ORIGINAL ARTICLE

Factors associated with frailty and the effect of frailty on postoperative outcomes in older adults with hip fracture

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ABSTRACT

BACKGROUND: The incidence of hip fractures is also increasing rapidly with the aging population and is currently considered a major significant global health issue due to its high mortality rate. The aim of this research is to investigate the relationship between pre-fracture frailty and postoperative patient outcomes and identify factors associated with frailty in older adults operated for hip fracture.

METHODS: Descriptive, cross-sectional study. Patients aged 65 and older who underwent surgery for hip fracture were included. Data were collected in face-to-face interviews with patients in their rooms preoperatively and on the first postoperative day. The study was approved by the non-interventional research ethics committee of Dokuz Eylul University. Data analysis was performed using descriptive statistics, independent samples t-test, One Way ANOVA, correlation, and multiple linear regression analyses.

RESULTS: Of the 128 patients included in the study (mean age 78.45±8.36 years), 46.1% (n=59) were prefrail, and 39.8% (n=51) were frail. Higher frailty scores were associated with female sex, chronic disease, use of multiple long-term medications, being immobile or requiring mobility assistive devices prior to the fracture, recent decrease in appetite, need for postoperative intensive care, postoperative complications, postoperative pressure injury development, and mortality within the first month of discharge ($p<0.05$). Preoperative frailty score was positively correlated with number of chronic diseases, preoperative fear of falling, nutritional risk score, comorbidity index score, and length of hospital stay and negatively correlated with preoperative and postoperative Katz ADL score and postoperative creatinine concentration($p<0.05$). The mean Frailty Scale score was 2.16±1.26; pre-fracture nutritional status ($\beta=0.312$, $p<0.001$) and functional independence status ($\beta=0.216$, $p=0.012$) were significant predictors of frailty.

CONCLUSION: This study showed that frailty was prevalent among older adults undergoing hip fracture surgery and had a significant impact on postoperative patient outcomes. Pre-fracture nutritional and functional status were significant factors associated with frailty. Preoperative frailty assessment of patients presenting with hip fractures, especially focusing on nutritional and functional status, may contribute to better management of treatment and care.

Keywords: Aging; frailty; hip fracture surgery.

INTRODUCTION

Due to demographic aging, the prevalence of frailty is expected to increase significantly. Frailty impacts 70% of older adults,[1] increasing the risk of functional decline and dependency.[2] Frailty encompasses issues such as cognitive impairments, delirium, urinary incontinence, malnutrition, falls, gait disturbances, pressure injury, sleep disorders, sensory deficits, fatigue, and dizziness.[3] These problems are common among older adults and result in significant disability and impaired quality of life.[1,4]

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The incidence of hip fractures is also increasing rapidly with the aging population and is currently considered a major significant global health issue due to its high mortality rate.[5] The occurrence of hip fractures in frail patients is especially high due to lengthening life expectancy and increased comorbidities.[6] Frailty is also associated with lower quality of life after a hip fracture and may require personalized treatment, particularly in patients with a short life expectancy and those expected to experience a decline in postoperative functional capacity.[7]

The presence of frailty in older patients influences surgical outcomes and is associated with increased postoperative complications and mortality, prolonged length of hostpital stay, and discharge to a rehabilitation facility.[8-11] The authors of a systematic review noted that studies on functional decline and decreased quality of life after surgery are limited.[10]

There is currently significant interest in enhanced recovery programs, with most studies focusing primarily on total joint arthroplasties.[12] As patients are being discharged early both because of enhanced recovery programs and to reduce infection risk and costs, there is a growing need to evaluate the factors affecting postoperative recovery and functional dependency. Aside from frailty, significant factors in the postoperative recovery process include the surgical techniques used, technological advancements in the healthcare field, and the care received.[13] Preoperative assessment of frailty in older patients has become increasingly important to modify treatment options, evaluate prognosis and recovery expectations, and optimize treatment and care.[8,14] Therefore, routine frailty assessment is recommended in the comprehensive evaluation of patients planned for surgery.[15] The need for research to determine which adverse postoperative outcomes are most strongly predicted by frailty has been emphasized in the literature.[16] Thus, the aim of this study was to investigate preoperative frailty levels, their relationship with postoperative patient outcomes, and factors associated with frailty in older adults with hip fracture. The results are expected to contribute to a better understanding of frailty and its impact on postoperative outcomes and possibly improve the surgical care of older hip fracture patients.

MATERIALS AND METHODS

Study design

A cross-sectional, descriptive, correlational, predictive study was performed.

Research Questions:

1. What is the pre-fracture frailty level of older patients undergoing hip fracture surgery?

2. Do the pre-fracture frailty scores of older patients undergoing hip fracture surgery differ according to gender, presence of chronic disease, use of long-term medications, postoperative complications, postoperative delirium, history of falls within the last year, falls after hip fracture surgery, pre- and postoperative incontinence, pre- and postoperative pressure injury development, decreased appetite, weight loss, and hospital readmission and mortality within the first month after discharge.

3. Are the pre-fracture frailty levels of older patients undergoing hip fracture associated with age, body mass index (BMI), comorbidity index score, American Society of Anesthesiologists (ASA) physical status score, time from fracture to surgery, length of hospital stay, and pre- and postoperative pain levels, nutritional risk, albumin level, creatinine level, hemoglobin level, fear of falling, and functional status?

4. What factors predict the pre-fracture frailty levels of older patients undergoing hip fracture surgery?

Participants and sample size

The study sample consisted of 128 patients who underwent hip fracture surgery in the orthopedics and traumatology clinic of a training and research hospital and met the sampling criteria.

Inclusion criteria for the study were as follows: agreeing to participate in the study, being at least 65 years of age, undergoing surgery for intracapsular or extracapsular proximal femoral fracture, having no hearing or other sensory impairment, and having no psychiatric diagnosis. Patients who underwent hip surgery due to coxarthrosis, had periprosthetic fractures, underwent revision hip surgery, or had any speech impairment were excluded.

