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ORIGINAL RESEARCH

Investigation of Exercise Status and Related Influencing Factors Among Maintenance Hemodialysis Patients in Nantong Region: A Cross-Sectional Study in China (2024–2025)

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Background: The physical activity level of Maintenance Hemodialysis (MHD) patients is closely associated with prognosis and quality of life. This study aimed to investigate the exercise status and influencing factors among MHD patients in the Nantong region.

Methods: A cross-sectional study was conducted among 227 MHD patients from three hospitals in Nantong, China, between June 2024 and February 2025. The Physical Activity Stage of Change Scale was used to assess exercise behavior stage; the Dialysis Patient Exercise Benefits/Barriers Scale was used to evaluate exercise cognition; and the Perceived Social Support Scale was used to assess perceived social support. Patients were divided into regular exercise and non-regular exercise groups based on behavior stage. Influencing factors were analyzed using univariate and multivariate methods.

Results: Among 227 patients, 83 (36.56%) engaged in regular exercise, while 144 (63.44%) did not. Univariate analysis showed that age, marital status, education level, exercise cognition, and social support differed significantly between the two groups ($P<0.05$). Multivariate logistic regression revealed that marital status, exercise cognition, and social support were independent influencing factors of regular exercise behavior.

Conclusion: Exercise participation among MHD patients in Nantong remains insufficient. Targeted interventions addressing exercise cognition and social support should be adopted to promote regular physical activity in this population.

Keywords: Maintenance Hemodialysis; Physical Activity; Cross-sectional Study; Social Support; Exercise Cognition.

Introduction

With the increasing global prevalence of chronic kidney disease (CKD), Maintenance Hemodialysis (MHD) has become one of the primary treatment modalities for patients with end-stage renal disease (ESRD).[1] Although MHD plays a critical role in prolonging patient survival, long-term dialysis treatment is often accompanied by a progressive decline in physical function, particularly in musculoskeletal capacity, which severely compromises patients' daily activity ability and overall quality of life.[2,3]

In recent years, a growing number of studies[4–6] have confirmed that exercise interventions can bring substantial health benefits to MHD patients. Exercise not only contributes to improvements in cardiovascular function, immune response, and mental health, but also helps mitigate complications such as muscle atrophy and decreased bone mineral density associated with prolonged inactivity. Moreover, exercise has been shown to improve dialysis adequacy and enhance health-related quality of life in this population. For instance, a recent study by Rohmah et al (2024) demonstrated that intradialytic aerobic exercise significantly improved both dialysis adequacy and quality of life in ESRD patients undergoing MHD.[7]

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Despite these benefits, many MHD patients still fail to engage in regular physical activity. Previous literature suggests that this may be attributed to multiple barriers, including low exercise awareness, physical discomfort, lack of social support, and insufficient individualized guidance.[8,9] While existing research has predominantly emphasized the outcomes of exercise interventions, there is a paucity of data focusing on the current exercise behavior of MHD patients and its influencing factors, especially within specific regional contexts.

Therefore, this study aims to investigate the exercise status and related influencing factors among MHD patients in the Nantong region, utilizing cross-sectional data from three major hospitals. The findings are expected to offer a theoretical foundation and practical reference for developing targeted exercise programs, ultimately improving exercise adherence and enhancing the quality of life in this patient population.

Subjects and Methods

Study Subjects

This cross-sectional study was conducted from June 2024 to February 2025 in China, at the hemodialysis centers of three tertiary general hospitals in Nantong City, Jiangsu Province, namely the Affiliated Hospital of Nantong University, Nantong First People's Hospital, and Tongzhou District People's Hospital.

