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Assessment of frailty status in non-geriatric peritoneal dialysis and hemodialysis patients

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ABSTRACT

Aims: The aim of this study was to evaluate and compare frailty status in non-geriatric hemodialysis (HD) and peritoneal dialysis (PD) patients and to assess whether there is a difference between frail and non-frail patients in HD and PD patients.

Methods: 28 PD and 28 HD patients were included in this cross-sectional study. The Edmonton Frailty Scale (EFS) was used to assess frailty status, including questions on cognition, general health status, addiction, social support, medication, nutrition, depression and sphincter continence, and a physical test assessing standing and walking.

Results: The mean age was 51.3+9.6 years and 24 (43%) of the individuals were female. There was no difference between HD and PD patients in terms of EFS score. Twelve (43%) of HD patients and 10 (36%) of PD patients were found to be frail (p=0.784). There was a positive correlation between age and EFS score in both HD and PD patients (r=0.896, p<0.001, r=0.661, p<0.001, respectively). In HD patients, there was a correlation between the EFS score and HbA1c (r=0.570, p=0.002). In HD patients, frail patients were older, had lower creatinine values and higher HbA1c levels (p<0.001, p=0.008, and p=0.006, respectively), while in PD patients, frail patients were older (p<0.001).

Conclusion: There was no difference in frailty between HD and PD patients. It should be noted that frailty is common in non-geriatric dialysis patients. Measuring frailty may help clinicians to identify vulnerable patients and intervene early to mitigate adverse outcomes.

Keywords: Frailty, hemodialysis, peritoneal dialysis, non-geriatric frailty

INTRODUCTION

Frailty is defined as a medical syndrome characterized by decreased strength, resilience, and reduced physiological function, which increases an individual's susceptibility to adverse health outcomes such as dependency or mortality. It has multiple causes and contributing factors.[1] Although it is commonly associated with advanced age, certain conditions that involve processes similar to aging—such as sarcopenia, oxidative stress, chronic inflammation, and hormonal imbalances—can also lead to frailty at younger ages.[2]

Chronic kidney disease (CKD) is a public health problem that can progress to end-stage renal disease (ESRD) requiring renal replacement therapies such as kidney transplantation, hemodialysis (HD) and peritoneal dialysis (PD). Cellular aging, loss of telomeric structures, mitochondrial dysfunction, and impaired DNA repair capacity play a crucial role in the development of frailty during the aging process.[3] These processes occur prematurely in the CKD population, ultimately leading to conditions such as sarcopenia, vascular dysfunction, and progressive organ damage.[4] Additionally, factors such as anorexia caused by uremic toxins, sarcopenia, losses occurring through dialysate and urine, catabolic effects, chronic low-grade inflammation, anabolic hormone deficiency or resistance, physical inactivity, cognitive decline, and comorbidities contribute to frailty in patients with CKD and ESRD.[5] Studies have shown that CKD increases the likelihood of frailty compared to individuals without renal dysfunction and those with other chronic conditions such as diabetes, cancer, and rheumatoid arthritis.[6] In ESRD patients receiving dialysis treatment, it has been revealed that there is a higher rate of frailty than both individuals without renal dysfunction and CKD patients.[7] Furthermore, frailty is associated with a higher risk of mortality in the ESRD population regardless of age.[8]

The Edmonton Frail Scale (EFS) is an easily applicable, multidimensional tool that assesses various aspects of frailty, including cognitive status, level of dependency, social support, physiological factors, and psychological well-being.[9] It has been previously used in several studies to evaluate frailty in patients with CKD and ESRD.[10] A study conducted on HD patients demonstrated that frailty, as determined by EFS, was

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associated with an increased risk of mortality, emergency department visits, and hospitalizations.[11]

In this study, it was aimed to evaluate and compare the frailty status in non-geriatric HD and PD patients, and to evaluate whether there is a difference between frail and non-frail patients in HD and PD patients by using the EFS, which assesses different frailty dimensions.

METHODS

Written informed consent was obtained from all participants after a full explanation of the study's procedures and objectives. This study Malatya Turgut Özal University Approved by the Non-interventional Clinical Researches Ethics Committee (Date: 10.07.2024, Decision No: 45). The study was conducted in accordance with the principles of the Declaration of Helsinki. Data were collected between 15 July and 15 August 2024. Individuals receiving dialysis treatment for less than 3 months, individuals with a history of hospitalisation for any reason other than vascular access problem in the last 3 months, individuals with active infection, individuals with severe visual or hearing problems, individuals with neurological or psychiatric conditions preventing proper test administration, amputees and individuals with active malignancy were excluded.