The sample size was calculated at a 95% confidence level using the G*Power 3.1.9.4 program. The minimum sample size was determined as 111 participants based on Cohen's medium effect size (d=0.30) and a theoretical power of 0.80. After the study was completed, a post hoc power analysis was conducted using the same program based on the difference in mean frailty scores by gender. With an effect size of 0.54, a p-value of 0.05, and a sample size of 128, the study power was calculated as 0.84.

Data collection

The study data were collected between October 2022 and December 2023 in the orthopedics and traumatology clinic of a tertiary care training and research hospital. Patients presenting with hip fracture were admitted for preoperative preparations, underwent surgery, and were discharged after an average of 5-6 days of postoperative follow-up in the clinic. Data were collected in face-to-face interviews with patients in their rooms preoperatively and on the first postoperative day. Sociodemographic and clinical data were obtained using a patient information form, the Charlson Comorbidity Index (CCI), Nursing Delirium Screening Scale (Nu-DESC) for delirium assessment, FRAIL Scale for frailty evaluation, Nutritional Risk Screening 2002 (NRS-2002) tool for malnu-

trition risk assessment, and the Katz Activities of Daily Living (ADL) Index for functional status evaluation. Other clinical data were obtained from patient charts and digital records (laboratory results, medications, surgical notes, length of hospital stay, and radiological imaging methods) in the hospital information management system. The patients' relatives were also contacted after a month to inquire about hospital readmissions and mortality within 30 days of discharge.

Data collection tools

Patient Information Form: This form was developed by the researchers in accordance with the literature.[6,10,11,14] The form includes 34 questions regarding sociodemographic and clinical information such as the patient's age, gender, BMI, marital status, education level, and smoking and alcohol consumption; comorbidities, long-term medications, ASA score, recent decrease in appetite, type of anesthesia, and type of surgery; postoperative complications; pre- and postoperative incontinence, pressure injury, pain levels, fear of falling, and hemoglobin, albumin, and creatinine levels; length of hospital stay; history of falls within the past year; and hospital readmission and mortality within 30 days after discharge. Patients were asked to rate their fear of falling and pain on a numerical rating scale of 0 to 5. Complications were identified based on the physician's diagnoses.

Charlson Comorbidity Index (CCI): The CCI is a mortality predictor developed in 1987 by Charlson and colleagues by classifying comorbid conditions and quantifying their severity. The index includes 19 medical conditions scored from 1 to 6 according to the relative risk of 1-year mortality, with a total score ranging from 0 to 37. The total score is then adjusted by adding 1 point for every decade over the age of 40 to yield the Charlson Comorbidity Index score.[17] This index is widely used to assess the comorbidity burden in surgical patients in our country.[18,19]

Nursing Delirium Screening Scale (Nu-DESC): Developed by Gaudreau and colleagues in 2005,[20] the Nu-DESC is a 5-item observational scale that can be administered rapidly (in approximately 1 minute). The items (disorientation, inappropriate behavior, inappropriate communication, hallucinations, and psychomotor retardation) are each scored between 0 and 2, for a score ranging between 0 and 10. Scores of 2 or higher are interpreted as delirium. The Nu-DESC was shown to have 85.7% sensitivity and 86.8% specificity in diagnosing delirium.[20] Validity and reliability studies in Turkish were conducted by Çınar and Aslan, who reported 92.3% sensitivity and 92.7% specificity.[21]

FRAIL Scale: This scale was developed by Morley and colleagues in 2012.[22] The validity and reliability study in the geriatric Turkish population was conducted by Muradi and Yavuz in 2017.[23] The scale consists of five items evaluating the patient's fatigue level, resistance (ability to walk up a flight of stairs), ambulation (ability to walk several hundred meters), illnesses, and unintentional weight loss. Each item is scored 0 or 1 based on the patients' responses, for a total score of 0 to 5. Patients are considered nonfrail at a score of 0, prefrail at scores of 1-2, and frail at scores higher than 2. In the adaptation study for the Turkish population, the Cronbach's alpha internal consistency coefficient of the scale was 0.787.[23]

Nutritional Risk Screening 2002 (NRS-2002): The NRS-2002 is a nutritional screening tool developed in 2002 by Kondrup and colleagues with contributions from the Danish Society for Parenteral and Enteral Nutrition.[24] Its purpose is to identify individuals at risk of malnutrition. Patients are asked four questions in the initial screening. If all answers are negative, nutritional risk is considered low and the screening is repeated at a specified interval. If the patient answers affirmatively to any question in the initial screening, they proceed to the secondary screening to assess their nutritional impairment and severity of illness. These scores are summed, with an additional point added for individuals over 70 years of age, to yield the total score. A total score of 3 or higher is interpreted as malnutrition risk and a nutritional care plan is implemented; if the total score is below 3, the screening test is repeated at the specified intervals. A study conducted by Bolayır (2014) assessed the Turkish validity and reliability of the scale on 271 patients in surgical and internal medicine departments.[25]

Katz ADL Index: Developed by Katz and colleagues in 1963,[26] this index includes basic ADL parameters such as bathing, dressing, toileting, transferring, urinary and bowel control, and feeding. Items are scored as independent (1 point) if the patient can perform them without supervision, guidance, or personal assistance or dependent (0 points) if they cannot. The total score ranges from 0 to 6, with a score of 6 indicating full function, 4 indicating moderate function, and 2 or less indicating severe functional impairment. The Turkish validity and reliability study was conducted by Arık and colleagues in 2015.[27]

Ethical consideration

This study conducted in accordance with the Helsinki Decleration Priciples. The study was approved by the non-interventional research ethics committee of Dokuz Eylul University (decision no: 2022/31-12; date: 28.09.2022). Written permission was obtained from the institution and clinic where the study was conducted. Additionally, informed consent was obtained from the patients who agreed to participate in the study.