Participants A total of 227 MHD patients were recruited using a convenience sampling method. Inclusion criteria were: (1) aged ≥ 18 years; (2) on MHD for ≥ 3 months; (3) conscious and able to understand and independently complete the questionnaire; (4) provided written informed consent together with family members. Exclusion criteria included: (1) receiving treatment for acute kidney injury or other acute diseases; (2) communication disorders, cognitive impairment, or mental illness; (3) severe complications (eg, NYHA class III/IV heart failure, active cancers, or systemic infections requiring hospitalization); (4) serious physical disabilities preventing activity. The study was approved by the Ethics Committee of the Affiliated Hospital of Nantong University (Approval No. XTDC-250003). The ethics committee of the university was responsible for the ethical oversight of the study, and the approval covered all collaborating hospitals. All the methods were carried out in accordance with the Declaration of Helsinki.

Sample Size and Data Collection

Sample size was based on the rule of at least 10 events per variable for logistic regression, considering an expected regular exercise prevalence of ~40%, 10 predictors, and a 10% attrition rate. A minimum of 225 patients was estimated. Patients were recruited consecutively from dialysis shifts across all three hospitals during the study period. All eligible patients were approached until the target sample size was reached. Data collection was conducted in Chinese using standardized, pre-tested questionnaires. All investigators underwent uniform training. A pilot test of the questionnaire was conducted with 15 patients to ensure clarity and feasibility.

Research Instruments

General Information

A self-designed general information questionnaire collected the following variables: age (≤ 60 years, > 60 years), gender (male, female), marital status (married, unmarried/divorced/widowed), educational level (high school or below, college or above), dialysis duration (≤ 48 months, > 48 months), body mass index (BMI, < 24.0 kg/m², ≥ 24.0 kg/m²), and number of comorbidities (< 3, ≥ 3). The cutoff points for dialysis duration and BMI were based on the sample median values.

Regular Exercise Status

Regular exercise was defined as engaging in physical activity at least 3 times per week, with each session lasting more than 30 minutes. The Physical Activity Stage Distribution Scale[10] (Cronbach's α = 0.835, Split-half reliability = 0.852, Test-retest reliability = 0.814, Content validity index = 0.823) was used to assess the exercise behavior stages of MHD patients. This scale, based on the Transtheoretical Model, categorizes exercise behavior into five stages: Precontemplation stage: The patient is not exercising and does not plan to start within the next six months. Contemplation stage: The patient is not currently exercising but intends to start within the next six months.

Preparation stage: The patient exercises occasionally but lacks consistency and has not yet established a regular exercise habit. Action stage: The patient has started regular exercise but has been doing so for less than six months. Maintenance stage: The patient has been exercising regularly for more than six months. According to the definition of regular exercise, patients in the precontemplation, contemplation, and preparation stages were classified as the non-regular exercise group, while patients in the action and maintenance stages were classified as the regular exercise group.

Exercise Cognition

The Dialysis Patient-Perceived Exercise Benefits and Barriers Scale (DPEBBS) was used to evaluate exercise cognition (Cronbach's $\alpha = 0.87$, test–retest reliability = 0.84).[11] This scale includes 24 items, scored using a 4-point Likert scale. The benefit items were scored positively, while the barrier items were scored reversely. The total score ranges from 24 to 96, with higher scores indicating greater perceived exercise benefits and fewer barriers.

Social Support

The Multidimensional Scale of Perceived Social Support (MSPSS) was used to measure social support (Cronbach's $\alpha = 0.85$).[12] The scale includes 12 items across three dimensions: support from family, friends, and significant others. Total scores range from 12 to 84, with higher scores indicating stronger perceived support.

Data Collection Method

Before data collection, investigators received standardized training. All patients were informed of the study purpose and gave written consent. For those with reading or comprehension difficulties, the questionnaire was read aloud, and responses were recorded by trained personnel. Questionnaires were reviewed in real time to ensure completeness. A total of 230 questionnaires were distributed, and 227 valid ones were collected, yielding a 98.70% response rate.

Statistical Analysis

Data were analyzed using SPSS 22.0, and figures were produced using GraphPad Prism 8. Categorical variables were expressed as n (%) and analyzed using the chi-square test. Continuous variables were presented as mean ± SD and compared using the independent sample *t*-test. Variables with $p < 0.05$ in univariate analysis were included in multivariate logistic regression to identify factors influencing regular exercise. A p-value < 0.05 was considered statistically significant.

