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The frailty in older hemodialysis patients and associations with depression, functional status, dialysis adequacy

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Abstract

Introduction: The aim of this study was to determine the level of frailty in older hemodialysis patients and to examine the relationship between their functional capacity, depression, and laboratory variables.

Method: This was a cross-sectional study, and the data were collected 243 dialysis patients aged 65 and over between May 2021 and May 2022.

Results: The frailty rate was 49%. A statistically significant positive correlation was found between the frailty and age, hemodialysis vintage, and the number of hospitalizations. The frailty was negatively correlated with body mass index, Kt/V, Albumin, and parathyroid hormone. There was a statistically significant positive correlation between frailty and depression and a negative correlation between functional capacity.

Conclusion: A relationship was found between frailty and depression, functional capacity, and laboratory variables. In addition, the variables affecting the level of frailty in geriatric dialysis patients included dialysis vintage, dialysis adequacy, number of hospitalizations, albumin level, and patient weight.

KEYWORDS

aging, depression, frailty, functional status, geriatric, hemodialysis

1 | INTRODUCTION

Hemodialysis (HD) is the most commonly used treatment for end-stage renal disease (ESRD) [1]. In the country where the study was conducted, the population of older individuals is increasing, and the average age of patients undergoing kidney replacement therapy (KRT) is also rising. The incidence of ESRD requiring kidney KRT in Turkey was calculated as 160.9 pmp. The number of prevalent patients receiving KRT was 86.665 at the end of 2022. The incidence of ESRD treated with HD also increases gradually with age, with 90.31% of patients aged 65–74 years receiving HD and 94% of patients over 75 years receiving HD [2].

Frailty is common among hemodialysis patients and a robust independent predictor of hospitalizations and mortality [3]. The prevalence of frailty among hemodialysis patients is 13.8%–66.7%, which is higher than the general population and conservative chronic kidney diseases (CKD) patients, and frailty has prognostic value for dialysis patients [4, 5]. Frailty in hemodialysis patients is closely associated with impaired quality of life [6], increased risk of hospitalization [3, 7], falls [5], bone loss [8], and mortality [4, 9].

Mental and psychological factors such as cognitive impairment and depression are closely related to frailty [10]. Frailty and depression are two common conditions in older adults. A general population meta-

analysis suggests an interaction between depression and frailty in older adults [11]. Hemodialysis patients have high levels of frailty and depression, which are significantly higher than in the community-dwelling elderly population [5, 11, 12]. Despite significant advances in assessing frailty, especially in dialysis patients, and our understanding that frailty predisposes patients to poor outcomes, no studies were found in our country. Also, dialysis nurses will increasingly care for elderly patients. Therefore, this study investigated the relationship between frailty and depression, laboratory results, and functional capacity in older patients on chronic dialysis.

2 | METHODS

2.1 | Aim

This study was conducted to determine the frailty levels of geriatric patients receiving chronic hemodialysis treatment and to examine the relationship between their functional capacity, depression, and laboratory variables.

2.2 | Design

A cross-sectional, descriptive study was conducted and reported using the strengthening the reporting of observational studies in epidemiology guidelines.

2.3 | Setting

Data were collected between May 2021 and May 2022 in patients receiving treatment at a private dialysis center.

2.4 | Participants

The population of the study consisted of hemodialysis patients who were receiving HD treatment in dialysis centers. Convenience sampling was used to recruit participants. Of the patients who presented to the hemodialysis unit between May 2021, and May 2022, 243 who met the inclusion criteria were included in the study sample. The inclusion criteria of the study are to receive hemodialysis due to diagnosis of CKDs received at least 4 months earlier, persons 65 years or older, have no mental health disorders, have not been on antidepressant drugs, and communicate and collaborate to participate in the study.

2.5 | Data collection

Personal information form, Tilburg Frailty Indicator (TFI), Geriatric Depression Scale (GDS-15), and Modified Barthel Index were used to collect the data. The researchers collected the data through face-to-face interviews. The laboratory variables were obtained from the patients' medical records for the most recent month of routine monthly blood analysis results.

2.5.1 | Personal information form

This form was developed based on a literature review and became two parts. The first part contains 16 questions regarding the sociodemographic and clinical data of the patients, such as their age, gender, education level, chronic diseases, HD duration, fatigue (Visual analog scale; 1–10), number of falls (past year), and the number of hospitalizations (past year). The second part consists of laboratory variables; these were body mass index (BMI), Kt/V, albumin, sodium (Na), potassium (K), calcium (Ca), phosphorus (P), and parathyroid hormone (PTH).

