Journal of Multidisciplinary Healthcare

Dovepress
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ORIGINAL RESEARCH

Analysis of Risk Factors of Sarcopenia in Patients with Maintenance Hemodialysis and Its Correlation with Emotional Status and Quality of Life

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Objective: Sarcopenia is more common in maintenance hemodialysis (MHD) patients, and the aim of this study is to analyze the risk factors associated with sarcopenia in MHD patients, along with its correlation to emotional status and quality of life.

Methods: This is a cross-sectional cohort study. A total of 111 MHD patients who were treated in the Department of Nephrology of our hospital were selected as the study subjects by convenience sampling. The quality of life and emotional status were evaluated by health survey scale (SF-36), self-rating anxiety scale (SAS) and self-rating depression scale (SDS). Regression analysis was used to explore the influencing factors of sarcopenia. Correlation analysis was used to investigate the correlation between sarcopenia and quality of life and emotional status.

Results: The prevalence of sarcopenia was 59.8%. The results showed that age, gender, body mass index (BMI), dialysis time, economic status, marital status and pre-dialysis creatinine were significant factors affecting the development of sarcopenia in hemodialysis patients ($p<0.05$). The SF-36 total score was significantly lower in the sarcopenia group (72.05±12.28 vs 78.03 ±10.55) than in the non-sarcopenia group, but the anxiety scale score (52.97±4.67 vs 36.2±3.36) and depression scale score (57.67 ±4.58 vs 38.71±3.77) were significantly higher than those in the non-sarcopenia group ($p< 0.001$). Correlation analysis showed that sarcopenia was positively correlated with SAS and SDS scores and negatively correlated with SF-36 total score ($p < 0.05$).

Conclusion: The risk of sarcopenia was higher among MHD patients who were older, male, single, with a longer MHD duration, lower economic status, lower BMI, comorbid diabetes and lower levels of creatinine.

Keywords: maintenance hemodialysis, sarcopenia, quality of life, risk factors, cross-sectional studies

Introduction

Sarcopenia is a syndrome characterized by the progressive loss of muscle mass, strength, and decreased physical function.[1] Patients with chronic kidney disease, especially those with uremia, exhibit a higher prevalence of sarcopenia. This not only alters the lifestyle of patients but also increases the occurrence of cardiovascular-related complications, leading to higher hospitalization rates and mortality.[2,3] Sarcopenia significantly impacts the clinical prognosis of patients undergoing maintenance hemodialysis (MHD).[4] The pathogenesis of sarcopenia is complex and is believed to be associated with factors such as genetics, environment, aging, malnutrition, lack of exercise, and changes in age-related hormones.[5,6] It is the result of interactions between various risk factors and related pathogenic mechanisms.

Received: 20 March 2024
Accepted: 21 June 2024
Published: 1 August 2024

As research progresses, the relationship between sarcopenia, quality of life, and psychological well-being has gradually gained attention from researchers.[7,8] Many researchers believe that the two can coexist, and the persistent and complex symptoms often lead to anxiety, depression, and other negative emotions in patients, affecting their quality of life.[9] However, most studies focus on either the risk factors of sarcopenia or the quality of life and psychological status. There is limited research on the relationship between the risk factors of sarcopenia and emotional status, as well as quality of life. Specifically, previous research has predominantly addressed either the physiological aspects of sarcopenia or its psychological impacts in isolation, neglecting the holistic interaction between these elements. Therefore, this study aims to explore the risk factors for sarcopenia in MHD patients and their relationship with emotional status and quality of life.

Materials and Methods

Study Subjects

This is a cross-sectional cohort study. Convenience sampling method was used to select MHD patients who were treated in the Blood Purification Center of Ningbo Lihuili Hospital from May to July 2022 as the study subjects. All potential participants were approached during their clinic visits for hemodialysis, and each patient was asked if they were interested in participating. A total of 111 individuals agreed to take part, while 2 declined. According to the presence of sarcopenia, they were divided into sarcopenia group (n=74) and non-sarcopenia group (n=37). Inclusion criteria: ①age ≥ 18 years; ②MHD duration ≥ 6 months; ③provided informed consent and willing to participate in the study. Exclusion criteria: ①patients with severe cardiovascular, liver, or hematologic diseases; ②patients with metal stents or cardiac pacemakers; ③patients with senile dementia or unable to cooperate; ④patients who have undergone joint replacement or amputation surgery; ⑤patients with concomitant tumors, etc. Ethical approval was obtained from the Ethics Committee of LH Hospital, Ningbo City (Approval No. KY2023PJ204), and all enrolled patients provided voluntary informed consent.

