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# The relationship between fear of falling and frailty in older adults undergoing hemodialysis

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## Abstract

**Background:** Frailty and fear of falling (FOF) are highly prevalent in older adults undergoing hemodialysis (HD). However, there is no reliable evidence of the association between FOF and frailty in older adults undergoing HD.

**Objectives:** This study aimed to determine the association between FOF and frailty in older adults undergoing HD.

**Methods:** This cross-sectional study was conducted on 194 older adults undergoing HD in the east of Mazandaran province, Iran. Data were collected using of demographic and clinical characteristics questionnaire, Edmonton Frail Scale (EFS), and Falls Efficacy Scale–International (FES-I). Independent t-test, analysis of variance, Pearson's correlation coefficient, and stepwise multiple regression were used to analyze the data.

**Results:** The mean score of the FOF was 34.41±12.20, and most of the participants (38.4%) had moderate FOF. The mean score of the frailty was 6.91±3.12 and most of older adults (34.3%) were vulnerable to frailty. There was a positive and significant association between FOF and frailty in older adults undergoing HD (r=0.802, P<0.001).

**Conclusion:** The majority of older adults receiving chronic HD have moderate to high FOF and are prone to frailty. Therefore, it is necessary to perform appropriate educational, behavioral, and cognitive interventions to reduce the FOF in these patients.

**Keywords:** Older adults, Fear of falling, Frailty, Hemodialysis.

## Introduction

Frailty is a serious public health problem in aging societies. In low- and middle-income countries, the prevalence of frailty among community-dwelling people aged 60 years and over ranges from 3.9% to 51.4%.[1] Frailty is a complex and multidimensional syndrome of high vulnerability to intrinsic and extrinsic stressors. It reduces the functional capacity and reserve of various physiological systems, increases the potential for adverse health outcomes, and increases the risk of disability, cognitive impairment, hospitalization, and death.[2] As the proportion of older adults requiring hemodialysis (HD) increases, the issue of frailty and its effect on clinical outcomes in these patients has received much attention.[3] A majority of patients needing HD are in the age group of 65 years and over.[4] The prevalence of frailty in these patients ranges from 19% to 82% in different studies.[5-7]

Fear of falling (FOF) is another common problem in older adults. People with FOF have low self-efficacy in avoiding falls during essential, nonhazardous activities of daily living.[8] The prevalence of FOF in community-dwelling older adults has been reported to range from 33 to 85%.[9] It is also reported that 69% of older adults needing HD have a high FOF.[10]

FOF can be considered a protective response, as it allows people to be more cautious about their surroundings. However, when irrational and exaggerated, FOF can compromise an individual's physical and psychosocial well-being by limiting or avoiding activities.[5] Long-term activity restriction can lead to deconditioning, muscle weakness, postural instability, and poor balance, which in turn can contribute to future falls.[11] FOF is also linked to other negative consequences such as the inability to perform activities of daily living (ADL), reduced social

interactions, depression, and poor quality of life. These changes make older people more susceptible to frailty.[8,12] Studies have shown that FOF increases the risk of frailty in community-dwelling older adults.[13,14] A recent study found that those with FOF were 7.2 times more likely to be frail than those who did not report such a fear. [15] Another study ranked FOF as one of the four major factors associated with frailty in older adults.[16] Older adults undergoing HD experience more physiological and psychological problems, which make them more susceptible to balance and gait disorders and falls than other older people. This in turn exacerbates FOF[10] and increases the risk of frailty in these patients.[17] However, there is no reliable evidence of the association between fear of falling and frailty in older adults undergoing HD.

## Objectives

The aim of this study was to determine the association between FOF and frailty in older adults undergoing HD.

## Methods

### Study design, setting, and participants

This cross-sectional study was conducted from July to November 2020. The study population included all older adults undergoing HD in dialysis centers of selected hospitals in the East of Mazandaran province, Iran.

The sample size was estimated using the formula for calculating a proportion in a limited population [Formula 1] where N= the total number of people in the target population, Z= Z-statistic for the confidence level, d= measurement precision, and p= expected proportion. Totally, 300 HD patients were accessible in this study (i.e. N= 300), then considering a confidence level of 95% (i.e. Z= 1.96), the expected proportion of 50% (i.e. p = 0.5), and measurement precision of 0.05, it was estimated that 169 subjects are needed for the study. However, given a possible dropout of 15%, we enrolled 194 older adults in the study.