Results

Exercise Participation Status

According to the Physical Activity Behavior Stage Distribution Scale, among the 227 MHD patients, 39 (17.18%) were in the pre-contemplation stage, 13 (5.73%) were in the contemplation stage, 92 (40.53%) were in the preparation stage, 39 (17.18%) were in the action stage, and 44 (19.38%) were in the maintenance stage. A total of 144 patients (63.44%) in the pre-contemplation, contemplation, and preparation stages were categorized into the non-regular exercise group, while 83 patients (36.56%) in the action and maintenance stages were categorized into the regular exercise group.

Comparison of General Data Among Patients with Different Exercise Participation

Among the 227 MHD patients, 139 (61.23%) were male, and 88 (38.77%) were female; the average age was (57.96 ±6.85) years; the average BMI was (22.74±3.11) kg/m^2; 169 (74.45%) were married, while the remaining 58 (25.55%) were unmarried/divorced/widowed; regarding education level, 155 (68.28%) had a high school education or lower, while 72 (31.72%) had a college education or higher; 97 (42.73%) had a dialysis duration of ≤48 months, while 130 (57.27%) had a dialysis duration of >48 months; 201 (88.55%) had fewer than 3 comorbidities, while 26 (11.45%) had 3 or more comorbidities. There were statistically significant differences between groups in terms of age, marital status, and education level ($P < 0.05$), as shown in Table 1.

Table 1 Comparison of General Data Among Maintenance Hemodialysis Patients by Exercise Participation in Nantong Region, 2024 [n (%)]

	Total (n=227)	Regular Exercise Group (n=83)	Non-Regular Exercise Group (n=144)	t/x^2	*P*
Gender	–	–	–	2.143	0.143
Male	139 (61.23)	56 (67.47)	83 (57.64)	–	–
Female	88 (38.77)	27 (32.53)	61 (42.36)	–	–
Age (years)	–	–	–	4.734	0.029
≤60	189 (83.26)	75 (90.36)	114 (79.17)	–	–
>60	38 (16.74)	8 (9.64)	30 (20.83)	–	–
BMI (kg/m²)	–	–	–	0.486	0.485
<24.0	169 (74.45)	64 (77.11)	105 (72.92)	–	–
≥24.0	58 (25.55)	19 (22.89)	39 (27.08)	–	–
Marital Status	–	–	–	8.463	0.003
Married	169 (74.45)	71 (85.54)	98 (68.06)	–	–
Unmarried/Divorced/Widowed	58 (25.55)	12 (14.46)	46 (31.94)	–	–
Education Level	–	–	–	6.598	0.010
High School or Below	155 (68.28)	48 (57.83)	107 (74.31)	–	–
College or Above	72 (31.72)	35 (42.17)	37 (25.69)	–	–
Dialysis Duration (months)	–	–	–	0.182	0.669
≤48	97 (42.73)	37 (44.58)	60 (41.67)	–	–
>48	130 (57.27)	46 (55.42)	84 (58.33)	–	–
Number of Comorbidities	–	–	–	1.176	0.278
<3	201 (88.55)	76 (91.57)	125 (86.81)	–	–
≥3	26 (11.45)	7 (8.43)	19 (13.19)	–	–

Note: P < 0.05 represents a significant difference.

Comparison of Exercise Cognition Among Patients with Different Exercise Participation

The total exercise cognition score, benefits score, and barriers score for the regular exercise group were (69.67±5.42), (36.13±2.85), and (33.53±2.56), respectively; for the non-regular exercise group, the total score, benefits score, and barriers score were (62.24±7.42), (32.31±3.68), and (29.92±3.73), respectively. The regular exercise group had higher total, benefits, and barriers scores than the non-regular exercise group (P < 0.05), as shown in Figure 1.