Sample Size Calculation

The sample size was calculated based on the prevalence of sarcopenia in MHD patients reported in previous studies. Assuming a prevalence of 30%, a confidence level of 95%, and a margin of error of 10%, the required sample size was determined using the formula for estimating a population proportion:

$$n = Z^2 \times p \times (1 - p)/E^2$$

Where:

n is the required sample size

Z is the Z-value (1.96 for 95% confidence)

p is the estimated prevalence (0.30)

E is the margin of error (0.10)

Using this formula, the minimum required sample size was calculated to be approximately 81 patients. To account for potential dropouts and ensure sufficient power for subgroup analyses, we aimed to include at least 100 patients. Ultimately, 111 patients were enrolled in the study.

Research Methods

Diagnostic Criteria for Sarcopenia

The diagnostic criteria for sarcopenia were based on the guidelines of the Asian Working Group for Sarcopenia (AWGS),[10] which include three main aspects: muscle mass, muscle strength, and muscle function. Sarcopenia diagnosis was confirmed in collaboration with a nephrologist. The criteria used were as follows: Skeletal Muscle Mass Index (SMI) measured by bioelectrical impedance analysis (BIA) (SMI < 7.0 for men, SMI < 5.7 for women), Hand Grip Strength (HGS) < 26 kg for men, < 18 kg for women, and/or gait speed < 0.8 m/s. A diagnosis of sarcopenia was made if one of the following conditions was met: (1) low muscle mass and low muscle strength or (2) low muscle mass and low gait speed.

Data Collection Methods

① Screening methods for sarcopenia: On the dialysis day, hand grip strength of the patients was measured using an electronic hand dynamometer. Three measurements were taken with a 5-second interval between each measurement, and the maximum value was recorded. Gait speed was also measured by having the patients walk on a flat surface, and the time taken to cover a distance of 6 meters was recorded. Bioelectrical impedance analysis (BIA) was used to calculate the Skeletal Muscle Mass Index (SMI) 30–60 minutes after dialysis and before food and water intake.

② General information and medical history questionnaire: A general information questionnaire was used to collect demographic data of the patients, including gender, age, economic status, marital status, etc. The questionnaire also collected information on the primary disease diagnosis, presence of diabetes, and MHD duration. Fasting venous blood samples were collected in the morning to measure hemoglobin (Hb), calcium (Ca), phosphorus (P), parathyroid hormone (PTH), albumin (ALB), prealbumin (PA), and creatinine (scr). Urea nitrogen and creatinine levels were measured before and after dialysis to calculate dialysis adequacy (Kt/V). Body Mass Index (BMI) was calculated as body weight divided by height squared (kg/m^2).

③ Assessment of emotional status: The Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS) were used to evaluate the emotional status of the patients.[11,12] A score of >50 on the SAS indicated anxiety, while a score of >53 on the SDS indicated depression. The 2 scales are widely used in China and have good reliability and validity.[13] The Cronbach's alpha value in this study were found to be 0.80 and 0.81, respectively.

④ Health survey scale (SF-36):[14] The SF-36 questionnaire was used to assess health-related quality of life (QOL) and consisted of eight dimensions: physical functioning (PF), role-physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role-emotional (RE), and mental health (MH). These eight dimensions can be grouped into two component summaries: the physical component summary (PCS) and the mental component summary (MCS). The research tool had a reliability value of 0.853 and validity of 0.903.

Statistical Methods

Statistical analysis was performed using SPSS 22.0 software. Count data were presented as relative numbers, and group comparisons were conducted using the chi-square test. Normally distributed continuous data were presented as mean ± standard deviation ($\bar{x}\pm$ SD), and group comparisons were performed using independent sample *t*-tests. Continuous data that did not obey the normal distribution were expressed by median and interquartile range, and rank sum test was used for comparison between groups. Binary logistic regression analysis was used to identify independent risk factors for sarcopenia in hemodialysis patients. Pearson correlation analysis was used for correlation analysis. A p-value < 0.05 was considered statistically significant for all analyses.

