	48.85 ± 7.02	11.923[b]	< 0.001	A < B*
	1001–2999 (B)	51.62 ± 5.19			B < C*
	3000–4999 (C)	53.97 ± 6.30			
	≥5000 (D)	54.76 ± 8.91			
Healthcare payment methods	Resident Basic Medical Insurance (A)	51.48 ± 6.22	18.017[b]	< 0.001	A < B*
	Employee Basic Medical Insurance (B)	55.73 ± 7.46			B > C*
	Minimum Living Subsidy (C)	48.05 ± 7.47			

Notes: [a] represents the *t*-value, [b] represents the *F*-value.* represents $P < 0.05$.

Table 3 Scores of Self-Management, Fear of Disease Progression, Motivation for Fluid Intake, and Autonomous Perception Among MHD Patients (n = 341)

Scale and Subscales	Min-Max	Mean ± SD
Self-management		
Total score	30–78	52.39 ± 6.97
Problem-solving	6–20	13.09 ± 2.32

(*Continued*)

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Table 3 (Continued).

Scale and Subscales	Min-Max	Mean ± SD
Self-care	10–27	19.81 ± 2.83
Partnership	4–16	10.00 ± 1.88
Emotional handling	4–16	9.50 ± 2.30
Fear of disease progression		
Total score	20–54	29.34 ± 6.63
Social family	10–29	14.57 ± 3.76
Physical health	9–27	14.77 ± 3.43
Motivation for fluid intake		
Total score	39–100	78.32 ± 9.18
Internal rewards	3–15	11.73 ± 2.40
External rewards	3–15	11.36 ± 2.18
Behavioral efficacy	3–15	12.02 ± 1.52
Behavioral costs	4–20	14.30 ± 2.38
Self-efficacy	3–14	8.05 ± 2.59
Autonomous perception		
Total score	67–154	114.40 ± 12.96
Freedom	28–68	51. 17 ± 8.01
Independence	20–74	53.42 ± 7.89
Individuality	4–16	10. 19 ± 2.86

Table 4 Correlation Analysis of Self-Management with Fear of Disease Progression, Motivation for Fluid Intake, and Autonomous Perception Among Patients Undergoing MHD (n = 341)

Item	Self-Management	Fear of Disease Progression	Motivation for Fluid Intake	Autonomous Perception
Self-management	1			
Fear of disease progression	0.286**	1		
Motivation for fluid intake	0.386*	−0.436**	1	
Autonomous perception	0.392**	0.292**	0.269**	1

Notes: ** represents $P < 0.01$, * represents $P < 0.05$.

Selection of Predictors for Self-Management in Patients Undergoing MHD

Ranking of Variable Importance

The total self-management score served as the dependent variable, and 10 variables identified from univariate and correlation analyses as statistically significant were included in a random forest model, which was implemented using the Random Forest package in R Studio to generate the variable importance ranking. The order of importance, from highest to lowest, was as follows: motivation for fluid intake, autonomous perception, gender, educational level, monthly household income, healthcare payment method, employment status, fear of disease progression, age, and place of residence (Figure 1).

Variable Screening

Based on the variable importance ranking, LASSO analysis was conducted using the glmnet package in R Studio for the 10 statistically significant variables identified in univariate and correlation analyses. The optimal lambda value (lambda.1se) was 0.1279, at which six non-zero coefficients were retained. Accordingly, these six most influential variables, as identified by the random forest and LASSO analyses, were included in the subsequent multiple linear stepwise regression (Figure 2).

Multifactorial Analysis of Self-Management in MHD Patients

All assumptions of the multiple linear regression model were satisfied, including linearity, independence of residuals, homoscedasticity, normality of residuals, and absence of multicollinearity. Using the total self-management score as the dependent variable, multiple linear stepwise regression was performed with the six variables selected by the random forest and LASSO analyses as independent variables ($\alpha_{entry} = 0.05$, $\alpha_{removal} = 0.10$). Collinearity diagnostics revealed that tolerance values ranged from 0.816 to 1, and variance inflation factors (VIF) ranged from 1 to 1.226, confirming no multicollinearity. The results demonstrated that place of residence, educational level, motivation for fluid intake, and autonomous perception were the primary predictors of self-management in MHD patients ($P < 0.05$), as shown in Table 5.