The study was conducted in the HD and PD unit of the nephrology clinic in a training and research hospital, where 112 HD patients and 43 PD patients were followed up. The flow chart illustrating the study population selection is shown in **Figure**. The study included 28 PD and 28 HD patients who were older than 18 years and younger than 65 years, who agreed to participate in the study, who had the capacity to understand the tests and sign the informed consent form, who had been receiving HD or PD for more than three months.

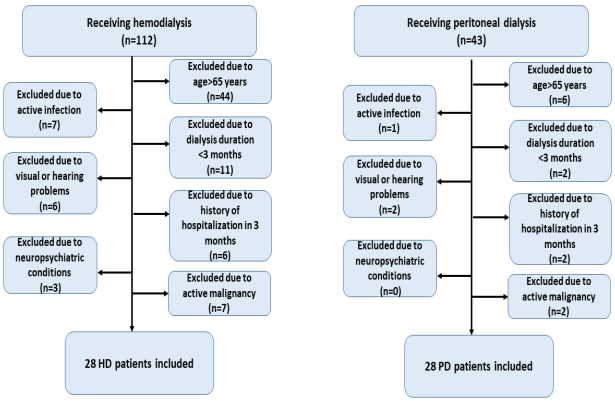

Figure. Flow chart illustrating the study population selection

The EFS, a frailty assessment tool consisting of 11 items distributed across nine domains, was used to evaluate frailty status. The scale was first developed by Rolfson et al.[9] in 2006, and its Turkish version was validated by Aygör et al.[12] in 2014. **Table 1** presents the EFS. The EFS includes questions on cognition (clock drawing test), general health status, dependency, social support, medication, nutrition, depression and sphincter continence, and a physical test including standing and walking. Each item in the EFS can be scored between 0 and 2. The total score varies between 0 and 17. Scores between 0-5 correspond to non-frail, 6-7 to sensitive, 8-9 to mildly frail, 10-11 to moderately frail and 12-17 to severely frail.

In HD patients, the physical test involving walking and the clock drawing test assessing cognitive function were conducted before the midweek dialysis session. After the patients were connected to the dialysis machine, the remaining nine items of the EFS were administered, and their responses were recorded. EFS assessment of HD patients was not performed in the post-weekend session to avoid the effects of prolonged uremia. In a previous study evaluating frailty in HD patients with EFS, physical assessments were performed before the dialysis session, while other assessments were performed during the dialysis session.[13] Similarly, in our study, we performed physical assessments before the dialysis session and other assessments during the dialysis session. For PD patients, the frailty assessment was performed during routine follow-ups, ensuring that the evaluation took place when the abdominal cavity was empty.

During data collection, demographic variables recorded included age, sex, body-mass index (BMI; kg/m^2), presence of diabetes mellitus (DM), dialysis duration (months), and marital status. Hemoglobin, serum albumin, urea, creatinine, sodium, potassium, calcium, phosphorus, intact parathyroid hormone (iPTH) and HbA1c were recorded as laboratory parameters. DM was defined based on self-reported history, medical records indicating a DM diagnosis, or a fasting glucose level of ≥126 mg/dl.

Statistical Analysis

Data analyses in this study were performed using SPSS version 20. The normality of numerical data was assessed using the Kolmogorov-Smirnov test. Parametric data were presented as mean±standard deviation (SD), non-parametric data as median (interquartile range, IQR), and categorical variables as frequency (percentage). For comparisons between two independent groups, Student's t-test was used for parametric data, while Mann-Whitney U test was applied for non-parametric data. Categorical variables were compared using Pearson's chi-square test or Fisher's exact test, as appropriate. Correlation analysis was conducted to assess relationships between numerical variables. p-value <0.05 was considered statistically significant.

RESULTS

A total of 56 individuals were included in the study, with 28 receiving HD and 28 receiving PD. The mean age of the participants was 51.3±9.6 years, and 24 (43%) were female. Among the HD patients, 14 (50%) were receiving HD via an arteriovenous fistula, while 27 PD patients were receiving continuous ambulatory PD. No significant difference was found between HD and PD patients regarding total EFS scores. Frailty was identified in 12 (43%) HD patients and 10 (35%) PD patients (p=0.784). A summary of the demographic characteristics, frailty status, and laboratory parameters of HD and PD patients is presented in **Table 2**. The results of the correlation analysis for HD and PD patients are shown in **Table 3**. Comparisons between frail and non-frail patients within the HD and PD groups are detailed in **Table 4**.