Results

Baseline Characteristics

A total of 111 MHD patients, including 75 males and 36 females, met the inclusion criteria for this study. The mean age of the participants was 62.10 ± 8.15 years, with an age range of 45 to 81 years. The average MHD duration was 3.8 ± 1.1 years. The leading causes of end-stage renal failure were chronic nephritis (39.6%), diabetic nephropathy (27%), hypertensive nephropathy (19.8%), polycystic kidney disease (6.3%), and other causes (7.2%). Among the 111 enrolled patients, 74 (66.7%) were classified as the sarcopenia group, and 37 (33.3%) were classified as the non-sarcopenia group. Statistically significant differences were observed between the two groups in terms of gender, age, marital status, economic status, duration of dialysis, body mass index (BMI), pre-dialysis creatinine, the presence of comorbid diabetes, phosphorus and C-reactive protein ($p < 0.05$). However, there were no statistically significant differences in Kt/V, intact parathyroid hormone (iPTH), hemoglobin (Hb), calcium (Ca), albumin (ALB), and prealbumin (PA) levels between the two groups ($p > 0.05$) (Table 1).

SF-36 Scores

The sarcopenia group had significantly lower SF-36 total scores compared to the non-sarcopenia group (72.05±12.28 vs 78.03±10.55, t = 10.48; *p =0.034*). The SF-36 bodily pain (BP) score was higher in the sarcopenia group compared to the

Table 1 Comparison of Background, Anthropometric Indicators, and Clinical Measurements Between Two Groups of Patients (N =111)

Characteristics		Sarcopenia group (74)	Non- sarcopenia group (37)	*p*
Gender, N (%)	Men	51(68.9)	24 (64.8)	0.031
	Women	23(31.1)	13(35.2)	
Age, N (%)	≤50 years	11(14.9)	29(78.4)	<0.001
	>50 years	63(85.1)	8(21.6)	
MHD duration (months)		52±23	54±25	0.039
Economic status, N (%)	High (≥10,000$)	21(28.4)	22(59.5)	0.048
	Moderate and below (<10,000$)	53(71.6)	15(40.5)	
Marital status, N (%)	Married	25(33.8%)	27(73.0%)	0.049
	Single	49(66.2%)	10(27.0%)	
BMI (kg/m2)		22±3	24±3	<0.001
Laboratory Measurements	Hb	97.6±17.8	96.5±19.0	0.376
	Ca	2.23±0.07	2.27±0.31	0.575
	P	1.12±0.23	1.98±0.54	0.044
	Scr	834±260.1	1093±208.7	<0.001
	ALB	39.8 (36.5, 43.1)	41.2 (38.8, 43.7)	0.105
	iPTH	299.0 (157, 599)	438.6 (223, 761)	0.052
	PA	271±82	304±106	0.126
	CRP	4.4±1.8	3.6±1.6	0.036
	Kt/V	1.32 (1.19, 1.59)	1.31 (1.17, 1.59)	0.716
Diabetic, N (%)	Y	46 (62.2%)	8 (21.6%)	0.032
	N	28 (37.8%)	29 (78.4%)	
Etiology of ESRD, N (%)	Chronic nephritis	30 (40.5)	14 (37.8)	0.634
	Diabetic nephropathy	21 (28.4)	9 (24.3)	
	Hypertensive nephropathy	15 (20.3)	7 (18.9)	
	Polycystic kidney disease	3 (4.0)	4 (10.8)	
	Others	5 (6.8)	3 (8.1)	

Notes: Kt/V is a number used to quantify the adequacy of peritoneal dialysis and hemodialysis, and represents the clearance of Urea by the peritoneum and/or by the kidney, normalized by total body water. K is the clearance of urea by the peritoneum or the kidney, in mL/min, t is the time on dialysis (min), and V is the volume of distribution of urea, approximately equal to the volume of the patient's total body water.
Abbreviations: MHD, maintenance hemodialysis; BMI, body mass index; Hb, hemoglobin; Ca, calcium; P, phosphorus; Scr, serum creatinine; ALB, albumin; iPTH, intact parathyroid hormone; PA, prealbumin; CRP, C-reactive protein; ESRD, End-Stage Renal Disease.

non-sarcopenia group (54.6±15.4 vs 26.4±11.10, t = 7.432; $p < 0.001$). Additionally, the SF-36 total score and scores in the physical functioning, role-physical (, general health, vitality, social functioning, role-emotional, and mental health dimensions were all lower in the sarcopenia group compared to the non-sarcopenia group ($p < 0.001$). (Table 2).