Among HD centers in the east of Mazandaran, three centers were randomly selected to prepare a sampling framework. Lists of accessible patients with inclusion criteria were received from the authorities of the selected HD centers. After integrating the lists and numbering the patients in the final list, we used a random number generator to select the required number of patients from the final framework.

$$n = \frac{N * Z^2 * p(1-p)}{N * d^2 + Z^2 * p(1-p)}$$

**Formula 1.** Sample size calculation formula

Inclusion criteria were age ≥60 years, history of HD for at least 6 months, no mental disorders, no neuromuscular disorders such as rheumatoid arthritis, spinal cord injuries, stroke, multiple sclerosis (based on medical records), no self-reported visual and auditory problems, and inclination to participate in the study. Participants were excluded if their clinical condition deteriorated during the interview or while completing the questionnaires.

### Data collection instruments

A demographic and clinical characteristics questionnaire, Falls Efficacy Scale–International (FES-I), and Edmonton Frail Scale (EFS) were used for data collection. The demographic and clinical characteristics questionnaire included 16 questions about age, gender, marital status, employment status, education level, income, place of residence, insurance status, housing ownership status, coexistence status, frequency of HD in a week, length of each HD session, time of HD (i.e. morning/evening), presence of other comorbidities, and medications taken.

FES-I includes 16 items. All items are scored on a four-point Likert scale from "1=not at all concerned to 4=very concerned," and the total score varies from 16 to 64. Scores 1-16, 17-32, 48-33, and 49-64 indicate no FOF, low FOF, moderate FOF, and high FOF or low self-efficacy, respectively. Fadavi-Ghafferi et al., confirmed the validity and reliability of the Persian version of FES-I in Iranian nursing home residents with a total Cronbach's alpha of 0.95.[18]

EFS comprises 11 items distributed into nine domains: cognitive status (clock drawing test), general health status (2 items), functional independence (1 item), social support (1 item), medication use (2 items), nutrition (1 item), mood (1 item), incontinence (1 item), and functional performance (standing up and walking test). The score for each domain ranges from zero to two, and the total score of EFS is 17. The scores of 0-5, 6-7, 8-9, 10-11, and 12-17 represent no frailty, vulnerable to frailty, mild frailty, moderate frailty, and severe frailty, respectively.[19] The validity and reliability of this scale have been confirmed in other studies.[19] In this study, the content validity of FES-I and EFS was evaluated qualitatively. To this end, we presented the Persian versions of FES-I and EFS to ten nursing instructors at the nursing department of Babol University of Medical Sciences and they confirmed the content validity of the two scales. To examine the reliability of the two scales, we also test-retested the scales on 20 older adults undergoing

HD at a 2-week interval. Spearman correlation coefficients of the FES-I and EFS were 0.95 and 0.97, respectively.

Participants manually completed the demographic and clinical characteristics questionnaire and the FES-I at the end of the HD session. The EFS was then completed through face-to-face individual interviews. It took about 40 minutes per participant to complete the questionnaires.

### Statistical analysis

The data were analyzed in SPSS (version 16.0, SPSS Inc, Chicago, IL, USA). The normality of the data was examined using the Kolmogorov-Smirnov test and all the quantitative variables showed a normal distribution. The independent-samples t-test and one-way analysis of variance were used to compare the mean scores of FOF and frailty between the subgroups of the participants. Pearson's correlation coefficient was employed to estimate the correlation between some of the quantitative variables with FOF and frailty. A stepwise multiple regression was conducted to examine the relationship between frailty and personal and clinical characteristics as well as the FOF score. $P<0.05$ were considered significant.

### Ethical considerations

The Ethics Committee of Babol University of Medical Sciences, Babol, Iran approved the study protocol (Ethics code: IR.MUBABOL.REC.1399.144). Written informed consent was obtained from all participants prior to data collection. Participants were also briefed on the purpose of the study and ensured about the confidentiality of their data, voluntary participation, and the right to withdraw from the study at any time. The study was conducted in accordance with the Declaration of Helsinki.

## Results

In total, 194 older adults participated in this study. The mean age of participants was 68.10±7.40 years, and 54% of them were male. The mean duration of HD treatment was 35.64±15.24 months. The majority of the participants (94.9%) received HD treatment three times a week, and 59% had cardiovascular diseases and hypertension [Table 1].

The participants' mean FOF score was 34.41±12.20, which was moderate. Of the participants, 18.05%, 38.66%, and 35.56% had high, moderate, and low FOF, respectively, and 7.73% had no FOF. The overall mean score of frailty was 6.91±3.12. Moreover, 7.7%, 19.1%, and 14.5% of older adults had severe, moderate, and mild frailty, whereas 35% were vulnerable to frailty and 23.7% showed no frailty. There was a positive and significant association between FOF and frailty in older adults undergoing HD ($r=0.802$, $P<0.001$). In addition, age of the participants was significantly correlated with FOF ($r=0.373$, $P<0.001$) and frailty ($r=0.372$, $P<0.001$).