Table 1. Edmonton frail scale[9]

Frailty domain	Item	0 points	1 point	2 points
Cognition	Please imagine that this pre-drawn circle is a clock. I would like you to place the numbers in the correct positions then place the hands to indicate a time of 'ten after eleven'	No errors	Minor spacing errors	Other errors
General health status	In the past year, how many times have you been admitted to a hospital?	0	1-2	>2
	In general, how would you describe your health?	Excellent, very good, good	Fair	Poor
Functional independence	How many of the following activities do you need assistance with? - Meal preparation - Shopping - Transportation - Telephone - Housekeeping - Laundry - Managing money - Taking medications	0-1	2-4	5-8
Social support	When you need help, can you count on someone who is willing and able to meet your needs?	Always	Sometimes	Never
Medication use	Do you use five or more different prescription medications on a regular basis?	No	Yes	-
	At times, do you forget to take your prescription medications?	No	Yes	-
Nutrition	Have you recently lost weight such that your clothing has become looser?	No	Yes	-
Mood	Do you often feel sad or depressed?	No	Yes	-
Continence	Do you have a problem with losing control of urine when you don't want to?	No	Yes	-
Functional performance	I would like you to sit in this chair with your back and arms resting. Then, when I say 'GO', please stand up and walk at a safe and comfortable pace to the mark on the floor (approximately 3 m away), return to the chair and sit down'	0-10 sec	11-20 sec	One of >20 s patient unwilling, or requires assistance
Total score	Final score is the sum of column totals			

Table 2. Comparison of patients' demographic characteristics, frailty status, and laboratory parameters

Variable	Hemodialysis (n=28)	Peritoneal dialysis (n=28)	p-value
Age mean±SD	51.3±9.6	51.3±9.6	0.989
Female, n (%)	12 (43)	12 (43)	1.000
Married, n (%)	26 (93)	27 (96)	1.000
Dialysis duration, months, mean±SD	67±46	34±18	0.001
Body-mass index, kg/m², mean±SD	25.1±6.1	23.8±4.0	0.252
Diabetes mellitus, n (%)	6 (21)	4 (14)	0.729
Total EFS score (median [IQR])	5 [0-10]	2 [0-10]	0.344
Non-frail (0-5), n (%)	14 (50)	17 (61)	0.561
Vulnerable (6-7), n (%)	2 (7)	1 (4)	1.000
Frail (8-17), n (%)	12 (43)	10 (35)	0.784
Mild frailty (8-9), n (%)	5 (18)	0 (0)	0.051
Moderate frailty (10-11), n (%)	2 (7)	7 (25)	0.143
Severe frailty (12-17), n (%)	5 (18)	3 (11)	0.700
Laboratory parameters			
Urea (mg/dl), mean±SD	119±26	119±35	0.930
Serum creatinine (mg/dl), mean±SD	9.1±3.1	8.9±2.5	0.787
Sodium (mEq/L), mean±SD	136±3	134±4	0.044
Potassium (mEq/L), mean±SD	5.2±0.6	4.4±0.8	<0.001
Calcium (mg/dl), mean±SD	9.0±0.8	8.6±0.6	0.044
Phosphorus (mg/dl), mean±SD	5.2±1.2	4.8±1.4	0.296
Hemoglobin (g/dl), mean±SD	10.7±1.8	10.6±1.5	0.857
Albumin (g/dl), mean±SD	3.7±0.3	3.2±0.5	<0.001
HbA1c (%), median [IQR]	5.2 [4.7-6.7]	5.1 [4.7-5.9]	0.572
Intact parathormone (pg/ml), median [IQR]	349 [168-733]	213 [152-334]	0.057

SD: Standard deviation, EFS: Edmonton frail scale; IQR: Interquartile range

Table 3. Correlation analysis results in hemodialysis and peritoneal dialysis patients