Statistical analysis

The data were analyzed using the IBM SPSS Statistics version 23.0 (released 2016; Armonk, NY: IBM Corp.). Descriptive data were analyzed using frequency, percentage, mean, and standard deviation values. Skewness and kurtosis values (+2

to −2) were used to assess the normality of data distributions.[28] Data with a normal distribution were evaluated using parametric tests, while nonnormally distributed data were assessed using nonparametric tests. The significance level was set at $p<0.05$. The relationship between mean scores was analyzed using Pearson and Spearman correlation analyses. Differences in mean score based on sociodemographic and clinical variables were evaluated using significance tests for the means of two or more groups. Multiple linear regression analysis was employed to examine the factors predicting the frailty levels of patients who underwent surgery due to hip fractures.

RESULTS

The hip fracture patients participating in the study had a mean age of 78.45±8.36 years and a mean BMI of 26.16±4.66. Of the patients, 62.5% (n=80) were women, 46.1% (n=59) were prefrail, and 39.8% (n=51) were frail. Over half (55%) of the patients were at risk of malnutrition, and 10.7% were malnourished. Additionally, 49.2% had femoral neck fractures, 68% underwent surgery with internal fixation (proximal femoral nail, plate/screw), and 81.3% received spinal anesthesia during surgery (Table 1). The majority of patients had chronic diseases (85.2%), used multiple long-term medications (74.2%), and a history of falls within the past year (70.3%), and 41.4% used mobility assistive devices before the fracture. In the first month after discharge, 10.9% of the patients were rehospitalized (Table 2).

Mean frailty scores were significantly higher among patients who were female, had comorbidities, used multiple long-term medications, used mobility assistive devices or were immobile before the fracture, experienced a recent decrease in appetite, were admitted to the intensive care unit postoperatively, had postoperative complications, developed pressure injury pre- or postoperatively, developed delirium postoperatively, and died within the first month after discharge ($p<0.05$; Table 2).

Preoperative frailty score showed a weak positive correlation with number of comorbidities ($r=0.286$, $p=0.001$), number of long-term medications ($r=0.170$ $p=0.05$), preoperative fear of falling score ($r=0.225$, $p=0.011$), postoperative pain score ($r=0.202$, $p=0.02$), CCI score ($r=0.231$, $p=0.009$), and length of hospital stay ($r=0.187$, $p=0.035$). There was a moderate positive correlation between FRAIL Scale and NRS-2002 scores ($r=0.411$, $p<0.001$) (Table 3).

In terms of functional independence, preoperative frailty score was found to correlate negatively with Katz ADL score preoperatively ($r=-0.362$, $p<0.001$) and postoperatively ($r=-0.241$, $p=0.006$). There was also a weak negative correlation between preoperative frailty score and creatinine level ($r=-0.191$, $p=0.031$) (Table 3).

Multiple linear regression analysis was performed to assess the contribution of variables found to be associated with

Table 1. Sociodemographic and clinical characteristics of the patients (N=128)

Variables	n (%)
Age, years (mean ± SD)	78.45±8.36
BMI (mean ± SD)	26.16±4.66
Gender	
Female	80 (62.5)
Male	48 (37.5)
Marital status	
Married	71 (55.5)
Single	57 (44.5)
Education level	
Literate	28 (21.9)
Primary school	63 (49.2)
Secondary school, high school, university	8 (6.3)
Illiterate	29 (22.7)
Smoking	
Yes	6 (4.7)
No	122 (95.3)
Alcohol consumption	
Yes	3 (2.3)
No	125 (97.7)
Type of fracture	
Femoral head fracture	11 (8.6)
Femoral neck fracture	63 (49.2)
Intertrochanteric/pertrochanteric fracture	49 (38.3)
Subtrochanteric fracture	5 (3.9)
Type of surgery	
Hemiarthroplasty (hip)	9 (7.0)
Total hip arthroplasty	32 (25.0)
Internal fixation (proximal femoral nail, plate/screw)	87 (68.0)
Type of anesthesia	
Spinal	104 (81.3)
Epidural	23 (18.0)
General	1 (0.8)
Frailty status	
Not frail	18 (14.1)
Prefrail	59 (46.1)
Frail	51 (39.8)
Nutritional Status	
Normal	48 (34.3)
At risk of malnutrition	77 (55)
Malnourished	15 (10.7)
FRAIL Scale score (mean ± SD)	2.16±1.26

Table 2. Comparison of frailty scores according to clinical characteristics

Variables	n (%) Mean ± SD	FRAIL Scale Score, p-value	Test statistic,
Gender			
Female	80 (62.5)	2.40±1.19	t=2.898
Male	48 (37.5)	1.75±1.28	p=0.004*
Chronic disease			
Yes	109 (85.2)	2.27±1.23	U= 710.500
No	19 (14.8)	1.53±1.26	p=0.025*
Long-term medication use			
Yes	110 (85.9)	2.27±1.26	U=622.500
No	18 (14.1)	1.44±1.04	p=0.010*
Multiple medication use			
Yes	95 (74.2)	2.29±1.23	t=2.132
No	33 (25.8)	1.76±1.27	p=0.035*
Pre-fracture mobility			
Mobile	72 (56.3)	1.57±1.16	t= -7.157
Mobile with assistive devices / Immobile	56 (43.7)	2.91±0.95	p<0.001*
Decrease in appetite in recent days			
Yes	63 (49.2)	2.46±1.22	t= 2.748
No	65 (50.8)	1.86±1.23	p=0.007*
History of falls in the past year			
Yes	90 (70.3)	2.18±1.18	t=0.273
No	38 (29.7)	2.11±1.44	p=0.786
Postoperative falls			
Yes	14 (10.9)	1.86±1.16	U=-673.500
No	114 (89.1)	2.19±1.27	p=0.328
Postoperative ICU** admission			
Yes	21 (16.4)	3.05±0.97	U=589.00
No	107 (83.6)	1.98±1.24	p<0.001*
Postoperative complication			
Yes	8 (6.3)	3.88±0.83	U=108.00
No	120 (93.8)	2.04±1.20	p<0.001*
Preoperative incontinence			
Yes	44 (34.4)	2.43±1.22	t=1.801
No	84 (65.6)	2.01±1.26	p=0.074
Postoperative incontinence			
Yes	49 (38.3)	2.35±1.14	t=1.349
No	79 (61.7)	2.04±1.32	p=0.18
Preoperative pressure ulcer			
Yes	6 (4.7)	3.00±1.09	U=675.500
No	122 (95.3)	2.11±1.26	p=0.027*
Postoperative pressure ulcer			
Yes	18 (14.10)	2.83±1.09	U=675.500
No	110 (85.90)	2.05±1.25	p=0.027*
Postoperative delirium			
Yes	44 (34.4)	2.84±1.09	t=4.806
No	84 (65.6)	1.80±1.20	p<0.001*
Hospital readmission in first month after discharge			
Yes	14 (10.90)	2.64±1.39	U= 633.500
No	114 (89.10)	2.10±1.24	p=0.196
Mortality in the first month after surgery			
Yes	13 (10.20)	3.00±1.00	U= 450.000
No	115 (89.80)	2.06±1.25	p=0.016*