**Table 1.** The demographic and clinical characteristics of the older adults (n = 194)

| Variables | | N (%) |
|---|---|---|
| **Gender** | Male | 105 (54) |
| | Female | 89 (46) |
| **Marital status** | Married | 162 (83.3) |
| | Widow/ widower | 32 (16.7) |
| **Employment status** | Employed | 58 (29.8) |
| | Unemployed | 102 (52.5) |
| | Retired | 34 (17.7) |
| **Education level** | Under diploma | 85 (43.9) |
| | High school diploma | 71 (36.4) |
| | Academic | 38 (19.7) |
| **Income status** | Sufficient | 156 (80.3) |
| | To some extent sufficient | 38 (19.7) |
| **Place of residence** | Urban | 121 (62.6) |
| | Rural | 73 (37.4) |
| **Having an active health insurance** | Yes | 192 (99) |
| | No | 2 (1) |
| **Housing ownership status** | Personal | 176 (90.9) |
| | Rental | 18 (9.1) |
| **Coexistence status** | Alone | 14 (7) |
| | With spouse | 148 (76.3) |
| | With children | 32 (16.7) |
| **Fall history** | Yes | 93 (48) |
| | No | 101 (52) |

The mean FOF and frailty were significantly higher in females, widowed, low literate, and unemployed patients, and in those who lived alone or experienced a fall in the previous year [Table 2]. Duration of chronic kidney disease and hemodialysis treatment, number of comorbidities and medications taken were also correlated with both FOF and frailty (all Pearson correlation coefficients were > 0.30 and all P values were < 0.001. The mean FOF and frailty were also significantly higher in patients with diabetes, more comorbidities, longer duration of renal failure and HD treatment, and those receiving more medications [Table 3].

**Table 2.** The mean scores of FOF (fear of falling) and frailty of the older adults in terms of their demographic characteristics

| Demographic characteristics | Fear of falling | Frailty | Demographic characteristics | Fear of falling | Frailty |
|---|---|---|---|---|---|
| **Gender** | | | **Place of residence** | | |
| Male | 31.72±11.63 | 6.16±2.80 | Urban | 34.01±11.26 | 6.68±3.16 |
| Female | 37.58±12.16 | 7.79±3.27 | Rural | 35.09±13.7 | 7.29±3.05 |
| P-value | 0.001 | <0.001 | P-value | 0.184 | 0.184 |
| **Marital status** | | | **Insurance status** | | |
| Married | 32.52±11.54 | 6.4±2.95 | Yes | 34.01±11.76 | 6.64±3.04 |
| Widow/ widower | 43.87±11.14 | 9.45±2.75 | No | 35.03±12.88 | 7.21±3.22 |
| P-value | <0.001 | <0.001 | P-value | 0.559 | 0.141 |
| **Employment status** | | | **Housing ownership status** | | |
| Employed | 26.30±8.98 | 5.18±2.43 | Personal | 34.88±12.24 | 6.99±3.20 |
| Unemployed | 38.90±11.71 | 7.90±3.17 | Rental | 29.77±11.13 | 6.11±2.13 |
| Retired | 34.77±11.59 | 6.88±2.80 | P-value | 0.091 | 0.255 |
| P-value | <0.001 | <0.001 | **Coexistence status** | | |
| **Education level** | | | Alone | 45.45±9.29 | 9.24±2.48 |
| Low literate | 38.08±12.61 | 7.98±3.26 | With spouse | 35.07±13.46 | 8.28±3.36 |
| High school diploma | 31.72±11.26 | 6.06±2.76 | With children | 31.94±11.34 | 6.27±2.96 |
| Academic | 31.23±10.98 | 6.07±2.76 | P-value | <0.001 | <0.001 |
| P-value | <0.001 | <0.001 | | | |
| **Income status** | | | **Fall history** | | |
| Sufficient | 34.11±12.11 | 6.83±3.08 | Yes | 39.49±11.69 | 8.40±2.82 |
| Relatively sufficient | 35.66±12.66 | 7.25±3.33 | No | 29.73±10.76 | 5.54±2.75 |
| P-value | 0.478 | 0.447 | P-value | <0.001 | <0.001 |