Comparison of Social Support Among Patients with Different Exercise Participation

The total social support score, family support score, friend support score, and other support score for the regular exercise group were (57.04±4.59), (23.26±1.98), (18.94±2.97), and (14.83±3.12), respectively; for the non-regular exercise group, the total score, family support score, friend support score, and other support score were (46.02±5.06), (20.75±2.89), (14.68±2.93), and (10.57±2.91), respectively. The regular exercise group had higher total social support score, family support score, friend support score, and other support score than the non-regular exercise group (P < 0.05), as shown in Figure 2.

Multivariate Logistic Regression Analysis of Factors Influencing Regular Exercise Participation

Using whether the patient participated in regular exercise as the dependent variable (regular exercise = 0, non-regular exercise = 1), and using the potential influencing factors from Table 1, Figure 2 as independent variables with assigned values (as shown in Table 2), a multivariate logistic regression analysis model was established. The results indicated that

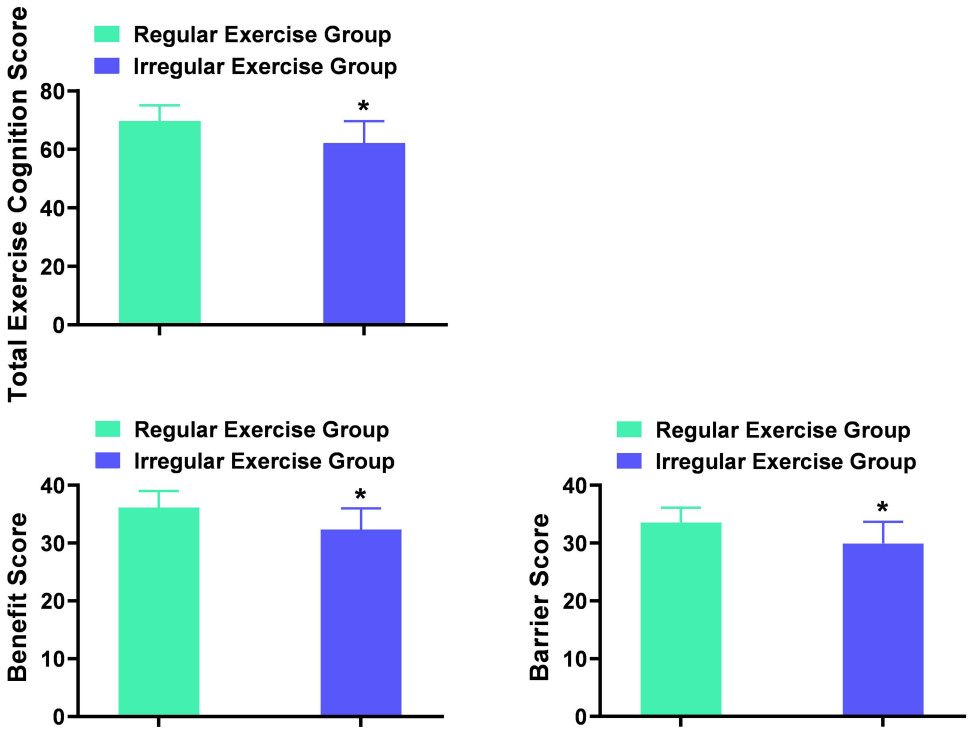

Figure 1 Comparison of Exercise Cognition Scores Among Patients with Different Exercise Participation in Nantong Region, 2024 (, Scores).
Note: Group comparisons, *P < 0.05; P < 0.05 represents a significant difference.

marital status, exercise cognition, and social support were independent factors influencing regular exercise participation in MHD patients (P < 0.05), as shown in Table 3.