2.5.2 | Tilburg frailty indicator (TFI)

The TFI was developed by Gobbens et al. in 2010, and the Turkish adaptation and validity-reliability were conducted by Arslan et al. [13, 14]. The TFI consists of two parts. The score range varies between 0 and 15, and a score of five or higher is considered frailty. The Cronbach's alpha coefficient for the Turkish version of the scale was found to be 0.758 in the validity and reliability study and 0.81 in the present study.

2.5.3 | Geriatric depression scale (GDS-15)

It was developed by Yesavage et al. in 1983 to investigate the presence of depression in patients with depression in the geriatric population. Its Turkish validity and reliability were performed by Durmaz et al. [15, 16]. The scale of consists of 15 questions, and a minimum of 3 and a maximum of 14 points were obtained from the scale, and a higher score indicates depression. The Turkish reliability and validity study reported that Cronbach's alpha internal consistency coefficient was 0.92. In the present study, Cronbach's alpha was found to be 0.90.

2.5.4 | Modified Barthel index (MBI)

The Barthel index was developed by Barthel and Mahoney (1965) to evaluate the individual's functional status. A Turkish validity and reliability study was conducted by Küçükdeveci et al. [17, 18]. There are 10 items on this scale, each scored differently from the others. The scores are 0, 1, 2, 3, 4, 5, 8, and 10. In this scale, where the score can be obtained between 0 and 100, the higher the score, the more independent the individual can function. In the Turkish reliability and validity study, Cronbach's alpha internal consistency coefficient was 0.93. In the present study, Cronbach's alpha was found to be 0.90.

2.6 | Ethical considerations

The XXXXXXXXXX Ethics Committee granted permission for the study dated XXXXXXXXX and numbered XXXXXXXXX. The individuals who volunteered to participate in the research were provided written and verbally informed consent by explaining the aim of the study, that all personal information would remain confidential, that they could leave the research at any time, and that the results would not be shared with anyone. The principles of the Declaration of Helsinki were followed in the study.

2.7 | Statistical analysis

SPSS Statistics version 25.0 was used in data analysis. According to the literature, skewness, and kurtosis values of ±2 were regarded as normal when assessing the normal distribution of the study's data. The study's parameters displayed normal distribution. Descriptive data were analyzed using numbers, percentages, means, and standard deviation. Independent Student's *t*-test, one-way ANOVA, Pearson correlation analysis, and linear regression analysis were used. The reliability of the scales was assessed using Cronbach's alpha coefficient. *p*-values <0.05 were considered statistically significant.

3 | RESULTS

3.1 | Demographic and clinical characteristics

The patients in the study sample had a mean age of 71.74 ± 4.58 years, 51.4% were male, 68.3% were married, 46.1% were primary school graduates, and 47.7% of perceived their economic level as middle. The mean duration of HD was 6.17 ± 4.56 years, fatigue was 5.05 ± 1.70, and the number of falls was 0.45 ± 0.80. The mean Kt/V was found to be 1.51 ± 0.23, mean albumin was found to be 3.94 ± 0.45 (Table 1). Also, the Frailty rate was found to be 49%.

3.2 | Association frailty with variables

The TFI level of illiterate patients was higher than those who graduated from primary school and high school ($p<0.05$). Patients with poor income status had higher TFI mean total scores than the other groups ($p<0.001$). The mean TFI score was significantly higher in patients who reported poor quality of life ($p<0.01$). Patients who exercised regularly had a statistically lower mean TFI total score than those who did not ($p<0.028$). A statistically significant positive correlation was found between the mean TFI total score and age ($p<0.001$), HD vintage ($p<0.01$), and the number of hospitalizations ($p<0.001$). TFI total mean score was negatively correlated with BMI ($p<0.05$), Kt/V ($p<0.01$), albumin ($p<0.01$), and PTH ($p<0.05$) (Table 2).

3.3 | Correlations between TFI, GDS-15, and MBI

The patients' mean TFI total score was 4.98 ± 2.52, the GDS-15 score was 5.22 ± 3.86, and the MBI score was 83.09 ± 16.10. There was a statistically significant positive correlation between the mean TFI total score and the GDS-15 total score ($p<0.038$) and a statistically significant negative correlation between the MBI total score ($p<0.000$) (Table 3).

3.4 | Regression analysis of TFI and variables

In Table 4, regression analysis of the patients' mean TFI total scores according to significant variables revealed that age, BMI, HD vintage, number of hospitalizations, albumin value, and MBI explained 32.7% of the variance in HD patients ($R^2 = 0.327$; $F = 28.560$; $p<0.001$).