t: Independent samples t-test; U: Mann-Whitney U test; *p<0.05. ** ICU: Intensive care unit.

Table 3 . Correlation analysis between FRAIL Scale score and clinical characteristics

Variables	Mean ± SD	Correlation coefficient (r), p-value
Age (years)[a]	78.45±8.36	r=0.108, p=0.225
BMI[a]	26.16±4.66	r=0.055, p=0.534
ASA Score[a]	2.81±0.55	r=0.064, p=0.47
Number of long-term medications[a]	3.52±2.65	r=0.170, p=0.05*
Charlson Comorbidity Index score[a]	4.98±1.60	r=0.231, p=0.009*
Number of comorbidities[a]	1.83±1.23	r=0.286, p=0.001*
Time from fracture to surgery (hours)[b]	47.66±42.90	r=-0.085, p=0.338
Preoperative hemoglobin level (g/dL)[a]	11.70±1.56	r=-0.133, p=0.13
Postoperative hemoglobin level (g/dL)[a]	10.37±1.48	r=-0.094, p=0.29
Preoperative creatinine level (mg/dL)[b]	0.94±0.50	r=-0.156, p=0.078
Postoperative creatinine level (mg/dL)[b]	0.92±0.58	r=-0.191, p=0.031*
Preoperative albumin level (g/dLl)[a]	38.34±5.57	r=-0.066, p=0.460
Postoperative albumin level (g/dL)[a]	31.55±4.89	r=-0.113, p=0.200
Length of hospital stay (days)[b]	5.40±2.91	r=0.187, p=0.035*
Preoperative pain score[b]	4.55±0.79	r=-0.110, p=0.217
Postoperative pain score[a]	2.94±1.14	r=0.202, p=0.02*
Preoperative fear of falling score[a]	2.73±1.95	r=0.225, p=0.011*
Postoperative fear of falling score[a]	3.99±1.32	r=0.081, p=0.365
Number of falls in past year[b]	1.09±1.11	r=0.136, p=0.127
Postoperative mobilization time (hours)[b]	28.20±14.48	r=0.116, p=0.193
Preoperative NRS-2002 score[a]	2.58±0.96	r=0.411, p<0.001*
Preoperative Katz ADL Index score[a]	5.07±1.47	r=-0.362, p<0.001*
Postoperative Katz ADL Index score[a]	0.88±1.07	r=-0.241, p=0.006*

[a]Pearson correlation analysis; [b]Spearman correlation analysis; BMI: Body Mass Index; ASA: American Society of Anesthesiologists; NRS: Nutritional Risk Screening, ADL: Activities of daily living; SD: Standard deviation; *p<0.05.

frailty status in univariate analysis. The regression model explained 24% of the total variance (F=5.220, p<0.001) in FRAIL Scale score. Among the independent variables included in the model, preoperative NRS-2002 score (nutritional status) (β=0.312, p=0.000) and Katz ADL score (functional independence status) (β=-0.216, p=0.012) were significant factors associated with frailty level in older patients undergoing hip fracture surgery (Table 4).

DISCUSSION

This study examined the prevalence of frailty, associated factors, and the relationship between pre-fracture frailty level and postoperative patient outcomes in older adults undergoing surgery for hip fracture. The results showed that frailty is common among these patients and has a significant impact on postoperative patient outcomes. Frailty scores were significantly higher among patients who were admitted to the intensive care unit after surgery, developed postoperative complications, developed pressure injury pre- or postoperatively, had delirium postoperatively, or died within the first month after discharge. In addition, pre-fracture nutritional status and functional dependence were independent predictors of frailty.

In our sample, the prevalence rates of prefrailty and frailty were 46.1% and 39.8%, respectively. In a previous study of 35 older hip fracture patients, 51% were assessed as frail using the Fried Frailty Index,[29] while in a larger study of 127,305 hip fracture patients in Sweden, 48.3% were frail and 27.7% were prefrail according to the Orthopedic Hip Frailty Score.[30] A meta-analysis study reported a prevalence of frailty among hip fracture patients ranging from 22.4% to 80.7%.[31] Frailty involves various risk factors such as multimorbidities, polypharmacy, impaired physical mobility, malnutrition, and increased risk of falls.[32-34] In our study, 85.2% of the patients had chronic diseases, 74.2% used multiple long-term medications, 41.4% required mobility assistive devices before the fracture, and 70.3% had fallen in the past year. These results indicate that these patients have many risk factors associated with frailty, thus explaining the large proportion of frail pa-

Table 4. Investigation of factors predicting frailty in older patients undergoing hip fracture surgery (N=128)

Independent variables	β	T	p	Tolerance	VIF
Number of long-term medications	-0.075	-0.690	0.492	0.505	1.979
Number of comorbidities	0.180	1.457	0.148	0.388	2.574
Preoperative fear of falling score	0.136	1.669	0.098	0.889	1.125
Preoperative nutritional risk (NRS-2002 score)	0.312	3.614	<0.001*	0.793	1.261
Preoperative functional independence (Katz ADL Index score)	-0.216	-2.563	0.012*	0.832	1.202
Postoperative functional independence (Katz ADL Index score)	-0.034	-0.385	0.701	0.763	1.311
Charlson Comorbidity Index score	0.025	0.219	0.827	0.448	2.233
Postoperative pain score	0.083	1.010	0.315	0.873	1.145
Postoperative creatinine level (mg/dL)	-0.051	-0.637	0.525	0.909	1.100
Length of hospital stay	-0.005	-0.062	0.951	0.803	1.245
Adjusted R2	0.249				
F	5.220				
P	<0.001*				

NRS: Nutritional Risk Screening; ADL: Activities of Daily Living; *p<0.05

tients. Although age is emphasized as an important parameter for frailty in the literature,[32,35] it did not show a significant relationship with frailty in this study. This is likely because our sample included only individuals over 65 with similar ages, and the average age was quite high.