Data presented as Mean ± SD

**Table 3.** The mean scores of fear of falling and frailty of the older adults in terms of their clinical characteristics

| Clinical characteristics | Fear of falling | Frailty | Clinical characteristics | Fear of falling | Frailty |
|---|---|---|---|---|---|
| **Underlying diseases** | | | **Frequency of hemodialysis per week** | | |
| Diabetes | 40.47±11.26 | 8.47±2.72 | Twice | 29.7±8.40 | 6.10±2.13 |
| Cardiovascular | 36.37±11.80 | 7.79±3.10 | Three times | 34.67±12.34 | 6.95±3.17 |
| Hypertension | 33.77±12.05 | 6.79±2.90 | P-value | 0.211 | 0.40 |
| Musculoskeletal | 28.27±9.94 | 5.04±2.82 | **Time of hemodialysis** | | |
| Gastrointestinal | 25.53±10.50 | 4.53±2.14 | Morning | 34.13±23.62 | 6.87±3.19 |
| P-value | <0.001 | <0.001 | Evening | 35.08±11.25 | 7.01±2.99 |
| **Duration of chronic kidney disease (month)** | | | P-value | 0.619 | 0.802 |
| 0-24 | 26.10±13.50 | 4.17±2.24 | **Number of medications taken** | | |
| 24-48 | 28.90±11.54 | 5.8±2.81 | 1-3 | 27.10±15.52 | 5.22±2.10 |
| ≥48 | 30.12±14.05 | 6.27±3.49 | 4-6 | 29.8±12.76 | 6.43±2.69 |
| P-value | <0.001 | <0.001 | ≥7 | 33.22±16.34 | 7.5±3.72 |
| **Duration of hemodialysis treatment (month)** | | | P-value | <0.001 | <0.001 |
| 6-18 | 24.13±14.50 | 4.45±2.24 | **Number of comorbidities** | | |
| 18-30 | 25.9±12.91 | 5.16±2.81 | 1 | 25.16±11.72 | 5.16±2.72 |
| 30-42 | 28.32±11.15 | 6.49±2.90 | 2 | 27.48±14.36 | 6.21±3.10 |
| ≥42 | 30.12±11.25 | 7.62±3.52 | ≥3 | 31.42±16.44 | 8.3±3.90 |
| P-value | <0.001 | <0.001 | P-value | <0.001 | <0.001 |

Data presented as Mean ± SD

**Table 4.** Final regression model (third model) of the effect of independent variables on the dependent variable (frailty)

| Variables | beta coefficient (β) | | Standard error | t-statistic | P-value | 90% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | Standard | Non-standard | | | | Lower limit | Upper limit |
| **Constant** | - | -0.36 | 0.39 | -0.930 | 0.354 | -1.13 | 0.40 |
| **Fear of falling** | 0.729 | 0.18 | 0.012 | 15.996 | <0.001 | 0.16 | 0.21 |
| **Number of medications taken** | 0.134 | 0.11 | 0.039 | 3.039 | 0.003 | 0.042 | 0.19 |
| **Education level** | 0.103 | 0.65 | 0.27 | 2.404 | 0.017 | 0.11 | 1.183 |
| **Summary of the third model** | F= 129.84; P<0.001 | | r-square=0.66 | | Adjusted r-square = 0.66 | | |

In the stepwise multiple regression [Table 4], the independent variables (i.e., personal characteristics and FOF scores) were entered into three models. In the first model, FOF score explained 64% of the variance of frailty. In the second model, the number of medications taken, and in the third, the education level entered into the model and, finally explaining 66% of the variance of frailty. The regression model also demonstrated that FOF had the greatest effect on frailty in older adults, with a standard beta coefficient of 0.72. This means that a 1-unit increase in FOF results in 0.72-unit increase in frailty score in older adults undergoing HD [Table 4].

## Discussion

In the present study, only 7.73% of patients had no FOF. The mean FOF of our older adults was 34.41. This finding is consistent with another study from Iran, where older adults undergoing HD scored 35.29 on the FES-I.[20] However, in a study in Brazil, older adults undergoing HD scored 28.2 on the same scale, even though the majority of them reported that they are highly concerned about falling.[10] A Japanese study also used the Modified Fall Efficacy Scale and reported that 69.6% of older adults undergoing HD had high FOF.[21] Although the variations between studies might be attributable to the patients' previous fall experiences, demographic and clinical characteristics, and living circumstances, our findings, along with other studies, confirm that older adults undergoing HD suffer from moderate to high levels of FOF.