Discussion

In this study, among 227 MHD patients, only 36.56% participated in regular exercise, a finding consistent with previous related research,[13,14] reflecting the general lack of exercise behavior among MHD patients. The causes of this phenomenon are complex and are closely related to the physiological burden caused by dialysis treatment, the cognitive biases of patients regarding exercise, and their psychological state. First, dialysis treatment itself significantly affects the patient's physical condition, with many patients experiencing extreme fatigue and physical exhaustion after dialysis,[15] leading to a sense of aversion to exercise. Moreover, patients' exercise cognition greatly influences their exercise behavior. Some MHD patients have a limited understanding of the benefits of exercise, believing that exercise does not significantly improve the condition of dialysis patients and even think that exercise may exacerbate physical discomfort.[16,17] More importantly, psychological factors play a crucial role in the exercise behavior of MHD patients. Patients who rely on dialysis treatment for a long time often feel depressed, and negative emotions such as anxiety and depression are common,[18,19] causing them to psychologically reject exercise. Patients with poor psychological states often do not actively seek exercise as a means to improve health and enhance quality of life, but instead tend to passively cope with treatment. Therefore, changing patients' cognition of exercise through psychological interventions and exercise education, reducing exercise barriers, and alleviating negative emotions are key to improving patients' exercise participation.

The results of the multivariate logistic regression analysis in this study indicated that marital status, exercise cognition, and social support are independent factors influencing regular exercise in MHD patients. This study found that married patients were more likely to participate in regular exercise than unmarried patients. This finding aligns with a study by Molsted et al, which reported that being married or having a permanent partner was associated with higher mental quality of life scores and increased physical activity among patients with chronic kidney disease (CKD) ($\beta = 2.88$; 95% CI: 0.99–4.77; $p = 0.003$).[20] The reason may be that married individuals tend to benefit from their spouses'

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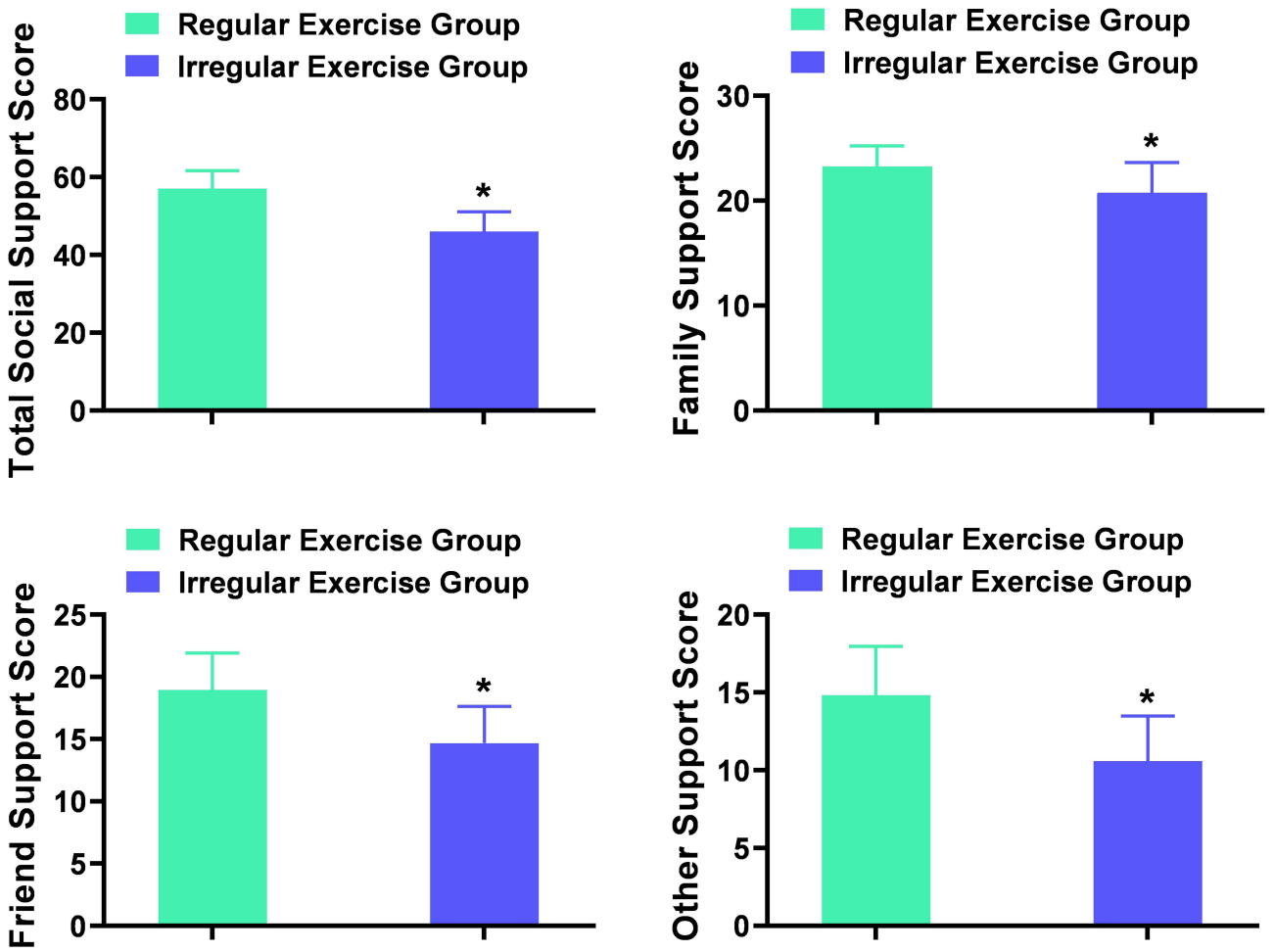