Discussion

The Self-Management Level of MHD Patients Requires Improvement

This study found that the total self-management score of MHD patients was 52.39 ± 6.97, reflecting a moderate level, which is slightly lower than the findings reported by Zhou et al.[42] This discrepancy may be attributed to two primary

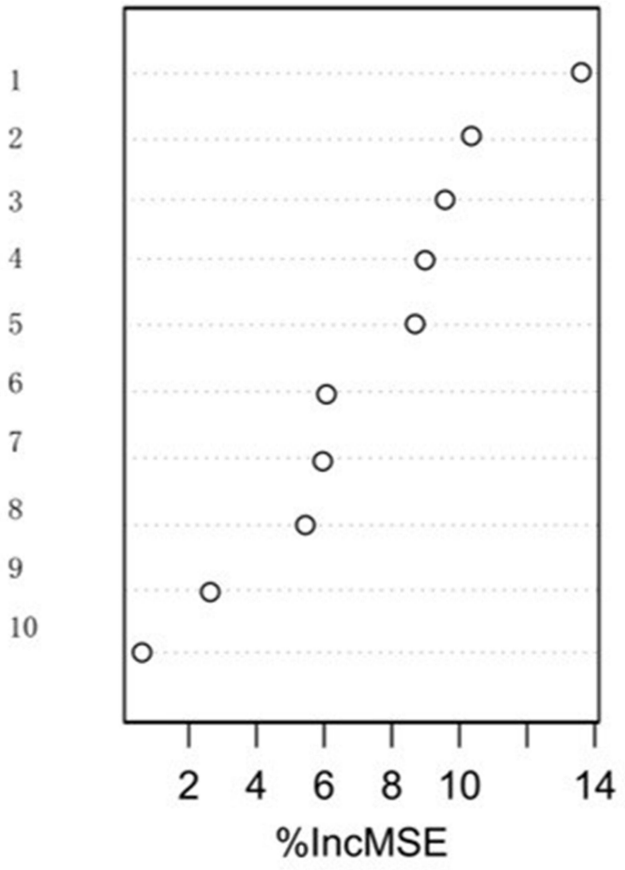

Figure 1 The ranking of variable importance.
Notes: 1. Motivation for fluid intake; 2. Autonomous perception; 3. Gender; 4. Educational level; 5. Monthly household income; 6. Healthcare payment methods; 7. Employment status; 8. Fear of disease progression; 9. Age; 10. Residence.

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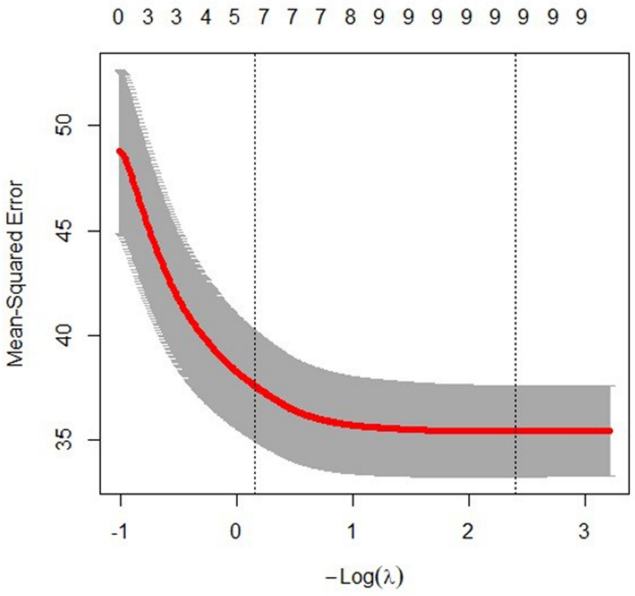