Comparison of Psychological Status Between the Two Groups

The sarcopenia group had higher scores on the anxiety scale (52.97±4.67 vs 36.2±3.36, t = 4.323) and depression scale (57.67±4.58 vs 38.71±3.77, t = 4.673) compared to the non-sarcopenia group, and the differences were statistically significant ($p < 0.001$) (Table 3).

Correlation Analysis Between Sarcopenia in Hemodialysis Patients and Psychological Status, and Quality of Life

Pearson correlation analysis showed that sarcopenia in patients with end-stage renal disease was positively correlated with SAS (r = 0.261) and SDS (r = 0.274) scores ($p < 0.05$). It was negatively correlated with the SF-36 total score (r = −0.316) and scores in the PF (r = −0.295), RP (r = −1.169), GH (r = −0.299), VT (r = −0.383), SF (r = −0.247), RE (r = −0.282), and MH (r = −0.391) dimensions ($p < 0.05$). Among these, the correlations with VT and MH dimensions were stronger ($p < 0.001$) (Table 4).

Table 2 Comparison of SF-36 Total and Dimension Scores Between the Two Groups ($\bar{x}\pm$ s, Score)

Group	SF-36	PF	RP	BP	VT	RE	MH	SF	GH
Sarcopenia group (74)	72.05±12.28	52.7±11.29	59.6±15.5	54.6±15.4	33±13.4	35.1±12.3	27.7±13.6	42.1±5.9	57.2±15.9
Non- sarcopenia group (37)	78.03±10.55	72.65±16.17	82.1±9.96	26.4±11.1	48.1±15.8	44.5±11.7	40±9.4	52.3±8.5	63.0±13.4
t	−10.48	−8.435	−9.254	7.432	−6.235	−7.213	−5.35	−9.739	−8.951
p	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Abbreviations: SF-36, Short Form 36; PF, Physical Functioning; RP, Role-Physical; BP, Bodily Pain; VT, Vitality; RE, Role-Emotional; MH, Mental Health; SF, Social Functioning; GH, General Health.

Table 3 Comparison of Psychological Status Between the Two Groups ($\bar{x}\pm$ s, Score)

Group	SAS	SDS
Sarcopenia group (74)	52.97±4.67	57.67±4.58
Non-sarcopenia group (37)	36.2±3.36	38.71±3.77
T	4.323	4.673
p	0.000	0.000

Abbreviations: SAS, Self-Rating Anxiety Scale; SDS, Self-Rating Depression Scale.

Table 4 Correlation Analysis Between Sarcopenia, Psychological Status and Quality of Life

Test statistic	SAS	SDS	SF-36	PF	RP	BP	VT	RE	MH	SF	GH
r	0.261	0.274	−0.316	−0.295	−1.169	2.545	−0.383	−0.282	−0.391	−0.247	−0.299
p	0.018	0.016	0.005	0.009	0.024	0.251	<0.001	0.008	<0.001	0.021	0.005

Abbreviations: SAS, Self-Rating Anxiety Scale; SDS, Self-Rating Depression Scale; SF-36, Short Form 36; PF, Physical Functioning; RP, Role-Physical; BP, Bodily Pain; VT, Vitality; RE, Role-Emotional; MH, Mental Health; SF, Social Functioning; GH, General Health.

Binary Logistic Regression Analysis of Factors Influencing the Development of Sarcopenia in Hemodialysis Patients

The binary logistic regression analysis was performed with the presence or absence of sarcopenia (0 - absent, 1 - present) as the dependent variable and the factors from Tables 1 and 2 as independent variables. After adjusting for age, kidney disease, and SMI, the Results showed that age (OR=1.049, 95% CI: 1.010,1.087), gender (OR=3.204, 95% CI: 1.298,8.134), BMI (OR=0.469, 95% CI: 0.269,0.810), MHD duration (OR=1.023, 95% CI: 1.00, 1.02), economic status (OR=0.358, 95% CI: 0.159, 0.817), marital status (OR=0.423,95% CI: 0.189, 0.948), and pre-dialysis creatinine (OR=3.179, 95% CI: 1.081, 9.321) were significant factors influencing the development of sarcopenia in hemodialysis patients ($p < 0.05$) (Table 5).