Hemodialysis							
	EFS total score	**Age**	**Dialysis duration**	**Body-mass index**	**Albumin**	**Hba1c**	**iPTH**
EFS total score	r	.896	-.313	.167	-.251	.570	-.290
	p	<0.001	.105	.397	.197	.002	.135
Age	r		-.259	.224	-.183	.446	-.292
	p		.183	.262	.352	.017	.132
Dialysis duration	r			-.282	-.532	-.221	.337
	p			.146	.004	.257	.079
Body-mass index	r				.121	-.166	-.240
	p				.538	.379	.218
Albumin	r					-.075	.068
	p					.703	.731
HbA1c	r						-.190
	p						.333
Peritoneal dialysis							
	EFS total score	**Age**	**Dialysis duration**	**Body-mass index**	**Albumin**	**Hba1c**	**iPTH**
EFS total score	r	.661	.119	-.002	-.216	.283	-.182
	p	<0.001	.547	.993	.270	.145	.355
Age	r		-.315	-.028	-.364	.469	-.599
	p		.103	.889	.057	.012	.001
Dialysis duration	r			.003	.030	-.228	.731
	p			.987	.878	.243	<0.001
Body mass index	r				-.098	-.204	-.112
	p				.621	.298	.570
Albumin	r					-.006	.036
	p					.975	.854
HbA1c	r						-.301
	p						.120

EFS: Edmonton frail scale, iPTH: Intact parathormone

DISCUSSION

In this study, no significant difference in frailty status was found between HD and PD patients who were not in the geriatric age group. We observed that frailty increased with age in both patient groups. Among HD patients, those classified as frail were older, had lower creatinine levels, and higher HbA1c levels. In PD patients, we found that frail patients were older.

Frailty is commonly observed in both young and elderly patients with ESRD. Studies conducted with different age groups and using various frailty assessment tools have reported that the prevalence of frailty ranges from 6% to 82% in HD patients and 27% to 76% in PD patients.[14] In one study focusing on HD patients, the prevalence of frailty was found to be 71% in elderly patients and 47% in younger patients.[15] Another study evaluating frailty in HD patients under the age of 65 using the EFS reported a frailty prevalence of 51%.[13] In our study, the prevalence of frailty among HD patients under 65 years old was 43%, as determined by EFS. A study by Chao et al.[16] also reported an EFS-based frailty prevalence of 43% in HD patients. In a study evaluating frailty in PD patients with a different scale, the prevalence of frailty was reported to be 34%.[17] In our study, the prevalence of frailty in PD patients was 36%. The prevalence of frailty in dialysis patients found in our study is consistent with the findings in the literature. A prospective study conducted on HD patients demonstrated that frailty, as measured by EFS, was associated with an increased risk of hospitalization, emergency department admission, and mortality.[11] Another study including both HD and PD patients also found that frailty was linked to higher mortality and hospitalization rates.[18] Given its high prevalence in dialysis patients and its association with adverse health outcomes, recognizing and detecting frailty at an early stage is of critical importance.

To the best of our knowledge, no previous study in the literature has compared frailty status between HD and PD patients using the EFS. In our study, no significant difference in frailty status was found between HD and PD patients, with 43% of HD patients and 36% of PD patients classified as frail. A study that assessed frailty using the frailty phenotype scale reported a frailty prevalence of 46% in HD patients and 34% in PD patients, with no significant difference between the two groups.[17] Similarly, another study including both HD and PD patients found that dialysis modality did not influence frailty status.[18] However, a study using the modified Fried frailty index indicated that HD patients were more likely to

Table 4. Comparison of frail and non-frail patients in hemodialysis and peritoneal dialysis