Figure 2 Comparison of Social Support Scores Among Patients with Different Exercise Participation in Nantong Region, 2024 (, Scores).
Note: Group comparisons, *P < 0.05; P < 0.05 represents a significant difference.

involvement in daily routines and health-related behaviors, such as exercise encouragement, reminders, and emotional support.[21,22] These factors can contribute to greater motivation and consistency in physical activity. Additionally, married patients often experience more stable emotional conditions and lower levels of loneliness and anxiety,[23,24] which may further support the development of regular exercise habits. In contrast, unmarried patients may lack such spousal support and encounter more psychosocial barriers to maintaining exercise routines.[25] Therefore, attention should be given to the unique needs of unmarried patients when designing individualized exercise promotion strategies, including targeted interventions that address emotional well-being and self-management capability.

The Health Belief Model suggests that whether an individual adopts a health behavior often depends on whether the perceived benefits of that behavior outweigh the perceived barriers.[26] Therefore, understanding MHD patients' cognition

Table 2 Variable Assignments of Independent Variables for Logistic Regression Analysis

Independent Variable	Assignment Method
Age	≤60 years = 0; >60 years = 1
Marital Status	Married = 0; Unmarried/Divorced/Widowed = 1
Education Level	College or above = 0; High school or below = 1
Exercise Cognition Total Score	Original value
Social Support Total Score	Original value

Table 3 Multivariate Logistic Regression Analysis of Factors Influencing Regular Exercise Participation Among Hemodialysis Patients in Nantong Region, 2024

Factor	β	SE	Wald x^2	P	OR	95% CI
Age (≤60 years)	0.549	0.562	0.991	0.318	1.726	0.597–5.143
Marital Status (Married)	−1.582	0.654	5.718	0.015	0.697	0.558–0.836
Education Level (College or above)	0.095	0.557	0.028	0.874	1.105	0.867–2.219
Exercise Cognition Total Score	−1.347	0.468	4.615	0.028	0.313	0.161–0.635
Social Support Total Score	−1.834	0.512	10.473	<0.001	0.534	0.349–0.787