Table 5 Binary Logistic Regression Analysis on Influencing Factors of MHD with Sarcopenia

Variable	*β*	SE	Waldχ^2	*p*	OR (95% CI)
Gender	1.134	0.441	6.689	0.008	3.204 (1.298, 8.134)
Age	0.051	0.022	5.324	0.022	1.049 (1.010, 1.087)
MHD duration	0.049	0.021	4.856	0.021	1.023 (1.000, 1.020)
Economic Status	−1.028	0.42	6.102	0.014	0.358 (0.159, 0.817)
Marital Status	−0.861	0.421	4.374	0.037	0.423 (0.189, 0.948)
BMI	−0.761	0.221	7.701	0.006	0.469 (0.269, 0.810)
Comorbid diabetes	1.114	0.401	6.701	0.011	2.885 (1.310, 6.114)
Pre-dialysis serum creatinine	1.254	0.465	5.782	0.018	3.179 (1.081, 9.321)

Notes: The binary logistic regression analysis was performed with the presence or absence of sarcopenia (0 - absent, 1 - present) as the dependent variable and the factors from Tables 1 and 2 as independent variables. Adjusted for age, kidney disease, and SMI.

Abbreviations: MHD, maintenance hemodialysis; BMI, body mass index.

Discussion

In this study, we investigated the risk factors and clinical implications of sarcopenia in maintenance hemodialysis (MHD) patients. We found a higher prevalence of sarcopenia among older, male, single patients with longer MHD duration, lower BMI, poorer economic status, and lower pre-dialysis serum creatinine levels. Sarcopenia was linked to poorer quality of life and emotional disorders. Our results highlight the significant association between emotional disorders and sarcopenia, suggesting that early screening and management of emotional issues could help delay and treat sarcopenia in MHD patients.

Studies have shown that approximately 3.9–63.3% of MHD patients suffer from sarcopenia.[15–18] In our study, the prevalence of sarcopenia in MHD patients was 59.8%, which is consistent with previous reports. Regression analysis revealed that older age, male gender, single marital status, longer MHD duration, poor economic income, lower BMI, comorbid diabetes and lower levels of creatinine were independent risk factors for sarcopenia in MHD patients. Furthermore, sarcopenia occurrence was closely associated with poor quality of life, anxiety, and depression symptoms in MHD patients. Previous studies have confirmed age as a risk factor for sarcopenia in MHD patients.[19,20] As age increases, organ function decreases, physical activity declines, appetite decreases, and inflammatory factors in the body rise, leading to reduced muscle protein synthesis and increased breakdown, resulting in sarcopenia development. With an increase in the MHD duration, MHD patients experience a higher incidence of complications. Our study identified an association between comorbid diabetes and an increased risk of developing sarcopenia in MHD patients, suggesting that there is a correlation between high blood sugar levels and the occurrence of sarcopenia in this population.[21]

The prevalence of sarcopenia was higher in male patients compared to female patients, which may be related to the decrease in testosterone levels with increasing age in male MHD patients.[22] Patients with better economic status had a lower prevalence of sarcopenia, possibly because those with better economic status have higher health awareness and a more diverse range of dietary and physical activity choices, while sarcopenic patients have more limited options in their diet and physical activity. It has been reported that nutritional status is closely related to sarcopenia, and malnutrition contributes to sarcopenia/severe sarcopenia in MHD patients by reducing muscle mass and strength as well as physical performance.[23] Low BMI has been recognized as an independent risk factor for sarcopenia. However, in our study, no differences were found in traditional nutritional assessment markers such as albumin and prealbumin between the two groups. On one hand, the levels of these serum proteins do not change with variations in nutritional intake, and on the other hand, they are influenced by the acuteness or chronicity of the disease and inflammation, making them unreliable indicators of nutritional status. Conversely, the sarcopenia group had significantly lower pre-dialysis serum creatinine levels compared to the non-sarcopenia group. Regression analysis indicated an association between pre-dialysis serum creatinine levels and the presence of sarcopenia in MHD patients. This suggests that pre-dialysis serum creatinine may serve as an indicator of nutritional status within the context of adequate dialysis, and it exhibits predictive value for the occurrence of sarcopenia in MHD patients. The higher prevalence of sarcopenia in unmarried individuals may also be related to imbalanced diet and malnutrition due to living alone. Therefore, healthcare providers should pay special attention to unmarried males, older individuals, and MHD patients with poor economic status and nutrition, and provide relevant health education to patients and their families.