Female patients in this study were more frail, consistent with previous reports.[36-38] Sex differences can be attributed to both biological and socioeconomic factors.[36] The greater tendency for frailty in women may be related to the higher prevalence of non-fatal diseases that negatively affect functioning and quality of life in women, as well as changes in body composition resulting from increased fat mass and the likelihood of metabolic syndrome.[37,39]

In terms of patient characteristics before hip fracture, we observed greater frailty among patients who had chronic diseases, used multiple long-term medications, were immobile or required mobility assistive devices, and had a recent decrease in appetite. In addition, greater frailty correlated with a higher number of comorbidities, higher number of medications, greater fear of falling, higher nutritional risk, and lower functional independence. The most commonly used criteria to define frailty are unintentional weight loss, weakness, reduced handgrip strength, low physical activity, sarcopenia (loss of muscle mass and coordination), fatigue, and slowness.[40,41] In previous studies, frailty has been associated with factors such as disability in ADL,[38] low weight, low exercise levels, polypharmacy, history of falls,[42] and presence of chronic diseases.[35,38,42] Furthermore, frailty has been shown to increase the risk of falls and fear of falling in older adults.[43,44] These findings also help explain the increased frailty in our patient group, which had similar characteristics.

The results of the present study indicated that preoperative frailty significantly impacts patient outcomes after hip fracture. Greater frailty was observed in patients who required intensive care after surgery, had postoperative complications, developed pressure injury before or after surgery, experienced delirium, or died within the first month post-discharge. In addition, higher preoperative frailty scores were associated with higher postoperative pain scores, longer hospital length of stay, and lower functional status and creatinine level. These findings support those of several previous studies. Zhao and colleagues showed that frailty in older patients undergoing hip fracture surgery was associated with major perioperative complications such as delirium and pneumonia, as well as long-term reduced quality of life.[45] Similarly, frailty has been associated with more complications and longer hospital stays;[29] increased mortality, higher risk of complications, and hospital readmission;[46] and poor functional recovery after surgery.[47] Yang et al. (2022) also reported that the development of pressure injury following hip fracture surgery was associated with patients' frailty status and multiple comorbidities.[48] The negative impact of frailty on functional status before and after surgery likely contributes to the development of pressure injury.

Similar studies have demonstrated that frailty predicts adverse outcomes after hip fracture surgery.[9,30,31,49,50] Frailty provides a holistic assessment of how certain characteristics affect an individual's function and health status, and identifies patients with diminished physiological reserves in multiple organ systems who are more susceptible to stress factors.[45,51] The contribution of frailty to postoperative adverse outcomes can be explained by sensitivity to internal and external stress factors, reduced cognitive and physiological reserves, and dysregulation of immune and inflammatory responses.[45,52]

Although the correlation was not strong, we also observed an inverse relationship between patients' preoperative frailty score and postoperative creatinine level. Ballew and colleagues reported that a lower creatinine muscle index, which is based on serum creatinine and cystatin C concentrations, was associated with frailty.[53] Creatinine is produced as a result of the breakdown of creatine phosphate during muscle energy metabolism, and its serum concentration is influenced by skeletal muscle mass.[53,54] Muscle loss (sarcopenia) is a common condition in older and frail individuals and can result in low creatinine levels. Additionally, sarcopenia and nutritional deficiency are important parameters used in the diagnosis of frailty.[40,41] Sarcopenia typically occurs in 8-13% of adults aged 60 and older.[55] In this study, the inclusion of individuals over 65 years old, many of whom were frail, explains the decrease in creatinine levels with greater frailty.

In our regression analysis, preoperative nutritional status and functional independence status were found to be significant predictors of frailty, with 24% of the variance in frailty score explained by these variables. In the study sample, 55% of the patients were at risk of malnutrition, 10.7% were malnourished, and 43.7% were either immobile or used mobility assistive devices prior to the fracture. In another study involving 216 older patients with hip fractures, 47% were at risk of malnutrition and 35% were malnourished.[56] Nutritional status is an important factor in the development of frailty. Malnutrition contributes to unintentional weight loss, low muscle strength, reduced physical activity, and low gait speed, all of which are among the diagnostic criteria for frailty.[57] Reduced protein intake in particular leads to loss of muscle mass and function, thereby increasing frailty.[58,59] The decline in functional capacity is another important factor that increases the risk of frailty. Walking speed, grip strength, and the level of independence in ADL are especially important in the diagnosis of frailty.[40,41] In frail hip fracture patients, a comprehensive approach combining nutritional management and rehabilitation is considered an important strategy for improving clinical outcomes.[60]

Limitations

This study has certain limitations. As the sample included only patients over 65 years old who underwent surgery for hip fracture, the generalizability of the findings to other surgically treated patients is limited. Additionally, the patients' long-term outcomes were not investigated. Studies focusing on long-term outcomes are needed in the future.

CONCLUSION

This study aimed to contribute to the understanding of the prevalence of frailty, its associated factors, and its impact on postoperative outcomes in older patients undergoing hip fracture surgery. Frailty was prevalent in this patient group, and pre-fracture nutritional status and functional independence status were found to be significant predictors of frailty. Preoperative assessment of frailty is important for predicting risk and identifying patients who could benefit from appropriate perioperative interventions to prevent adverse outcomes. In addition, identifying factors associated with frailty and increasing awareness among healthcare professionals working with frail groups will guide the perioperative treatment and care processes, thereby improving patient outcomes.