4 | DISCUSSION

In this study, 49% of geriatric patients on dialysis were found to be frail. In the literature, the prevalence of frailty has mostly been studied in chronic maintenance dialysis patients. The prevalence of frailty in dialysis

TABLE 1 Sociodemographic characteristics, clinical data, and laboratory values of the patients.

		Number (%)
Gender	Male	125 (51.4)
	Female	118 (48.6)
Marital status	Married	166 (68.3)
	Single/widow/ divorced	77 (31.7)
Education	Illiterate	13 (5.3)
	Literate	46 (18.9)
	Primary school	112 (46.1)
	High school	54 (22.2)
	University	18 (7.4)
Income	Low	42 (17.3)
	Moderate	116 (47.7)
	High	85 (35.0)
Chronic diseases	Yes	191 (78.6)
	No	52 (21.4)
Health quality	Good	56 (23.0)
	Moderate	130 (53.5)
	Bad	57 (23.5)
Exercise	Never	171 (70.4)
	Sometimes (walking)	51 (21.0)
	Regular	21 (8.6)
Having someone support in your care	Yes	175 (72.0)
	No	68 (28.0)
	Mean ± SD	
Age (year)	71.74 ± 4.58 (65.0–83.0)	
BMI (kg/m^2)	26.78 ± 4.08 (17.43–39.56)	
Hemodialysis vintage (year)	6.17 ± 4.56 (1–18)	
Number of medications (per day)	3.62 ± 1.76 (1–12)	
Number of hospitalizations (last year)	0.80 ± 0.99 (0–4)	
Number of falls (last year)	0.45 ± 0.80 (0–3)	
Fatigue (VAS)	5.05 ± 1.70 (0–9)	
Kt/V	1.51 ± 0.23 (1.00–2.60)	
Albumin (g/dL)	3.94 ± 0.45 (2.80–5.20)	
Na (mEq/L)	138.99 ± 4.26 (129.5–148.0)	
K (mmol/L)	4.62 ± 1.02 (3.5–8.3)	
Ca (mg/dL)	9.38 ± 0.88 (7.0–12.7)	
P (mg/dL)	4.37 ± 1.69 (2.4–8.8)	
PTH (pg/mL)	405.18 ± 288.01 (41.0–1820.0)	

patients is higher than in the general population [1, 4, 5, 19, 20]. This highlights the importance of assessing frailty in older dialysis patients.

In our study found low educational status and income status among sociodemographic findings to affect frailty. Similar to our results, it has been reported that patients with high educational levels in dialysis have less frailty [10]. Another study found that the prevalence of frailty was lower in patients with higher monthly household incomes [1]. This may be due to better education, which enables patients to understand healthcare practices and use resources, and higher income, which enables them to receive better hemodialysis treatment.

In the study, patients were asked to rate their quality of life as "good, moderate, or poor." High levels of frailty were associated with patients who felt their quality of life was poor. Frailty reduces the quality of daily life and puts patients at risk of illness-related health problems [21]. Early detection of frailty is important. It can lead to interventions that improve the quality of life of hemodialysis patients [22].

With advancing age, physical capacity declines, and the risk of frailty increases. Additional co-morbidities can lead to decreased physical function [20]. Furthermore, low physical activity is associated with frailty in both women and men, regardless of gender [8]. In older people, the physical function may decline further after the introduction of dialysis [23]. This study found that patients who exercised regularly had lower levels of frailty than those who did not. In parallel with our research, it was shown that the risk of frailty in hemodialysis patients who rarely exercised was 7.54 times higher than in those who exercised more than four times a week [1]. Exercise interventions for frail people are recommended to improve mobility, muscle strength, physical motor function, and daily living activities and prevent the progression of frailty [23]. Exercise interventions are anticipated to potentially reduce physical frailty and support improvements in mood and depression in the dialysis population [10].

Frailty was found to increase with the dialysis vintage in older patients. The study by Yuan et al. (2020) did not find an association between dialysis vintage and frailty [20]. Ye et al. (2023) found that pre-frailty and frailty were more common in maintenance hemodialysis patients within the first year of starting dialysis [1]. One of the most challenging stages for patients with ESRD is the initiation of dialysis. Many maintenance hemodialysis patients have a variety of pre-dialysis comorbidities and cognitive impairments that cannot be cured by dialysis alone and can lead to frailty. Although the initiation of hemodialysis can save a patient's life, the pathophysiological and psychosocial burden of initiating

TABLE 2 Comparison of patients' Mean TFI, GDS-15, and MBI Scores according to sociodemographic characteristics.