Previous studies have shown that MHD patients undergoing long-term dialysis treatment are prone to multiple complications, resulting in significant physical and psychological distress.[24] This can easily lead to negative emotions and even emotional disorders. The results of our study indicate that the sarcopenia group had significantly higher scores in the SAS and SDS compared to the non-sarcopenia group, especially among older males. This may be attributed to the physical discomfort and financial burden associated with long-term dialysis, as well as changes in the socioeconomic status of male patients before the onset of the disease. Correlation analysis was also conducted between the SF-36 quality of life scores and SAS/SDS scores in the sarcopenia group. The results showed a negative correlation between anxiety, depression scores, and quality of life in MHD patients, further confirming that emotional disorders can contribute to lower quality of life in patients. Previous research by Kurita N found an independent correlation between the occurrence of sarcopenia and emotional disorders in MHD patients.[25] The higher the scores of emotional disorders in MHD patients, the higher the risk of developing sarcopenia (OR= −1.69, 95% CI: 1.14–2.51). The correlation analysis results in our study also showed a negative correlation between sarcopenia and scores in SAS, SDS, and all six dimensions of the SF-36 quality of life assessment (except for bodily pain

and social functioning, which showed no significant correlation). The correlations with vitality and mental health dimensions were particularly strong ($P<0.01$). This suggests an association between sarcopenia and the quality of life as well as psychological status of patients, with the most notable impact observed in mental and psychological health. The lack of correlation with the bodily pain dimension may be due to the high frequency and intensity of physical pain episodes caused by complications such as renal bone disease and repeated hemodialysis punctures. The relationship between bodily pain and mental state appears to be weaker, with a stronger association to the disease itself. Additionally, the subjects in our study were all hemodialysis patients with a duration of hemodialysis treatment of at least 6 months, and they generally had limited social activities. This may explain the lack of significant correlation with social functioning.

The relationship between sarcopenia and emotional disorders involves complex mechanisms. Emotional disorders, such as anxiety and depression, can elevate pro-inflammatory cytokines like interleukin-6 (IL-6), intensifying inflammation. This inflammatory state activates pathways like nuclear factor-κB and the ubiquitin-proteasome system, accelerating muscle protein breakdown and hindering synthesis, thereby promoting muscle atrophy.[26] Moreover, emotional disorders often lead to detrimental behaviors such as reduced food intake and lack of exercise, both known contributors to sarcopenia risk. Additionally, research suggests direct pathways where emotional disorders could independently contribute to sarcopenia, particularly in advanced chronic kidney disease (CKD) and dialysis patients.[25] Our previous animal study demonstrated that inducing a depression model in uremic rats rapidly led to sarcopenia, supporting the notion of a direct link. This reciprocal relationship between emotional disorders and sarcopenia suggests a vicious cycle that warrants further exploration.[27] Early identification and proactive management of emotional disorders by healthcare providers may offer novel strategies to delay and mitigate sarcopenia progression in clinical settings.

Our study has several limitations that warrant consideration. First, the moderate sample size may restrict the generalizability of our findings to larger populations of maintenance hemodialysis patients. Second, the cross-sectional design of the study limits our ability to establish causality between sarcopenia and the identified risk factors. Additionally, the convenience sampling method employed may introduce selection bias. Despite these limitations, our study benefits from focused objectives, robust methodology including validated scales for assessing emotional status and quality of life, and rigorous statistical analysis to identify significant associations. These strengths contribute valuable insights into the prevalence, risk factors, and clinical implications of sarcopenia in maintenance hemodialysis patients, highlighting the importance of addressing emotional disorders in managing sarcopenia and improving patient outcomes.

Conclusion

In summary, sarcopenia has a higher prevalence in MHD patients, with a higher risk in patients with older, male, single, have a longer duration of MHD, lower economic status, lower BMI, comorbid diabetes, and lower levels of creatinine. The occurrence of sarcopenia is correlated with poorer quality of life and adverse clinical outcomes such as emotional disorders in hemodialysis patients. Emotional disorders are found to be significantly associated with sarcopenia. Identifying and screening emotional disorders early, along with actively managing and guiding emotions, could potentially delay and treat sarcopenia, thus improving the quality of life and emotional status for MHD patients.

Data Sharing Statement

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Committee of Li Huili Hospital, Ningbo City (Approval No.: KY2023PJ204), and informed consent was obtained from all participants. All methods were carried out in accordance with relevant guidelines and regulations.

Acknowledgments

There is no one who has contributed to the manuscript but does not qualify as a collaborator.

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 aspects of the work.

Consent for Publication

All authors final approval of the version to be published.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclosure

All of the authors had no any personal, financial, commercial, or academic conflicts of interest separately.

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