Ethics Committee Approval: This study was approved by the Dokuz Eylul University Ethics Committee (Date: 28.09.2022, Decision No: 2022/31-12).

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REFERENCES

1. Zhang X, Liu Y, der Schans CP Van, Krijnen W, Hobbelen JSM. Frailty among older people in a community setting in China. Geriatr Nurs (Minneap) [Internet] 2020;41:320–4. Available from: https://doi.org/10.1016/j.gerinurse.2019.11.013
2. Martínez-Arnau FM, Prieto-Contreras L, Pérez-Ros P. Factors associated with fear of falling among frail older adults. Geriatr Nurs (Minneap) 2021;42:1035–41.
3. Rushton J, Tyrell I, Astle A, Littlejohn G, Webster J. Frailty 2: identifying, assessing and screening frail older people: NT. Nurs Times 2023;119:47–52.
4. Cooper Z, Rogers SO, Ngo L, Guess J, Schmitt E, Jones RN, et al. Comparison of Frailty Measures as Predictors of Outcomes After Orthopedic Surgery. J Am Geriatr Soc 2016;64:2464–71.
5. Groff H, Kheir MM, George J, Azboy I, Higuera CA, Parvizi J. Causes of in-hospital mortality after hip fractures in the elderly. HIP International 2020;30:204–9.
6. Ferrucci L, Cooper R, Shardell M, Simonsick EM, Schrack JA, Kuh D. Age-related change in mobility: Perspectives from life course epidemiology and geroscience. Journals of Gerontology - Series A Biological Sciences and Medical Sciences2016;71:1184–94.
7. Kanters TA, van de Ree CLP, de Jongh MAC, Gosens T, Roijen LH van. Burden of illness of hip fractures in elderly Dutch patients. Arch Osteoporos 2020;15:11.
8. Watt J, Tricco AC, Talbot-Hamon C, Pham B, Rios P, Grudniewicz A, et al. Identifying older adults at risk of harm following elective surgery: A systematic review and meta-analysis. BMC Med 2018;16:1–14.
9. Jorissen RN, Lang C, Visvanathan R, Crotty M, Inacio MC. The effect of frailty on outcomes of surgically treated hip fractures in older people. Bone 2020;136:115527.
10. Lin HS, Watts JN, Peel NM, Hubbard RE. Frailty and post-operative outcomes in older surgical patients: A systematic review. BMC Geriatr [Internet] 2016;16:1–12. Available from: http://dx.doi.org/10.1186/s12877-016-0329-8
11. Saripella A, Wasef S, Nagappa M, Riazi S, Englesakis M, Wong J, et al. Effects of comprehensive geriatric care models on postoperative outcomes in geriatric surgical patients: a systematic review and meta-analysis. BMC Anesthesiol 2021;21:1–11.
12. Zhu S, Qian W, Jiang C, Ye C, Chen X. Enhanced recovery after surgery