of exercise, particularly their perceived benefits and barriers, is crucial for promoting their participation in exercise. Some studies[27] have shown that most MHD patients are aware of the potential benefits of exercise for health, but due to doubts about the effectiveness of exercise or physical discomfort caused by dialysis, many patients fail to incorporate exercise into their daily lives and thus do not form regular exercise behavior. The results of this study also support this view, ie, although MHD patients have a moderate level of exercise cognition and understand its potential benefits, many patients still choose to abandon exercise when faced with barriers. The barriers mainly include physical fatigue, psychological stress, discomfort after exercise, and lack of effective exercise guidance. In fact, these barriers are common in patients' daily lives and often become the key reasons preventing patients from actively participating in exercise.[28] This is consistent with findings from an integrative review by Hannan, which identified fatigue and low energy levels as the most frequently reported barriers to exercise among patients with renal disease.[29] Therefore, for medical staff, understanding and addressing these barriers is an important entry point for promoting regular exercise in MHD patients. Specifically, medical staff should engage in in-depth communication with patients to explore their true perceptions of exercise, identify the specific barriers to exercise participation, and provide personalized advice and support. This will not only help patients overcome practical difficulties in exercise but also enhance their confidence in the benefits of exercise, thereby promoting the formation of exercise habits.

This study also found that social support plays a crucial role in MHD patients' exercise behavior, particularly in enhancing their willingness and participation in physical activity. Social support is not limited to family assistance but also includes encouragement from friends, healthcare providers, and broader social networks. Studies have demonstrated that higher levels of social support are associated with increased exercise participation among MHD patients, which is consistent with our findings.[30–32] Dialysis not only places a significant physical burden on patients but also potentially affects their mental well-being. Although this study did not specifically assess anxiety or depression, previous research suggests that negative emotions may hinder patients' ability to maintain regular exercise. A systematic review and meta-analysis by Yang et al demonstrated that psychosocial interventions, which often involve enhancing social support, significantly reduced depressive symptoms in CKD patients.[33] Social support—particularly emotional and practical support from families, friends, and medical teams—can buffer against such emotional difficulties, potentially enhancing exercise motivation and self-confidence. Therefore, improving access to social support, especially emotional and instrumental support, may be an effective strategy to promote exercise participation.

Although this study provides valuable insight into the exercise behavior of MHD patients in the Nantong region, several limitations should be acknowledged. First, this was a cross-sectional study, which limits the ability to infer causality. Longitudinal research is needed to assess the long-term effects of influencing factors on exercise adherence. Second, the study was conducted at three hospitals in Nantong, which may limit the generalizability of the findings. Future studies should expand to different geographic regions and larger sample sizes. Third, the study did not collect data on patients' emotional states such as anxiety or depression. These psychological factors may influence exercise behavior and should be considered in future research. Additionally, exploring other relevant psychosocial variables such as self-efficacy and detailed exercise barriers will help to more comprehensively understand MHD patients' exercise behaviors.

Conclusion

This study systematically analyzed the exercise behavior and its influencing factors among MHD patients in the Nantong region. The results revealed a low rate of regular exercise participation among these patients, indicating a pressing need to improve physical activity engagement in this population. Multivariate logistic regression analysis identified three independent predictors of regular exercise: marital status, exercise cognition, and social support. Married patients were more likely to engage in regular exercise, likely due to spousal companionship, encouragement, and emotional stability. Patients with higher exercise-related knowledge showed greater motivation and adherence. Social support—spanning family, friends, and healthcare providers—was found to facilitate exercise participation by mitigating psychological and logistical barriers.

Although anxiety and depression were not directly assessed in this study, prior research suggests that social support may indirectly promote exercise behavior by buffering emotional distress. This underscores the importance of examining psychological mediators in future studies. Collectively, the findings of this study provide important empirical evidence for the development of tailored interventions. In clinical settings, attention should be paid to unmarried patients, those with limited exercise knowledge, and individuals lacking adequate support. Personalized strategies that include emotional support, exercise education, and social resource integration may be effective in enhancing physical activity among MHD patients, ultimately contributing to better physical health outcomes and improved quality of life.

Disclosure

The authors report no conflicts of interest in this work.

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