		TFI Mean ± SD	*Test F/t* *p*
Gender	Male	4.78 ± 2.40	0.136
	Female	5.16 ± 2.61	0.243
Marital status	Married	5.03 ± 2.28	8.008
	Single/widow/divorced	4.83 ± 2.96	0.566
Education	Illiterate	6.61 ± 3.59	2.644[a]
	Literate	5.52 ± 2.58	**0.034***
	Primary school	4.69 ± 2.27	
	High school	4.63 ± 2.51	
	University	5.11 ± 2.35	
Income	Low	5.93 ± 2.57	8.995[b]
	Moderate	4.30 ± 2.33	**0.000****
	High	5.40 ± 2.48	
Chronic diseases	Yes	5.10 ± 2.62	7.279
	No	4.46 ± 1.98	0.101
Health quality	Good	3.94 ± 1.62	5.853
	Moderate	5.13 ± 2.65	**0.003****
	Bad	5.45 ± 2.59	
Exercise	No exercise	5.22 ± 2.50	3.617[c]
	Sometimes (walking)	4.55 ± 2.72	**.028***
	Regular	3.84 ± 1.30	
Having someone support in your care	Yes	4.98 ± 2.48	0.248
	No	4.93 ± 2.60	0.875
		r	***p***
Age (year)		**0.255**	**0.000****
BMI (kg/m^2)		**−0.165**	**0.010***
Hemodialysis vintage (year)		**0.189**	**0.003****
Number of medications (per day)		−0.017	0.793
Number of hospitalizations (last year)		**0.262**	**0.000****
Number of falls		−0.050	0.438
Fatigue (VAS)		0.105	0.101
Kt/V		**−0.184**	**0.004****
Albumin (g/dL)		**−0.221**	**0.001****
Na (mEq/L)		0.034	0.596
K (mmol/L)		−0.099	0.123
Ca (mg/dL)		0.006	0.920
P (mg/dL)		−0.036	0.575
PTH (pg/mL)		**−0.141**	**0.028***

Note: F = one-way ANOVA; t = independent Student's t-test; r = Pearson correlation test. Bold indicates significant values.

[a]Statistical significance between illiterate with primary school, and high school (LSD test).

[b]Statistical significance between low-income with moderate income and high-income (LSD test).

[c]Statistical significance between not exercising with regular (LSD test).

*$p < 0.05$.**$p < 0.01$.

		GDS-15		MBI	
		5.22 ± 3.86 (0–13.00)*		83.09 ± 16.10 (33–100)*	
	Test	*r*	*p*	*r*	*p*
TFI	4.98 ± 2.52 (0–12.00)*	**0.133**	**0.038****	**−0.335**	**0.000*****

TABLE 3 Correlations of patients' Mean TFI, GDS-15, and MBI Scores sociodemographic characteristics, clinical data, and laboratory values.

Note: r = Pearson correlation test. Bold indicates significant values.
*Mean ± SD (Min-Max).
$p < 0.05$.*$p < 0.01$.

TABLE 4 Regression analyses TFI with variables.

							95.0% CI	
		B	S.E.	Beta	*t*	*p*	Lower bound	Upper bound
TFI	Constant	7.834	3.395		2.307	0.022	1.144	14.524
	Education	0.045	0.155	0.017	0.291	0.771	−0.260	0.351
	Income	0.059	0.214	0.016	0.274	0.784	−0.363	0.480
	Health quality	0.189	0.225	0.051	0.842	0.401	−0.254	0.633
	Exercise	−0.038	0.273	−0.010	−0.141	0.888	−0.575	0.499
	Age (year)	0.081	0.032	0.148	2.526	**0.012***	0.018	0.144
	BMI (kg/m^2)	−0.070	0.035	−0.114	−1.991	**0.048***	−0.139	−0.001
	Hemodialysis vintage (year)	0.148	0.032	0.270	4.678	**0.000****	0.086	0.211
	Number of hospitalizations (last year)	0.606	0.140	0.239	4.323	**0.000****	0.330	0.882
	Kt/V	−0.982	0.625	−0.091	−1.571	0.118	−2.213	0.250
	Albumin (g/dL)	−0.941	0.318	−0.170	−2.953	**0.003****	−1.568	−0.313
	PTH (pg/mL)	0.000	0.000	−0.051	−0.897	0.370	−0.001	0.001
	GDS-15	−0.008	0.045	−0.012	−0.170	0.865	−0.097	0.082
	MBI	−0.041	0.012	−0.262	−3.308	**0.001****	−0.065	−0.017

Note: $R = 0.572$, $R^2 = 0.327$, $F = 8.560$, $p < 0.001$.
*$p < 0.05$.**$p < 0.01$.

hemodialysis can be detrimental to the patient's health. Dialysis treatment causing hemodynamic changes, dialysis-related complications, vascular access problems, dialysis-related dietary and exercise restrictions, depressive symptoms, a decline in physical function, and social isolation can hinder the recovery of hemodialysis patients and lead to frailty [10, 24]. Therefore, elderly hemodialysis patients are a group vulnerable to frailty. Effective dialysis management, including diet, vascular access preparation, complication prevention, lifestyle modification, and psychological care, can effectively reduce patients' frailty.