for hip and knee arthroplasty: A systematic review and meta-analysis. Postgrad Med J2017;93:736–42.
13. Gökalp O, Arı B, Arı B. Transtrochanteric vs. posterolateral approaches in hemiarthroplasty after proximal femoral nail complications: A comparative study. Ulusal Travma ve Acil Cerrahi Dergisi 2025;31:458–64.
14. Gleason LJ, Benton EA, Alvarez-Nebreda ML, Weaver MJ, Harris MB, Javedan H. FRAIL Questionnaire Screening Tool and Short-Term Outcomes in Geriatric Fracture Patients. J Am Med Dir Assoc [Internet] 2017;18:1082–6. Available from: https://doi.org/10.1016/j.jamda.2017.07.005
15. Lee JA, Yanagawa B, An KR, Arora RC, Verma S, Friedrich JO. Frailty and pre-frailty in cardiac surgery: a systematic review and meta-analysis of 66,448 patients. J Cardiothorac Surg2021;16:1–10.
16. Sepehri A, Beggs T, Hassan A, Rigatto C, Shaw-Daigle C, Tangri N, et al. The impact of frailty on outcomes after cardiac surgery: A systematic review. Journal of Thoracic and Cardiovascular Surgery [Internet] 2014;148:3110–7. Available from: http://dx.doi.org/10.1016/j.jtcvs.2014.07.087
17. Charlson M, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. J Chronic Dis 1987;40:373–83.
18. Cavuşoğlu Türker B, Türker F, Ahbab S, Hoca E, Urvasızoğlu AO, Cetin SI, et al. Evaluation of the Charlson Comorbidity Index and Laboratory Parameters as Independent Early Mortality Predictors in Covid 19 Patients. Int J Gen Med 2022;15:6301.
19. Canaslan K, Ates Bulut E, Kocyigit SE, Aydin AE, Isik AT. Predictivity of the comorbidity indices for geriatric syndromes. BMC Geriatr 2022;22:440.
20. Gaudreau JD, Gagnon P, Harel F, Tremblay A, Roy MA. Fast, systematic, and continuous delirium assessment in hospitalized patients: The nursing delirium screening scale. J Pain Symptom Manage 2005;29:368–75.
21. Çınar F, Eti Aslan F. Evaluation of Postoperative Delirium: Validity and Reliability of the Nursing Delirium Screening Scale in the Turkish Language. Dement Geriatr Cogn Dis Extra 2019;9:362–73.
22. Morley JE, Malmstrom TK, Miller DK. A simple frailty questionnaire (FRAIL) predicts outcomes in middle aged african americans. Journal of Nutrition, Health and Aging 2012;16:601–8.
23. Muradi H, Yavuz B. Validation of FRAIL Scale in Turkish older adults. 2017.
24. Kondrup J, Ramussen HH, Hamberg O, Stanga Z, Camilo M, Richardson R, et al. Nutritional risk screening (NRS 2002): A new method based on an analysis of controlled clinical trials. Clinical Nutrition 2003;22:321–36.
25. Bolayir B, Arik G, Yeşil Y, Kuyumcu ME, Varan HD, Kara Ö, et al. Validation of Nutritional Risk Screening-2002 in a Hospitalized Adult Population. Nutrition in Clinical Practice 2019;34:297–303.
26. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of Illness in the Aged: The Index of ADL: A Standardized Measure of Biological and Psychosocial Function. JAMA: The Journal of the American Medical Association 1963;185:914–9.
27. Arik G, Varan HD, Yavuz BB, Karabulut E, Kara O, Kilic MK, et al. Validation of Katz index of independence in activities of daily living in Turkish older adults. Arch Gerontol Geriatr 2015;61:344–50.
28. George D, Mallery P. SPSS for Windows Step by Step: A Simple Guide and Reference Fourth Edition. 10a ed. Pearson; 2010.
29. Kistler EA, Nicholas JA, Kates SL, Friedman SM. Frailty and Short-Term Outcomes in Patients With Hip Fracture. Geriatr Orthop Surg Rehabil 2015;6:209–14.
30. Forssten MP, Mohammad Ismail A, Ioannidis I, Wretenberg P, Borg T, Cao Y, et al. The mortality burden of frailty in hip fracture patients: a nationwide retrospective study of cause-specific mortality. European Journal of Trauma and Emergency Surgery 2023;49:1467–75.
31. Yan B, Sun W, Wang W, Wu J, Wang G, Dou Q. Prognostic significance of frailty in older patients with hip fracture: a systematic review and meta-analysis. Int Orthop2022;46.
32. Setiati S, Laksmi PW, Aryana IGPS, Sunarti S, Widajanti N, Dwipa L, et al. Frailty state among Indonesian elderly: Prevalence, associated factors, and frailty state transition. BMC Geriatr 2019;19:182.
33. Jiao J, Wang Y, Zhu C, Li F, Zhu M, Wen X, et al. Prevalence and associated factors for frailty among elder patients in China: A multicentre cross-sectional study. BMC Geriatr 2020;20:100.
34. Qin Y, Hao X, Lv M, Zhao X, Wu S, Li K. A global perspective on risk factors for frailty in community-dwelling older adults: A systematic review and meta-analysis. Arch Gerontol Geriatr2023;105:104844.
35. Alqahtani BA, Alenazi AM, Alshehri MM, Osailan AM, Alsubaie SF, Alqahtani MA. Prevalence of frailty and associated factors among Saudi community-dwelling older adults: a cross-sectional study. BMC Geriatr 2021;21:185.
36. Ofori-Asenso R, Chin KL, Mazidi M, Zomer E, Ilomaki J, Zullo AR, et al. Global Incidence of Frailty and Prefrailty among Community-Dwelling Older Adults: A Systematic Review and Meta-analysis. JAMA Netw Open 2019;2:e198398-e198398.
37. Gordon EH, Peel NM, Samanta M, Theou O, Howlett SE, Hubbard RE. Sex differences in frailty: A systematic review and meta-analysis. Exp Gerontol2017;89:30–40.
38. He B, Ma Y, Wang C, Jiang M, Geng C, Chang X, et al. Prevalence and Risk Factors for Frailty Among Community-Dwelling Older People in China: A Systematic Review and Meta-Analysis. Journal of Nutrition, Health and Aging2019;23.
39. Romero-Márquez JM, Varela-López A, Navarro-Hortal MD, Badillo-Carrasco A, Forbes-Hernández TY, Giampieri F, et al. Molecular interactions between dietary lipids and bone tissue during aging. Int J Mol Sci 2021;22:6473.
40. Xue QL. The Frailty Syndrome: Definition and Natural History. Clin Geriatr Med2011;27:1.
41. Hogan DB. Models, definitions, and criteria for frailty. In: Conn's Handbook of Models for Human Aging. 2018. page 35–44.
42. Wang X, Hu J, Wu D. Risk factors for frailty in older adults. Medicine (United States)2022;101:e30169.
43. Kendhapedi KK, Devasenapathy N. Prevalence and factors associated with frailty among community-dwelling older people in rural Thanjavur district of South India: a cross-sectional study. BMJ Open 2019;9:e032904.
44. Makino K, Lee S, Bae S, Chiba I, Harada K, Katayama O, et al. Prospective Associations of Physical Frailty With Future Falls and Fear of Falling: A 48-Month Cohort Study. Phys Ther 2021;101:pzab059.
45. Zhao H, Wei P, Feng Y. Association between Frailty and Clinical Outcomes and Quality of Life in Older Adults following Hip Fracture Surgery: A Retrospective Cohort Study. Anesth Analg 2022;134:1035-1042.
46. Chen CL, Chen CM, Wang CY, Ko PW, Chen CH, Hsieh CP, et al. Frailty is Associated with an Increased Risk of Major Adverse Outcomes in Elderly Patients Following Surgical Treatment of Hip Fracture. Sci Rep 2019;9:19135.
47. Inoue T, Misu S, Tanaka T, Kakehi T, Kakiuchi M, Chuman Y, et al. Frailty defined by 19 items as a predictor of short-term functional recovery in patients with hip fracture. Injury 2019;50:2272-2276.
48. Yang Q, Li J, Shi D, Xie H, Wang J, Shi Z, et al. Incidence and risk factors associated with hospital-acquired pressure ulcers following total hip arthroplasty: A retrospective nationwide inpatient sample database study. J Tissue Viability 2022;31:332–8.
49. Wong BLL, Chan YH, O'Neill GK, Murphy D, Merchant RA. Frailty, length of stay and cost in hip fracture patients. Osteoporosis International [Internet] 2022;(0123456789). Available from: https://doi.org/10.1007/s00198-022-06553-1
50. Lemos JL, Welch JM, Xiao M, Shapiro LM, Adeli E, Kamal RN. Is Frailty Associated with Adverse Outcomes After Orthopaedic Surgery?: A Systematic Review and Assessment of Definitions. JBJS Rev 2021;9:e21.
51. Beggs T, Sepehri A, Szwajcer A, Tangri N, Arora RC. Frailty and perioperative outcomes: a narrative review. Canadian Journal of Anesthesia 2015;62:143–57.