	Hemodialysis		
	Frail (n=12)	**Non-frail (n=16)**	**p-value**
Age, mean±SD	59.8±5.1	44.9±6.8	<0.001
Female, n (%)	4 (33)	8 (50)	0.620
Married, n (%)	11 (92)	15 (94)	1.000
Dialysis duration, months, mean±SD	50±28	81±53	0.080
Body-mass index (kg/m²), mean±SD	26.2±7.7	24.3±4.7	0.418
Diabetes mellitus, n (%)	3 (25)	3 (19)	1.000
Laboratory parameters			
Urea (mg/dl), mean±SD	112±14	124±32	0.253
Creatinine (mg/dl), mean±SD	7.4±1.9	10.4±3.2	0.008
Sodium (mEq/L), mean±SD	136±3	136±3	0.680
Potassium (mEq/L), mean±SD	5.2±0.5	5.2±0.6	0.952
Calcium (mg/dl), mean±SD	9.0±0.8	9.0±0.9	0.933
Phosphorus (mg/dl), mean±SD	5.1±1.3	5.2±1.1	0.833
Hemoglobin (g/dl), mean±SD	10.5±1.0	10.8±2.3	0.683
Albumin (g/dl), mean±SD	3.6±0.2	3.8±0.4	0.220
HbA1c (%) median [IQR]	6.2 [5.2-7.1]	4.8 [4.5-5.2]	0.006
Intact parathormone (pg/ml) median [IQR]	245 [126-574]	417 [232-859]	0.059
	Peritoneal dialysis		
	Frail (n=10)	**Non-frail (n=18)**	**p-value**
Age, mean±SD	59.3±5.7	46.9±8.5	<0.001
Female, n (%)	5 (50)	7 (39)	0.864
Married, n (%)	10 (100)	17 (94)	1.000
Dialysis duration, months, mean±SD	37±13	32±21	0.491
Body-mass index (kg/m²), mean±SD	21.8±3.0	21.8±4.7	0.914
Diabetes mellitus, n (%)	3 (33)	1 (6)	0.116
Laboratory parameters			
Urea (mg/dl), mean±SD	122±38	118±35	0.772
Creatinine (mg/dl), mean±SD	8.6±2.7	9.1±2.5	0.620
Sodium (mEq/L), mean±SD	133±6	134±3	0.494
Potassium (mEq/L), mean±SD	4.0±0.6	4.6±0.8	0.085
Calcium (mg/dl), mean±SD	8.7±0.5	8.6±0.7	0.560
Phosphorus (mg/dl), mean±SD	4.5±0.8	5.0±1.6	0.399
Hemoglobin (g/dl), mean±SD	10.2±1.5	10.8±1.5	0.309
Albumin (g/dl), mean±SD	3.0±0.3	3.3±0.6	0.179
HbA1c (%), median [IQR]	5.3 [4.9-6.6]	5.0 [4.7-5.7]	0.175
Intact parathormone (pg/ml), median [IQR]	271 [128-366]	213 [164-306]	0.759

SD: Standard deviation, IQR: Interquartile range

be frail compared to PD patients.[19] Due to the small number of patients included in our study, comprehensive studies with more patients comparing frailty status in HD and PD patients are needed.

A study comparing frail and non-frail HD patients based on the EFS found results similar to ours, showing that frail patients were older and had lower creatinine levels.[11] It has been shown that each year of life increases the probability of frailty by 3% in dialysis patients.[20] In our study, a positive correlation between age and frailty was observed in both patient groups. A study including both HD and PD patients also found that frailty increased with age, while higher creatinine levels were associated with lower frailty.[18] The relationship between serum creatinine and frailty in HD patients may be explained by muscle mass loss due to sarcopenia.[21,22] Sarcopenia is more prevalent in HD patients than in PD patients.[23] In our study, the absence of a significant difference in creatinine levels between frail and non-frail PD patients may be attributed to the lower prevalence of sarcopenia in PD patients. Furthermore, we found that frail HD patients had higher HbA1c levels. A meta-analysis evaluating factors associated with frailty in HD patients concluded that the presence of DM was linked to frailty.[24] However, in our study, no significant difference was found between frail and non-frail patients

in terms of DM prevalence, which may be due to the small number of diabetic patients in our sample. The relationship between HbA1c levels and frailty in dialysis patients has not been extensively studied. However, a study conducted in elderly patients demonstrated that higher HbA1c levels were associated with an increased risk of frailty.[25] Further research is needed to evaluate the potential link between HbA1c levels and frailty in dialysis patients. We also showed that, although not statistically significant, frail patients tend to have lower iPTH in HD patients. A study in HD patients showed that frail patients had lower iPTH levels.[26] The lower iPTH levels in frail patients in HD patients may be related to the tendency to adynamic bone disease. On the other hand, another study found no difference in iPTH levels between frail and non-frail patients in HD patients.[11] More comprehensive studies with more patients focusing on the relationship between frailty, iPTH and mineral bone disorders in HD patients may contribute to the literature.

Limitations

Our study has several limitations. The first is the small number of patients. Second, the study was conducted at a single center. Third, frailty was assessed cross-sectionally at a single time point, and no prospective follow-up was conducted. Strength of our study is that, to the best of our knowledge, it is the first study to compare frailty status between HD and PD patients using the EFS.

CONCLUSION

In our study, no significant difference in frailty status was found between HD and PD patients. It is important to recognize that frailty is prevalent among non-geriatric dialysis patients. Assessing frailty can assist clinicians in identifying vulnerable patients and enabling early interventions to mitigate adverse outcomes. This is particularly crucial for ESRD patients, who are at high risk for morbidity and poor clinical outcomes. Due to the small number of patients included in the study, larger-scale studies with a greater number of patients are needed to improve the generalizability of our findings.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study Malatya Turgut Özal University Approved by the Non-interventional Clinical Researches Ethics Committee (Date: 10.07.2024, Decision No: 45).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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