Figure 2 Variable selection based on LASSO analysis.

factors: one is the limited management capacity of the hospitals in the study region and insufficient health education for patients, which may have contributed to the relatively lower self-management levels. This highlights the need for greater attention and support from policymakers and society to enhance self-management among hemodialysis patients in medically underserved areas. It is suggested that relevant stakeholders and policymakers increase investment and support for self-management in economically underdeveloped regions, and strengthen self-management training and guidance for these patients, thereby improving their health outcomes and overall well-being. The other one is that among the participants, 218 (63.93%) were male. Traditional gender roles often assign men the primary role of family breadwinner, which often entails substantial work-related pressures. This may lead them to prioritize maintaining income over seeking medical care and adhering to treatment, adversely affecting their self-management. Furthermore, men often experience greater psychological distress when facing disease-related burdens, are less inclined to express emotions or seek external support, and tend to internalize negative feelings. Consequently, they demonstrate poorer emotional and cognitive management compared with female patients. In the present study, most male patients relied heavily on their spouses for disease management, resulting in lower self-management levels than their female counterparts.

Table 5 Multiple Linear Regression Analysis of Factors Influencing Self-Management in MHD Patients

Item	B	SE	*β*	t	95% CI	*P*
(Constant)	22.536	3.859	–	5.840	(14.945, 30.126)	< 0.001
Place of residence	−2.603	0.838	−0.149	−3.106	(−4.251, −0.955)	0.002
Educational level	1.005	0.297	0.171	3.386	(0.421, 1.588)	< 0.001
Motivation for fluid intake	0.214	0.037	0.282	5.865	(0.142, 0.286)	< 0.001
Autonomous perception	0.120	0.027	0.223	4.399	(0.066, 0.174)	< 0.001

Notes: $R = 0.542$, $R^2 = 0.294$, adjusted $R^2 = 0.285$, $F = 34.916$, $P < 0.001$.

Multiple Factors Influence Self-Management in MHD Patients

Triadic reciprocal determinism proposes that individual behavior arises from the interaction between internal factors and the external environment. Guided by this theoretical framework, this study examines the factors influencing self-management in MHD patients. On one hand, when patients possess sufficient confidence in managing their disease, internal factors such as motivation for fluid intake and autonomous perception positively shape their behavior, increasing their willingness to actively engage in self-management. On the other hand, external environmental factors, such as place of residence, also significantly impact self-management levels. Specifically, patients living in urban areas were found to have markedly higher self-management levels compared to those residing in rural areas.

Urban Residents Show Higher Levels of Self-Management

This study revealed that patients residing in rural areas had lower self-management levels than their urban counterparts, which aligns with the findings reported by Guo Xuejie.[43] This disparity may be attributed to factors such as lower health awareness, agricultural labor demands, and transportation barriers, which collectively reduce adherence to regular follow-up and thus diminish self-management. These findings suggest that policymakers should pay greater attention to the specific needs of rural patients, enhance support measures, and implement targeted strategies to improve their self-management awareness and capabilities. Such efforts would help ensure equitable access to medical resources and services for rural patients, comparable to those available in urban areas.

Higher Educational Level Is Associated with Better Self-Management Abilities

This study revealed that MHD patients with higher educational levels exhibited better self-management abilities, a finding consistent with those reported by Fan Chunqin.[44] Several factors may explain this result. In the present cohort, over half of the patients (51.61%) had completed senior high school or higher education. Patients with more years of formal schooling generally possess stronger abilities to acquire and interpret health-related information, which facilitates a deeper understanding of their condition and enhances self-management awareness. Conversely, those with lower educational levels often encounter difficulties in accessing and comprehending self-management knowledge, resulting in relatively weaker awareness and competencies. Therefore, during hospitalization, healthcare providers should deliver supportive education and guidance tailored to patients' educational backgrounds, primarily through verbal instruction. In addition, it is recommended to develop a repository of easy-to-understand health education videos and organize both online and offline health lectures to ensure patients across all literacy levels can effectively receive and understand health information. During home-based rehabilitation, continuous nursing services should be strengthened, and a round-the-clock health information support system should be established via mobile health platforms. Intelligent delivery of personalized rehabilitation guidance plans should also be implemented to effectively improve patients' self-management levels.