In older adults with CKD on dialysis, frailty is associated with an increased risk of adverse health outcomes, such as the increased risk of hospitalization, falls, and poor quality of life [5–7]. In the prospective study by DeMarco et al., frailty was associated with a 1.4-fold increase in hospital admissions in hemodialysis patients, and the rate of two or more falls in the previous year was 42.6% in frail patients [5]. In our study, the number of hospitalizations was associated with frailty. However, this study found no association between falls and frailty. Clark et al. showed that they observed higher hazard ratios for the combined risk of hospitalization and death in patients with higher levels of frailty [25]. This may be because the patients included in our study received outpatient dialysis treatment at the time of data collection. Elderly dialysis patients, in particular, should be assessed and their care needs met, considering that they may be frail and that their risk of falls and hospitalization rates may increase.

Malnutrition and frailty are common in the elderly population. Malnutrition is assessed by this study found that the frailty of maintenance hemodialysis patients was affected by low albumin levels and obesity. Specifically, for every 1 g/L increase in albumin, the risk of frailty decreased by 12% [1]. Maintenance hemodialysis patients often have inadequate protein intake due to various physiological changes [26]. Older patients have lower lean body mass and weaker muscle strength and are more

prone to sarcopenia, an important pathological basis of frailty [19]. This finding is consistent with another study showing that patients with low serum albumin levels are at higher risk of frailty [27]. Therefore, frailty should be actively screened in elderly maintenance hemodialysis patients.

Patients undergoing hemodialysis develop several conditions that affect bone health, such as CKD mineral and bone disease. Our study found a negative correlation between Parathyroid Hormone and frailty. In ESRD patients, inflammatory markers and nutritional status vary, and changes in hormones, bone, and muscle tissue occur [26]. It is recommended that health professionals consider frailty as a risk factor for bone loss [8]. In particular, a sedentary lifestyle with low physical activity levels is a known modifiable risk factor associated with poor bone health [26]. Although this study was descriptive, these findings may provide valuable data for planning effective therapeutic regimens in hemodialysis patients in future studies.

A meta-analysis suggests an interaction between depression and frailty in older adults. Specifically, each condition is associated with increased prevalence and incidence of the other and may be a risk factor for the development of the other. In this study, participants with frailty were four times more likely to have depression, and people with depression were about four times more likely to have frailty [11]. Studies examining the relationship between depression and frailty also show that depression may increase the risk of frailty [12]. A study that followed patients over the age of 69 who initiated hemodialysis for a period of 12 months revealed that those with a higher mortality rate. However, frail patients who survived after starting dialysis showed improvements in physical function, depression, and emotional state, with improvement in laboratory parameters (higher hemoglobin values and lower CRP values) [24]. The identification of modifiable physical and psychosocial health problems in older adults undergoing or initiating hemodialysis may help to reduce indicators of depressive symptoms and the prevention of frailty.

The study results assessed that frailty decreased as patients' independence in performing routine activities of daily living increased. In support of our findings, Iyasere et al. found significance between frailty and the Bartel index [28]. Another study showed that patients with frailty had worse functional status [24]. Generally, patients who reach ESRD tend to experience functional impairment. Poor functional performance may be associated with a higher risk of adverse health outcomes—frail patients experience a decline in physical functioning. When caring for patients on dialysis, it is essential to observe changes in their conditions, provide them with relevant health education, remind them to take their medication on time, improve patient compliance, and encourage exercise to strengthen the body and reduce the incidence of frailty [20].

5 | CONCLUSION

Our results are consistent with existing findings that the proportion of frail people is higher in hemodialysis patients. There is an association between frailty and depression. Furthermore, frailty is lower in older dialysis patients who are physically active and perform activities of daily living themselves. Assessing frailty, depression, and physical activity status in older dialysis patients can help target care needs and treatments for high-risk patients. Healthcare professionals should, therefore, pay close attention to older ESRD patients undergoing hemodialysis and take steps to prevent the development and progression of frailty.

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CONFLICT OF INTEREST STATEMENT

The authors declared that there is no conflict of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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