52. Mcisaac DI, Macdonald DB, Aucoin SD. Frailty for Perioperative Clinicians: A Narrative Review. Anesth Analg2020;130:1450–60.
53. Ballew SH, Zhou L, Surapaneni A, Grams ME, Windham BG, Selvin E, et al. A Novel Creatinine Muscle Index Based on Creatinine Filtration: Associations with Frailty and Mortality. Journal of the American Society of Nephrology 2023;34:495-504.
54. Tabara Y, Kohara K, Okada Y, Ohyagi Y, Igase M. Creatinine-to-cystatin C ratio as a marker of skeletal muscle mass in older adults: J-SHIPP study. Clinical Nutrition 2020;39:1857-1862.
55. Shafiee G, Keshtkar A, Soltani A, Ahadi Z, Larijani B, Heshmat R. Prevalence of sarcopenia in the world: A systematic review and meta- analysis of general population studies. J Diabetes Metab Disord 2017;16:21.
56. Li Y, Liu F, Xie H, Zhu Y. Investigation and analysis of frailty and nutrition status in older adult patients with hip fracture. Nutrition in Clinical Practice 2023;38:1063-1072.
57. Yannakoulia M, Ntanasi E, Anastasiou CA, Scarmeas N. Frailty and nutrition: From epidemiological and clinical evidence to potential mechanisms. Metabolism2017;68:64-76.
58. Hong X, Yan J, Xu L, Shen S, Zeng X, Chen L. Relationship between nutritional status and frailty in hospitalized older patients. Clin Interv Aging 2019;14:105–11.
59. Zhao Y, Lin T, Hou L, Zhang M, Peng X, Xie D, et al. Association between geriatric nutritional risk index and frailty in older hospitalized patients. Clin Interv Aging 2021;16:1241-1249.
60. Inoue T, Maeda K, Nagano A, Shimizu A, Ueshima J, Murotani K, et al. Undernutrition, sarcopenia, and frailty in fragility hip fracture: Advanced strategies for improving clinical outcomes. Nutrients 2020;12:3743.

ORİJİNAL ÇALIŞMA - *ÖZ*

Kalça kırığı olan yaşlı erişkinlerde kırılganlık ile ilişkili faktörler ve kırılganlığın postoperatif sonuçlara etkisi

AMAÇ: Kalça kırığı insidansı yaşlanan nüfusla birlikte hızla artmakta ve yüksek ölüm oranı nedeniyle şu anda dünya çapında en önemli sağlık sorunlarından biri olarak kabul edilmektedir. Bu araştımanın amacı, kalça kırığı öncesi kırılganlık düzeyi ile ameliyat sonrası hasta sonuçları arasındaki ilişkinin ve kırılganlığı etkileyen faktörlerin incelenmesidir.

GEREÇ VE YÖNTEM: Tanımlayıcı ve kesitsel bir çalışmadır. Kalça kırığı nedeni ile ameliyat olan 65 yaş ve üstü hastalar dahil edilmiştir. Veriler, ameliyat öncesi ve ameliyat sonrası birinci günde hasta odasında yüz yüze görüşme yöntemi ile toplanmıştır. Bu çalışma, Dokuz Eylül Üniversitesi Girişimsel Olmayan Araştırmalar Etik Kurulu tarafından onaylanmıştır. Verilerin değerlendirilmesinde; tanımlayıcı istatistikler, bağımsız iki grup t testi, One Way Anova testi, korelasyon ve multiple lineer regresyon analizleri kullanılmıştır.

BULGULAR: Çalışmaya dahil edilen 128 hastanın (yaş ortalaması 78.45±8.36), %46.1'i (n=59) pre-kırılgan ve %39.8'i (n=51) kırılgandı. Kadın olan, kronik hastalığı olan, sürekli ve çoklu ilaç kullanan, kırık öncesi yardımcı araç gereç ile mobilize olan veya immobil ve son günlerde iştah azalması olan, ameliyat sonrası yoğun bakımda kalan ve komplikasyon gelişen, ameliyat sonrası basınç yarası olan ve taburculuk sonrası ilk bir ay içinde vefat eden hastaların daha kırılgan olduğu belirlenmiştir ($p<0.05$). Hastaların ameliyat öncesi kırılganlık düzeyi ile kronik hastalık sayısı, ameliyat öncesi düşme korkusu, nutrisyonel risk tanılama skoru, komorbidite indeks puanı ve hastanede yatış süresi ile arasında pozitif yönde; ameliyat öncesi ve sonrası fonksiyonel düzeyi ve ameliyat sonrası kreatinin düzeyi ile arasında negatif yönde istatiksel olarak anlamlı ilişki olduğu belirlenmiştir ($p<0.05$). Hastaların Frail Kırılganlık Ölçeği puan ortalamaları 2.16±1.26 olup; kırık öncesi beslenme durumu ($\beta=0.312$, $p=0.000$) ve fonksiyonel durum ($\beta=0.216$, $p=0.012$) kırılganlık düzeyinin anlamlı yordayıcılarıdır.

SONUÇ: Çalışmamız; kalça kırığı nedeniyle ameliyat olan hastalarda kırılganlığın yaygın olduğunu; kırılganlığın ameliyat sonrası hasta sonuçları üzerinde belirleyici bir etkisi olduğunu göstermektedir. Hastaların kırık oluşmadan önceki beslenme ve fonksiyonel durumları kırılganlığı etkileyen faktörlerdir. Kalça kırığı nedeniyle başvuran hastaların ameliyat öncesi dönemde kırılganlık durumlarının değerlendirilmesi ve etkileyen faktörlerin belirlenmesi, tedavi ve bakım sürecinin daha iyi yönetilmesine katkı sağlayabilir.

Anahtar sözcükler: Kalça kırığı; kırılganlık; yaşlılık.

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