In the current study, 41.3% of participants were frail to some extent and most of them (35%) were vulnerable to frailty. In a study of the prevalence of frailty in Japanese hemodialysis patients, 26.0% of participants were not-frail, 52.6% were pre-frail, and 21.4% were frail.[22] A Brazilian study also assessed the frailty level in older adults with chronic kidney disease (CKD) undergoing HD and reported that 35% of patients had no frailty, but 26.7% were vulnerable, 20% showed mild frailty, 13.3% moderate frailty, and 5% showed severe frailty. [23] However, some studies found higher levels of frailty among older adults undergoing HD. For instance, a study in Maryland compared the prevalence of frailty among people of all ages who underwent HD. Results showed that 50% of older adults (≥ 65) and 35.4% of younger (<65) patients undergoing HD were frail. In addition, 35.9% of older adults and 29.3% of younger patients were moderately frail.[24] Again, the variation between studies might be attributable to the differences in the demographic and clinical characteristics of the patients studied and the instruments used to measure frailty.

Our results showed that mean frailty was higher in females, widowed, low literate, and unemployed patients, and in those who lived alone or experienced a fall in the previous year. Mean frailty was also significantly higher in patients with diabetes, with more comorbidities, with longer duration of renal failure and HD treatment, and in those who received more medications. These findings are consistent with those of an Iranian study that studied frailty in hospitalized older adults.[25] A systematic review also concluded that the severity of frailty increases with age and in older women.[26] A study also reported that frailty and muscle atrophy are more common in older women due to postmenopausal hormonal changes.[17] There is also evidence that low literacy,[27] living alone, loss of a spouse, unemployment, lack of social support, having other concomitant disorders, and receiving multiple medications make older adults vulnerable to physical and mental health conditions and frailty.[22,25,27-29] However, a Brazilian study reported that, of all personal and clinical variables, only monthly per capita income was significantly associated with frailty in older adults with CKD.[17]

The results also showed a significant relationship between frailty and FOF. In other words, frailty increases with increasing FOF. These findings are consistent with those of previous studies.[13-15] FOF can lead to self-imposed restrictions in activities of daily living, reducing physical performance and increasing the risk of

sarcopenia,[8] and impairing gait and walking in older adults.[30] These changes have been shown to occur more rapidly and more severely in patients undergoing chronic HD.[3,26]

Regression analysis showed that, of all the variables, FOF had the highest effect on frailty. This finding is consistent with what was reported by Qin et al.[31] Older adults receiving chronic HD are more susceptible to FOF and frailty due to the physiological and psychological consequences of renal failure and HD. They are also at increased risk of impaired mobility, leading to increased FOF[10] and frailty.[22] The regression model also showed that, after FOF, the number of medications taken and education level had the greatest effect on the frailty in older adults undergoing HD. Other studies have also shown that taking multiple medications is associated with longer hospital stays, readmissions, falls, functional impairment, and dementia, all of which predispose older adults to frailty.[23,32] Education level is also associated with socioeconomic status, lifestyle, biomedical, behavioral, and psychosocial factors.[27] Low literate older people usually do not have a healthy lifestyle, lack sufficient social support, and are more likely to suffer from mental health problems such as depression,[27,33] all of which make them prone to frailty.

This study was the first study on the association between FOF and frailty in Iranian older adults undergoing HD. However, it was a cross-sectional study and used self-report instruments. Then, the results may suffer from social desirability bias. Further studies with a more rigorous design are recommended. We also encourage the use of more objective methods to assess frailty.

## Conclusions

The results suggest that frailty increases with increasing FOF. This finding is important for clinical practice. Nurses are advised to screen older adults receiving HD for FOF and implement interventions through educational, rehabilitative, behavioral, cognitive, and preventive programs to reduce the risk of FOF and frailty in older adults undergoing HD. Family caregivers of these patients should also be trained to modify the living environment of these patients to decrease the risk of falling and increase the patients' activity and quality of life, thereby reducing the process of frailty.

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### Competing interests

The authors declare that they have no competing interests.

### Abbreviations

Fear of falling: FOF; Falls Efficacy Scale–International: FES-I; Edmonton Frail Scale: EFS; Hemodialysis: HD; Activities of daily living: ADL; Chronic kidney disease: CKD.

### Authors' contributions

All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

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### Role of the funding source

None.

### Availability of data and materials

The data used in this study are available from the corresponding author on request.

### Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. The Ethics Committee of Babol University of Medical Sciences, Babol, Iran approved the study protocol (Ethics code: IR.MUBABOL.REC.1399.144). All participants signed an informed consent form.

### Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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