Higher Motivation for Fluid Intake Is Linked to Better Self-Management

This study found that motivation for fluid intake positively influenced self-management levels among MHD patients, supporting the results of Xing Wei.[40] One possible explanation is that repeated health education from doctors and nurses helps patients recognize that adherence to fluid restriction not only enhances hemodialysis efficacy but also reduces the risk of complications such as pericardial effusion and heart failure. Additionally, patients often experience physical comfort from stable body weight, further reinforcing their motivation to comply with fluid intake guidelines. These findings underscore the importance for healthcare providers to address patients' actual needs and motivational states. Interventions such as motivational interviewing, mindfulness training, and emotional support[45] should be tailored to enhance patients' understanding of their own adherence motivation and ultimately improve their self-management.

Greater Autonomous Perception Is Associated with Better Self-Management

This study demonstrated that autonomous perception positively influenced self-management levels in MHD patients, which is consistent with the findings of Min Lu.[46] Patients with higher autonomous perception are more likely to perceive empathy and support from healthcare providers, fostering a positive psychological state that promotes active participation in self-management behaviors, such as regularly monitoring and recording daily blood pressure, urine output, and body weight. Furthermore, Hertz et al[47] suggested that autonomous perception

directly translates into self-management behaviors, emphasizing the value of enhancing autonomous perception to improve self-management capabilities. These results indicate that healthcare providers should incorporate assessments of autonomous perception into routine care and design individualized interventions based on patients' autonomy levels. Additionally, in this study, 85.63% of patients had been on dialysis for one year or longer, and 78.89% underwent dialysis six times per two-week period. This may indicate that patients with longer dialysis vintage and higher frequency develop stronger self-management abilities, likely due to accumulated experience and knowledge in managing dialysis-related challenges. However, research on the application of autonomous perception to health-related self-management remains at an early stage, and available evidence is still limited. Further investigation is warranted to clarify the role of autonomous perception in enhancing self-management among MHD patients, thereby providing clinicians and healthcare professionals with stronger theoretical support and practical guidance.

Limitations

This study has several limitations. The generalizability of the findings is constrained by the fact that participants were recruited only from several general hospitals in Yulin, Shaanxi Province. Future research should include patients from healthcare institutions at various levels and diverse geographical regions to enhance sample representativeness. In addition, since self-management is a complex and dynamically changing construct with substantial individual variation, the cross-sectional design employed here cannot capture longitudinal changes in self-management behaviors. Future studies would benefit from adopting a longitudinal approach to better understand how self-management evolves over time. The use of face-to-face interviews for data collection may introduce social desirability bias. Subsequent research could incorporate objective indicators (eg, interdialytic weight gain as a measure of fluid adherence or laboratory results reflecting dietary control) to help minimize such bias.

Conclusion

Self-management among MHD patients remains at a moderate level and requires further improvement. Grounded in Triadic Reciprocal Determinism Theory, this study highlights that environmental and individual factors interact and collectively shape self-management behaviors. Key predictors such as place of residence, educational level, motivation for fluid intake adherence, and self-perceived autonomy significantly influence self-management in this population. In the future, targeted interventions should be implemented according to individuals' residential backgrounds and educational levels, with simultaneous improvements in motivation for fluid intake adherence and self-perception to enhance self-management capabilities.

Ethics Statement

All procedures in this study were conducted in accordance with the ethical principles of the Declaration of Helsinki. This study protocol received approval from the Ethics Committee of Ningxia Medical University (Approval No. 2023-043).

Written informed consent was obtained from all participants.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all.

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Disclosure

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